
bulletin of
Duke University
2000-2002

The Graduate School



The Mission of Duke University

The founding Indenture of Duke University directed the members of the university to "develop our resources, increase our wisdom, and promote human happiness."

To these ends, the mission of Duke University is to provide a superior liberal education to undergraduate students, attending not only to their intellectual growth but also to their development as adults committed to high ethical standards and full participation as leaders in their communities; to prepare future members of the learned professions for lives of skilled and ethical service by providing excellent graduate and professional education; to advance the frontiers of knowledge and contribute boldly to the international community of scholarship; to foster health and well-being through medical research and patient care; and to promote a sincere spirit of tolerance, a sense of the obligations and rewards of citizenship, and a commitment to learning, freedom, and truth.

By pursuing these objectives with vision and integrity, Duke University seeks to engage the mind, elevate the spirit, and stimulate the best effort of all who are associated with the university; to contribute in diverse ways to the local community, the state, the nation, and the world; and to attain and maintain a place of real leadership in all that we do.

ACADEMIC LIAISON
Leigh DeNeef
Associate Dean

EDITOR
Judith Smith

PUBLICATIONS COORDINATOR
Mary Nettleton

STAFF SPECIALIST: COURSE CATALOG MASTER
Margaret R. Sims

PHOTOGRAPHS
University Photography

The information in the bulletin applies to the academic years 2000-2002 and is accurate and current, to the best of our knowledge, as of May 2000. The university reserves the right to change programs of study, academic requirements, lecturers, teaching staffs, the announced university calendar, and other matters described in the bulletin without prior notice, in accordance with established procedures.

Duke University does not discriminate on the basis of race, color, national origin, handicap, sexual orientation or preference, gender, or age in the administration of educational policies, admission policies, financial aid, employment, or any other university program or activity. It admits qualified students to all the rights, privileges, programs, and activities generally accorded or made available to students.

Duke University recognizes and utilizes electronic mail as a medium for official communications. The university provides all students with e-mail accounts as well as access to e-mail services from public clusters if students do not have personal computers of their own. All students are expected to access their e-mail accounts on a regular basis to check for and respond as necessary to such communications, just as they currently do with paper/ postal service mail.

Information that the university is required to make available under the Student Right to Know and Campus Security Acts may be obtained from the Office of University Relations at 684-2823 or in writing at 615 Chapel Drive, Duke University, Durham, North Carolina 27708.

Duke University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools (1866 Southern Lane, Decatur, Georgia 30033-4097; telephone number 404-679-4501) to award baccalaureates, masters, doctorates, and professional degrees.

Volume 72

May 2000

Number 5A

The Bulletin of Duke University (USPS 073-680) is published by Duke University, Duke Station, Durham, North Carolina 27708 as follows: monthly—May; semimonthly—March, April, June, and August; thrice-monthly—September. Periodical rate paid at Durham, North Carolina.

Contents

Calendar of the Graduate School	4
University Administration	8
Graduate School Faculty	8
Academic and Cooperative Programs	28
Admission	32
Financial Information	38
Fellowships and Scholarships	39
Student Expenses	44
Registration	48
Regulations	52
General Academic Regulations	53
Degree Regulations—The Master’s Degree	55
Additional Master’s Regulations	56
Degree Regulations—The Doctoral Degree	57
Commencement	59
Standards of Conduct	59
Courses of Instruction	64
Special Study Centers, Programs, and Opportunities	276
Resources for Study	284
Student Life	296
Living Accommodations	297
Dining Services	298
Services Available	298
Student Affairs	301
Visiting Scholars	304
Postdoctoral Research	304
Index	306

Duke University Academic Calendar 2000-2002¹
Trinity College of Arts and Sciences; The Pratt School of Engineering
The Nicholas School of the Environment; The Graduate School; The Graduate Nursing
Program

Summer 2000

March	
29	Wednesday. Registration begins for Term I and/or Term II.
May	
18	Thursday. Term I classes begin.
22	Monday. Drop/Add for Term I ends.
29	Monday. Memorial Day. Classes in session.
June	
14	Wednesday. Last day to withdraw W/P or W/F from Term I courses.
26	Monday. Term I classes end.
27	Tuesday. Reading period.
28	Wednesday. Term I final examinations begin.
29	Thursday. Term I final examinations end.
July	
3	Monday. Term II classes begin.
3	Monday. Final date to submit the intention to receive degree form for September 2000 degree.
4	Tuesday. Independence Day. Classes in session.
5	Wednesday. Drop/Add for Term II ends.
28	Friday. Last day to withdraw W/P or W/F from Term II courses.
August	
1	Tuesday. Final date to submit for Graduate School approval master's theses and Ph.D. dissertations for September 2000 degree.
9	Wednesday. Term II classes end.
10	Thursday. Reading period.
11	Friday. Term II final examinations begin.
11	Friday. Final date for completing degree requirements for an advanced degree to be awarded September 2000. All final copies of examined and signed theses and dissertations must be returned to 013 Perkins Library by this date.
12	Saturday. Term II final examinations end.

Fall 2000

August	
22	Tuesday. New graduate student orientation.
24	Thursday 4:00 p.m. Convocation for graduate and professional school students.
24	Thursday. English language proficiency examinations for new international students whose native language is not English (See director of graduate studies for details.)
25	Friday. English language proficiency examinations for new international students whose native language is not English. (See director of graduate studies for details.)
28	Monday. 8:00 a.m. Fall Semester classes begin; Drop/Add continues.
September	
4	Monday. Labor Day. Classes in session.
8	Friday. Drop/Add ends.
October	
8	Sunday. Founders' Day.
13	Friday. 7:00 p.m. Fall break begins.

¹ The dates in this calendar are subject to change. Information on registration dates is available from the Office of the University Registrar.
The Nicholas School of the Environment, the Fuqua School of Business, the Marine Laboratory, and the Department of Physical Therapy have different term lengths and/or starting dates during the summer; consult the appropriate bulletins and schedules.

	18	Wednesday. 8:00 a.m. Classes resume.
	25	Wednesday. Registration begins for Spring Semester, 2001.
November		
	1	Wednesday. Final date to submit intention to receive degree form for December 2000 degree.
	17	Friday. Registration ends for Spring Semester, 2001.
	18	Saturday. Drop/Add begins.
	22	Wednesday. 12:40 p.m. Thanksgiving recess begins.
	27	Monday. 8:00 a.m. Classes resume.
December		
	1	Friday. 7:00 p.m. Graduate classes end.
	2-10	Saturday-Sunday. Graduate reading period; length of the 200-level course reading period is determined by the professor.
	6	Wednesday. Final date to submit for Graduate School approval master's theses and Ph.D. dissertations for December 2000 degree.
	11	Monday. Final examinations begin.
	15	Friday. Final date for completing degree requirements for an advanced degree to be awarded December 2000. All final copies of examined and signed theses and dissertations must be returned to 013 Perkins Library by this date.
	16	Saturday. 10:00 p.m. Final examinations end.

Spring 2001

January		
	10	Wednesday. 8:00 a.m. Spring Semester begins: ALL classes normally meeting on Mondays meet on this Wednesday only; Wednesday ONLY classes begin Wednesday, January 17; Drop/Add continues.
	15	Monday. Martin Luther King, Jr. Day holiday: classes are rescheduled on Wednesday, January 10.
	24	Wednesday. Drop/Add ends.
	25	Thursday. Final date to submit the intention to receive degree form for May 2001 degree.
March		
	9	Friday. 7:00 p.m. Spring recess begins.
	19	Monday. 8:00 a.m. Classes resume.
	28	Wednesday. Registration begins for Fall Semester, 2001, and Summer 2001.
April		
	13	Friday. Registration ends for Fall Semester, 2001;. Summer 2001 registration continues.
	14	Saturday. Drop/Add begins.
	16	Monday. Final date to submit for Graduate School approval master's theses and Ph.D. dissertations for May 2001 degree.
	20	Friday. 7:00 p.m. Graduate classes end.
	21-29	Saturday-Sunday. Graduate reading period; length of the 200-level course reading period is determined by the professor.
	30	Monday. Final examinations begin.
May		
	4	Friday. Final date for completing degree requirements for an advanced degree to be awarded May 2001. All final copies of examined and signed theses and dissertations must be returned to 013 Perkins Library by this date.
	5	Saturday. 10:00 p.m. Final examinations end.
	11	Friday. Commencement begins.
	13	Sunday. Graduation exercises; conferring of degrees.

Summer 2001

March		
	28	Wednesday. Registration begins for Term I and/or Term II
May		
	17	Thursday. Term I classes begin
June		
	28	Thursday. Term I classes end

July
 2 Monday. Term II classes begin
 4 Wednesday. Independence Day. Classes in session
August
 11 Saturday. Term II classes end

Fall 2001

August
 22 Tuesday. New graduate student orientation
 24 Thursday 4:00 p.m. Convocation for graduate and professional school students
 27 Monday. 8:00 a.m. Fall Semester classes begin
October
 12 Friday. 7:00 p.m. Fall break begins
 17 Wednesday. 8:00 a.m. Classes resume
November
 21 Wednesday. 12:30 p.m. Thanksgiving recess begins
 26 Monday. 8:00 a.m. Classes resume
December
 6 Thursday. 7:00 p.m. Graduate classes end
 10 Monday. Final examinations begin
 15 Saturday. 10:00 p.m. Final examinations end

Spring 2002

January
 9 Wednesday. 8:00 a.m. Spring Semester begins.
 21 Monday. Martin Luther King, Jr. Day holiday.
March
 8 Friday. 7:00 p.m. Spring recess begins
 18 Monday. 8:00 a.m. Classes resume
April
 24 Wednesday. 7:00 p.m. Graduate classes end
 29 Monday. Final examinations begin
May
 4 Saturday. 10:00 p.m. Final examinations end
 10 Friday. Commencement begins
 12 Sunday. Graduation exercises; conferring of degrees

University Administration

GENERAL ADMINISTRATION

Nannerl Overholser Keohane, Ph.D., *President*
Peter Lange, Ph.D., *Provost*
Ralph Snyderman, M.D., *Chancellor for Health Affairs and Executive Dean, School of Medicine*
Tallman Trask III, M.B.A., Ph.D., *Executive Vice-President*
John F. Burness, A.B., *Senior Vice-President for Public Affairs and Government Relations*
John J. Piva, Jr., B.A., *Senior Vice-President for Alumni Affairs and Development*
R. James Clack, Ph.D., *Interim Vice-President for Student Affairs*
H. Clint Davidson, Jr., M.B.A., *Vice-President for Human Resources*
Sally M. Dickson, J.D., *Vice-President for Institutional Equity*
Robert S. Shepard, Ph.D., *Vice-President for University Development*
N. Allison Haltom, A.B., *Vice-President and University Secretary*
David B. Adcock, J.D., *University Counsel*
William J. Donelan, M.S., *Vice-Chancellor for Health Affairs and Executive Vice-President, Duke University Health System*
Edward W. Holmes, M.D., *Vice-Chancellor for Academic Affairs and Dean, School of Medicine*
Michael D. Israel, M.P.H., *Vice-President and Chief of Hospital and Clinical Facilities and Chief Executive Officer, Duke University Hospital*
Steven A. Rum, M.S., *Vice-Chancellor for Development and Alumni Affairs*
Jean Gaillard Spaulding, M.D., *Vice-Chancellor for Health Affairs*
R. C. "Bucky" Waters, M.A., *Vice-Chancellor for Special Projects*
Gordon D. Williams, B.A., *Vice-Chancellor for Medical Center Operations and Vice-Dean for Administration and Finance, School of Medicine*
William H. Willimon, S.T.D., *Dean of the Chapel*
Joseph L. Alleva, M.B.A., *Director of Athletics*

GRADUATE SCHOOL ADMINISTRATION

Lewis Siegel, Ph.D., *Dean of the Graduate School*
A. Leigh DeNeef, Ph.D., *Associate Dean*
Donna Lee Giles, A.B., *Associate Dean*
Jacqueline Looney, Ph.D., *Associate Dean*

EXECUTIVE COMMITTEE OF THE GRADUATE FACULTY

Lewis Siegel, *Dean*
Leigh DeNeef, *Associate Dean*
John Brehm (Political Science)
Dona Chikaraishi (Neurobiology)
Elizabeth Clark (Religion)
Carol Eckerman (Psychology: Experimental)
Katherine Ewing (Cultural Anthropology)
Margaret Greer (Romance Studies)
Richard Kay (Biological Anthropology and Anatomy)
Cindy Kuhn (Pharmacology and Cancer Biology)
Tod Laursen (Civil and Environmental Engineering)
Richard MacPhail (Chemistry)
Stephen Nowicki (Biology)
Angela O'Rand (Sociology)
Monty Reichert (Biomedical Engineering)
Ken Surin (Literature)
Lawrence Virgin (Mechanical Engineering and Materials Science)
Annabel Wharton (Art and Art History)

Graduate School Faculty

(As of January 1, 2000.)

The date denotes the first year of service at Duke University.

Stanley Kenji Abe (1994), Ph.D., *Andrew Mellon Assistant Professor of Art and Art History*
Trudi Abel (1998), Ph.D., *Visiting Assistant Professor of History*
Mohamed Bahie Abou-Donia (1975), Ph.D., *Professor of Pharmacology and Cancer Biology and Professor of Neurobiology*
Robert Abraham (1998), Ph.D., *Professor of Pharmacology and Cancer Biology and Professor of Immunology*
Soman Abraham (1997), Ph.D., *Associate Professor of Pathology and Associate Professor of Microbiology*

David Aers (1994), Ph.D., *Professor of English and Professor of Religion*
 Pankaj K. Agarwal (1990), Ph.D., *Professor of Computer Science*
 Peter Aitken (1988), Ph.D., *Associate Medical Professor of Cell Biology*
 Susan Alberts (1998), Ph.D., *Assistant Professor of Zoology*
 John H. Aldrich (1987), Ph.D., *Pfizer, Inc./Edmund T. Pratt, Jr. University Professor of Political Science*
 Dimitri Alexandrou (1987), Ph.D., *Associate Professor of Electrical and Computer Engineering*
 William K. Allard (1975), Ph.D., *Professor of Mathematics*
 Anne Allison (1992), Ph.D., *Associate Professor of Cultural Anthropology*
 Andrea Amalfitano (1996), Ph.D., *Assistant Professor of Genetics*
 Mark An (1996), Ph.D., *Assistant Professor of Economics*
 Nels C. Anderson (1966), Ph.D., *Associate Professor of Cell Biology*
 Page A. W. Anderson (1973), M.D., *Assistant Professor of Cell Biology*
 Edna Andrews (1984), Ph.D., *Professor of Slavic Languages and Literatures*
 Mark Antliff (1998), Ph.D., *Associate Professor of Art and Art History*
 James J. Anton (1989), Ph.D., *Associate Professor of Business Administration*
 James W. Applewhite (1971), Ph.D., *Professor of English*
 Mahadev L. Apte (1965), Ph.D., *Professor of Cultural Anthropology*
 Peter Arcidiacono (1999), Ph.D., *Assistant Professor of Economics*
 William Louis Ascher (1984), Ph.D., *Professor of Public Policy Studies and Professor of Political Science*
 Alison Hubbard Ashton (1986), Ph.D., *Associate Professor of Business Administration*
 Robert H. Ashton (1986), Ph.D., *Martin L. Black, Jr., Professor of Business Administration*
 Paul Aspinwall (1998), Ph.D., *Associate Professor of Mathematics and Assistant Professor of Physics*
 Owen Astrachan (1992), Ph.D., *Associate Professor of the Practice of Computer Science*
 George J. Augustine (1991), Ph.D., *Professor of Neurobiology*
 Houston Baker (1999), Ph.D., *Professor of English*
 Lee Baker (1995), Ph.D., *Associate Professor of Cultural Anthropology*
 Paul A. Baker (1981), Ph.D., *Professor of Earth and Ocean Sciences*
 Andrew E. Balber (1985), Ph.D., *Associate Medical Research Professor of Immunology*
 Steven W. Baldwin (1978), Ph.D., *Professor of Chemistry*
 Helmy Hamdollah Baligh (1967), Ph.D., *Professor of Business Administration*
 Edward Balleisen (1996), Ph.D., *Assistant Professor of History*
 Ravi Bansal (1990), Ph.D., *Associate Professor of Business Administration and Adjunct Assistant Professor of Economics*
 Harold U. Baranger (1999), Ph.D., *Professor of Physics*
 Richard T. Barber (1980), Ph.D., *Harvey W. Smith Professor of Biological Oceanography and Professor of Botany*
 Roger C. Barr (1969), Ph.D., *Professor of Biomedical Engineering*
 Elizabeth C. Bartlet (1982), Ph.D., *Associate Professor of Music*
 Deepak Bastia (1979), Ph.D., *Professor of Microbiology*
 Michael Jesse Battle (1999), Ph.D., *Assistant Professor of Religion*
 Ian Baucom (1996), Ph.D., *Assistant Professor of English*
 Alan Baydush (1995), Ph.D., *Assistant Research Professor of Biomedical Engineering*
 J. Thomas Beale (1983), Ph.D., *Professor of Mathematics*
 Sarah Beckwith (1992), Ph.D., *Associate Professor of English*
 Michael Been (1987), Ph.D., *Associate Professor of Biochemistry*
 Lorena Beese (1992), Ph.D., *Associate Professor of Biochemistry*
 Robert D. Behn (1973), Ph.D., *Professor of Public Policy Studies*
 Robert Paul Behringer (1982), Ph.D., *James B. Duke Professor of Physics, Professor of Computer Science, and Professor of Mechanical Engineering and Materials Science*
 Adrian Bejan (1984), Ph.D., *J. A. Jones Professor of Mechanical Engineering and Materials Science*
 David F. Bell III (1983), Ph.D., *Professor of Romance Studies*
 Bruce A. Benjamin (1989), Ph.D., *Assistant Professor of Cell Biology*
 Peter Brian Bennett (1972), Ph.D., D.Sc., *Professor of Cell Biology*
 Vann Bennett (1987), Ph.D., *Professor of Biochemistry and Professor of Cell Biology*
 James O. Berger (1997), Ph.D., *Arts and Sciences Professor of Statistics and Decision Sciences*
 Teresa Berger (1987), Ph.D., *Associate Professor of Religion, Ecumenical Theology*
 Andrea L. Bertozzi (1995), Ph.D., *Professor of Mathematics and Professor of Physics*
 James R. Bettman (1982), Ph.D., *Burlington Industries Professor of Business Administration, Professor of Psychology: Experimental, and Professor of Psychology: Social and Health Sciences*
 Tami Davis Biddle (1995), Ph.D., *Assistant Professor of History*
 Alan Biermann (1974), Ph.D., *Professor of Computer Science*
 Darel D. Bigner (1972), M.D., Ph.D., *Professor of Pathology*
 Sandra H. Bigner (1977), M.D., *Professor of Pathology*
 Perry J. Blackshear (1984), M.D., Ph.D., *Professor of Biochemistry*
 Kalman P. Bland (1973), Ph.D., *Professor of Religion*

Donald B. Bliss (1985), Ph.D., *Associate Professor of Mechanical Engineering and Materials Science*
 James A. Blumenthal (1979), Ph.D., *Professor of Psychology: Social and Health Sciences*
 Fred K. Boadu (1994), Ph.D., *Assistant Professor of Civil and Environmental Engineering*
 John A. Board, Jr. (1986), Ph.D., *Associate Professor of Electrical and Computer Engineering and Associate Professor of Computer Science*
 Mary T. Boatwright (1979), Ph.D., *Professor of Classical Studies*
 Dani P. Bolognesi (1971), Ph.D., *Professor of Microbiology*
 Celia Bonaventura (1972), Ph.D., *Professor of Environment and Professor of Cell Biology*
 Joseph Bonaventura (1972), Ph.D., *Professor of Environment and Professor of Cell Biology*
 James F. Bonk (1959), Ph.D., *Professor of Chemistry*
 Melanie Bonner (1995), Ph.D., *Assistant Clinical Professor of Psychology: Social and Health Sciences*
 Frank Borchart (1971), Ph.D., *Professor of Germanic Languages and Literature*
 Edward H. Bossen (1972), M.D., *Professor of Pathology*
 Alan E. Boudreau (1988), Ph.D., *Associate Professor of Earth and Ocean Sciences*
 William F. Boulding (1984), Ph.D., *Professor of Business Administration*
 Rose-Mary Boustany (1994), Ph.D., *Assistant Professor of Neurobiology*
 John E. Boynton (1968), Ph.D., *Professor of Botany*
 William D. Bradford (1966), M.D., *Professor of Pathology*
 Michael Bradley (1995), Ph.D., *F. M. Kirby Professor of Business Administration*
 Robert N. Brandon (1979), Ph.D., *Professor of Philosophy and Professor of Zoology*
 Alon Brav (1997), Ph.D., *Assistant Professor of Business*
 John J. Brehm (1990), Ph.D., *Professor of Political Science*
 H. Keith H. Brodie (1970), M.D., D.Lit., *James B. Duke Professor of Psychology: Social and Health Sciences*
 Susan E. Brodt (1994), Ph.D., *Associate Professor of Business Administration*
 Thomas Brothers (1991), Ph.D., *Associate Professor of Music*
 Anthony Brown (1994), Ph.D., *Professor of the Practice of Public Policy Studies*
 Caroline A. Bruzelius (1981), Ph.D., *Professor of Art History*
 Robert Bryant (1987), Ph.D., *Juanita M. Kreps Professor of Mathematics*
 C. Edward Buckley, III (1963), M.D., *Assistant Professor of Immunology*
 Rebecca Buckley (1971), M.D., *J. B. Sidbury Professor of Immunology*
 Claudia Buchmann (1997), Ph.D., *Assistant Professor of Sociology*
 Donald S. Burdick (1962), Ph.D., *Associate Professor of Statistics and Decision Sciences, Associate Professor of Biomedical Engineering, and Associate Professor of Mathematics*
 Peter Burian (1968), Ph.D., *Professor of Classical Studies*
 Edwin Burmeister (1988), Ph.D., *Research Professor of Economics*
 Richard M. Burton (1970), D.B.A., *Professor of Business Administration*
 Ronald Richard Butters (1967), Ph.D., *Professor of English*
 Gale H. Buzzard (1957), Ph.D., *Assistant Professor of Mechanical Engineering and Materials Science*
 Nell B. Cant (1977), Ph.D., *Associate Professor of Neurobiology*
 Blanche Capel (1993), Ph.D., *Assistant Professor of Cell Biology*
 Lawrence Carin (1995), Ph.D., *Associate Professor of Electrical and Computer Engineering*
 Ziv Carmon (1993), Ph.D., *Associate Professor of Business Administration*
 Marc Caron (1983), Ph.D., *Professor of Cell Biology*
 Jackson W. Carroll (1993), Ph.D., *Ruth W. and A. Morris Williams, Jr., Professor of Religion and Professor of Sociology*
 Matt Cartmill (1969), Ph.D., *Professor of Biological Anthropology and Anatomy*
 Ernesto Caserta (1970), Ph.D., *Professor of Romance Studies*
 H. Craig Casey, Jr. (1979), Ph.D., *Professor of Electrical and Computer Engineering*
 Patrick John Casey (1990), Ph.D., *Professor of Pharmacology and Cancer Biology and Professor of Biochemistry*
 John W. Cell (1962), Ph.D., *Professor of History*
 William H. Chafe (1971), Ph.D., *Alice Mary Baldwin Professor of History*
 Krishnendu Chakrabarty (1998), Ph.D., *Assistant Professor of Computer Science*
 Jeffrey Chase (1995), Ph.D., *Assistant Professor of Computer Science*
 Y. T. Chen (1983), Ph.D., *Associate Professor of Genetics*
 Dona M. Chikaraishi (1995), Ph.D., *Professor of Neurobiology*
 Ashutosh Chilkoti (1996), Ph.D., *Assistant Professor of Biomedical Engineering*
 Norman L. Christensen, Jr. (1973), Ph.D., *Professor of Botany and Professor of Environmental Studies*
 Stephen E. Churchill (1995), Ph.D., *Assistant Professor of Biological Anthropology and Anatomy*
 Mikael Ciftan (1967), Ph.D., *Adjunct Professor of Physics*
 Elizabeth Ann Clark (1982), Ph.D., *John Carlisle Kilgo Professor of Religion*
 James S. Clark (1992), Ph.D., *Professor of Botany and Associate Professor of Earth and Ocean Sciences*
 Robert L. Clark (1992), Ph.D., *Professor of Mechanical Engineering and Materials Science*
 Diskin Clay (1990), Ph.D., *RJR Nabisco Professor of Classical Studies*
 Robert T. Clemen (1995), Ph.D., *Professor of Business Administration*

Charles T. Clotfelter (1979), Ph.D., *Z. Smith Reynolds Professor of Public Policy Studies and Professor of Economics*

John MacKenzie Clum (1986), Ph.D., *Professor of English*

Merlise Clyde (1994), Ph.D., *Associate Professor of Statistics and Decision Sciences*

Franklin H. Cocks (1972), Sc.D., *Professor of Mechanical Engineering and Materials Science*

W. John Coleman (1994), Ph.D., *Associate Professor of Business Administration*

Romand Coles (1988), Ph.D., *Associate Professor of Political Science*

Leslie M. Collins (1995), Ph.D., *Assistant Professor of Electrical and Computer Engineering and Assistant Professor of Biomedical Engineering*

Sheila Collins (1991), Ph.D., *Associate Research Professor of Pharmacology and Cancer Biology*

Michelle Connolly (1996), Ph.D., *Assistant Professor of Economics*

Walter Robert Connor (1990), Ph.D., *Professor of Classical Studies*

Robert Franklin Conrad (1988), Ph.D., *Associate Professor of Public Policy Studies and Associate Professor of Economics*

Philip J. Cook (1973), Ph.D., *ITT/Terry Sanford Professor of Public Policy Studies, Professor of Economics, and Professor of Sociology*

Miriam Cooke (1980), Ph.D., *Professor of Asian and African Languages and Literature and Professor of Literature*

Mark Coppejans (1996), Ph.D., *Assistant Professor of Economics*

Joseph M. Corless (1972), M.D., Ph.D., *Associate Professor of Cell Biology and Associate Professor of Neurobiology*

Bruce Hayward Corliss (1984), Ph.D., *Professor of Earth and Ocean Sciences*

Philip R. Costanzo (1968), Ph.D., *Professor of Psychology: Social and Health Sciences*

Stephen L. Craig (2000), Ph.D., *Assistant Professor of Chemistry*

Gregory Crawford (1997), Ph.D., *Assistant Professor of Economics*

Hugh C. Crenshaw (1991), Ph.D., *Assistant Professor of Zoology*

James L. Crenshaw (1987), Ph.D., *Robert L. Flowers Professor of Religion*

Peter Cresswell (1973), Ph.D., *Adjunct Professor of Immunology*

Herbert F. Croviiz (1963), Ph.D., *Professor of Psychology: Experimental*

Larry Crowder (1995), Ph.D., *Stephen A. Toth Professor of Environmental Studies and Professor of Zoology*

Alvin L. Crumbliss (1970), Ph.D., *Professor of Chemistry*

Bryan R. Cullen (1989), Ph.D., *Professor of Genetics and Microbiology*

Steven A. Cummer (1999), Ph.D., *Assistant Professor of Electrical and Computer Engineering*

Clifford Cunningham (1993), Ph.D., *Assistant Professor of Zoology*

John F. Curry (1978), Ph.D., *Associate Professor of Psychology: Social and Health Sciences*

Kim F. Curtis (1998), Ph.D., *Assistant Professor of the Practice of Political Science*

Roberto Dainotto (1998), Ph.D., *Assistant Professor of Romance Studies*

Leslie H. Damasceno (1994), Ph.D., *Assistant Professor of Romance Studies*

Theda Daniels-Race (1991), Ph.D., *Associate Research Professor of Electrical and Computer Engineering*

Donna Daniels (1996), Ph.D., *Assistant Professor of Cultural Anthropology*

Gopal Das Varma (1998), Ph.D., *Assistant Professor of Business Administration*

Cathy N. Davidson (1989), Ph.D., *Professor of English*

N. Gregson Davis (1991), Ph.D., *Distinguished Professor of Classical Studies*

Jeffrey R. Dawson (1972), Ph.D., *Professor of Immunology*

Ruth S. Day (1978), Ph.D., *Associate Professor of Psychology: Social and Health Sciences*

Maria de la Fuente (1999), Ph.D., *Assistant Professor of the Practice of Romance Studies*

Arturo De Lozanne (1991), Ph.D., *Assistant Professor of Cell Biology*

Neil Barry de Marchi (1971-80; 1983), Ph.D., *Professor of Economics*

A. Leigh DeNeef (1969), Ph.D., *Professor of English*

Mariatte Denman (2000), Ph.D., *Assistant Professor of Germanic Languages and Literature*

Jeffrey H. Derby (1983), Ph.D., *Adjunct Associate Professor of Electrical and Computer Engineering*

Preyas Desai (1999), Ph.D., *Associate Professor of Business Administration*

Gerardine DeSanctis (1994), Ph.D., *Professor of Business Administration*

Mark D. Dewhirst (1991), D.V.M., Ph.D., *Professor of Pathology*

Richard T. Di Giulio (1982), Ph.D., *Professor of Environmental Studies*

Thomas A. DiPrete (1988), Ph.D., *Professor of Sociology*

Arif Dirlik (1971), Ph.D., *Professor of History*

James Dobbins (1998), Ph.D., *Associate Professor of Biomedical Engineering*

Kenneth Dodge (1998), Ph.D., *William McDougall Professor of Public Policy and Professor of Psychology: Social and Health Sciences*

John Dolbow (1999), Ph.D., *Assistant Professor of Civil and Environmental Engineering*

Xinnian Dong (1992), Ph.D., *Associate Professor of Botany*

Ariel Dorfman (1988), Ph.D., *Walter Hines Page Research Professor of Literature and Latin American Studies, Research Professor of Romance Studies*

Earl H. Dowell (1983), Sc.D., *J. A. Jones Professor of Mechanical Engineering and Materials Science*

Carolyn Doyle (1990), Ph.D., *Associate Research Professor of Immunology*
 John W. Drake (1992), Ph.D., *Adjunct Professor of Genetics*
 Christine Drea (1999), Ph.D., *Assistant Professor of Biological Anthropology and Anatomy*
 John Edward Druesedow, Jr. (1990), Ph.D., *Assistant Professor of Music*
 Carol O. Eckerman (1972), Ph.D., *Professor of Psychology: Experimental and Professor of Psychology: Social and Health Sciences*
 Herbert Edelsbrunner (1999), Ph.D., *Professor of Computer Science*
 Julie A. Edell (1981), Ph.D., *Associate Professor of Business Administration*
 Glenn S. Edwards (1998), Ph.D., *Professor of Physics*
 Albert Eldridge (1970), Ph.D., *Associate Professor of Political Science*
 Everett H. Ellinwood, Jr. (1966), M.D., *Professor of Pharmacology and Cancer Biology*
 Carla S. Ellis (1986), Ph.D., *Professor of Computer Science*
 David Ellsworth (1994), Ph.D., *Adjunct Associate Professor of the Environment*
 Sharyn Endow (1978), Ph.D., *Professor of Microbiology*
 Peter C. English (1978), M.D., Ph.D., *Professor of History*
 Chang-Beom Eom (1993), Ph.D., *Associate Professor of Physics*
 Carl J. Erickson (1966), Ph.D., *Professor of Psychology: Experimental*
 Harold P. Erickson (1970), Ph.D., *Professor of Cell Biology*
 Lawrence E. Evans (1963), Ph.D., *Professor of Physics*
 Henry Everitt (1998), Ph.D., *Adjunct Professor of Physics*
 Janet J. Ewald (1983), Ph.D., *Associate Professor of History*
 Katherine P. Ewing (1991), Ph.D., *Associate Professor of Cultural Anthropology*
 Richard B. Fair (1981), Ph.D., *Professor of Electrical and Computer Engineering*
 Peter D. Feaver (1991), Ph.D., *Associate Professor of Political Science*
 Richard G. Fehon (1991), Ph.D., *Associate Professor of Zoology and Assistant Professor of Cell Biology*
 Guoping Feng (2000), Ph.D., *Assistant Professor of Neurobiology*
 Michael T. Ferejohn (1983), Ph.D., *Associate Professor of Philosophy*
 Thomas J. Ferraro (1988), Ph.D., *Associate Professor of English*
 Valeria Finucci (1986), Ph.D., *Associate Professor of Romance Studies*
 Gregory Fischer (1990), Ph.D., *Professor of Business Administration*
 Sibylle Fischer (1994), Ph.D., *Assistant Professor of Literature and Assistant Professor of Romance Studies*
 Peter G. Fish (1969), Ph.D., *Professor of Political Science*
 Michael Fitzgerald (1998), Ph.D., *Assistant Professor of Chemistry*
 David Fitzpatrick (1983), Ph.D., *Professor of Neurobiology and Adjunct Research Professor of Psychology*
 Owen Flanagan, Jr. (1992), Ph.D., *James B. Duke Professor of Philosophy and Professor of Neurobiology*
 Carol Flath (1988), Ph.D., *Associate Professor of the Practice of Slavic Languages and Literature*
 Joel Fleishman (1971), LL.M., *Professor of Public Policy Studies*
 Carey E. Floyd, Jr. (1989), Ph.D., *Research Professor of Biomedical Engineering*
 Rodney Folz (1996), Ph.D., *Assistant Professor of Toxicology and Cell Biology*
 John D. Forsyth (1978), D.B.A., *Professor of Business Administration*
 Richard B. Forward (1971), Ph.D., *Lee Hill Snowdon Professor of Zoology and Professor of Environmental Science*
 Craig R. Fox (1996), Ph.D., *Associate Professor of Business Administration*
 Jennifer Francis (1999), Ph.D., *Associate Professor of Business Administration*
 Michael M. Frank (1990), M.D., *Professor of Immunology*
 Linda Franzoni (1999), Ph.D., *Associate Professor of Mechanical Engineering and Materials Science*
 Jonathan Freedman (1994), *Assistant Professor of Environmental Studies and Assistant Professor of Microbiology*
 Michael Scott Freemark (1990), M.D., *Assistant Professor of Cell Biology*
 John French (1993), Ph.D., *Associate Professor of History*
 Henry S. Friedman (1992), M.D., *Assistant Professor of Pathology*
 Mary Fulkerson (1987), Ph.D., *Associate Professor of Religion*
 Jane Marie Gaines (1982), Ph.D., *Associate Professor of Literature and Associate Professor of English*
 A. Ronald Gallant (1983), Ph.D., *Research Professor of Economics*
 Bai Gao (1993), Ph.D., *Assistant Professor of Sociology*
 Miguel Garci-Gómez (1973), Ph.D., *Professor of Romance Languages*
 Mariano Agustin Garcia-Blanco (1984), M.D., Ph.D., *Associate Professor of Genetics and Associate Professor of Microbiology*
 Ronie Garcia-Johnson (1999), Ph.D., *Assistant Professor of the Environment*
 Devendra P. Garg (1972), Ph.D., *Professor of Mechanical Engineering and Materials Science*
 Stephen Garrett (1989), Ph.D., *Associate Research Professor of Pharmacology and Cancer Biology and Assistant Research Professor of Biochemistry*
 D. Barry Gaspar (1983), Ph.D., *Professor of History*
 Daniel J. Gauthier (1990), Ph.D., *Associate Professor of Physics*
 Henri P. Gavin (1995), Ph.D., *Assistant Professor of Civil and Environmental Engineering*

Raymond Gavins (1970), Ph.D., *Professor of History*
 Christopher Gelpi (1997), Ph.D., *Assistant Professor of Political Science*
 Linda K. George (1976), Ph.D., *Professor of Sociology and Professor of Psychology: Social and Health Sciences*
 Rhett Truesdale George, Jr. (1957), Ph.D., *Assistant Professor of Electrical and Computer Engineering*
 Gary Gereffi (1980), Ph.D., *Professor of Sociology*
 Daniel Gewirth (1998), Ph.D., *Assistant Professor of Biochemistry*
 Jehanne Gheith (1992), Ph.D., *Andrew W. Mellon Associate Professor of Slavic Languages and Literatures*
 Daniel Gigone (1996), Ph.D., *Assistant Professor of Business Administration*
 Eli Gilboa (1993), Ph.D., *Beard Professor of Immunology*
 Michael A. Gillespie (1983), Ph.D., *Professor of Political Science and Professor of Philosophy*
 Nicholas W. Gillham (1968), Ph.D., *James B. Duke Professor of Zoology*
 Bryan Gilliam (1986), Ph.D., *Professor of Music*
 Kenneth E. Glander (1975), Ph.D., *Professor of Biological Anthropology and Anatomy*
 Henk Goemans (1997), Ph.D., *Assistant Professor of Political Science*
 Deborah T. Gold (1991), Ph.D., *Associate Research Professor of Psychology: Social and Health Sciences and Associate Research Professor of Sociology*
 Martin P. Golding (1976), Ph.D., *Professor of Philosophy*
 Craufurd Goodwin (1962), Ph.D., *James B. Duke Professor of Economics*
 Lawrence C. Goodwyn (1971), Ph.D., *Professor of History*
 George D. Gopen (1985), Ph.D., *Professor of the Practice of Rhetoric*
 Alfred T. Goshaw (1973), Ph.D., *Professor of Physics*
 Henry G. Grabowski (1972), Ph.D., *Professor of Economics*
 Daniel A. Graham (1969), Ph.D., *Professor of Economics*
 John Graham (1997), Ph.D., *Associate Professor of Business Administration*
 Gregory Grandin (1999), Ph.D., *Assistant Professor of History*
 Ruth W. Grant (1987), Ph.D., *Associate Professor of Political Science*
 Stephen F. Gray (1994), Ph.D., *Associate Research Professor of Business Administration*
 Monica H. Green (1987), Ph.D., *Associate Professor of History*
 Charles S. Greenberg (1992), M.D., *Professor of Pathology*
 Ronald C. Greene (1958), Ph.D., *Associate Professor of Biochemistry*
 Joseph C. Greenfield (1962), M.D., *Associate Professor of Cell Biology*
 Arno L. Greenleaf (1977), Ph.D., *Professor of Biochemistry*
 Henry S. Greenside (1986), Ph.D., *Associate Professor of Computer Science and Associate Professor of Physics*
 Margaret Greer (1997), Ph.D., *Associate Professor of Romance Studies*
 Joseph M. Grieco (1982), Ph.D., *Professor of Political Science*
 Mark Grinstaff (1996), Ph.D., *Assistant Professor of Chemistry*
 Paul Gronke (1991), Ph.D., *Assistant Professor of Political Science*
 Matthias Gromeier (1999), M.D., *Assistant Professor of Microbiology*
 Bobby D. Guenther (1980), Ph.D., *Adjunct Professor of Physics*
 Farshid Guilak (1995), Ph.D., *Assistant Professor of Biomedical Engineering and Assistant Professor of Mechanical Engineering and Materials Science*
 Güven Güzeldere (1999), Ph.D., *Mellon Assistant Professor of Philosophy*
 Kathryn Gustafson (1989), Ph.D., *Assistant Professor of Psychology: Social and Health Sciences*
 Malachi Hacohen (1993), Ph.D., *Associate Professor of History*
 Peter K. Haff (1988), Ph.D., *Professor of Earth and Ocean Sciences and Professor of Civil and Environmental Engineering*
 Richard M. Hain (1991), Ph.D., *Professor of Mathematics*
 Laura Hale (1995), Ph.D., *Assistant Professor of Pathology*
 Amy Laura Hall (1999), Ph.D., *Assistant Professor of Religion*
 Kenneth C. Hall (1990), Sc.D., *Associate Professor of Mechanical Engineering and Materials Science*
 Warren G. Hall (1979), Ph.D., *Professor of Psychology: Experimental and Professor of Neurobiology*
 William C. Hall (1970), Ph.D., *Professor of Neurobiology and Professor of Psychology: Experimental*
 Patrick Halpin (1996), Ph.D., *Assistant Professor of the Practice of the Environment*
 James T. Hamilton (1991), Ph.D., *Associate Professor of Public Policy Studies, Associate Professor of Economics, and Associate Professor of Political Science*
 Jean A. Hamilton (1992), M.D., *Professor of Psychology: Social and Health Sciences*
 Gordon Hammes (1991), Ph.D., *Professor of Biochemistry*
 William E. Hammond (1968), Ph.D., *Professor of Biomedical Engineering*
 Moo-Young Han (1967), Ph.D., *Professor of Physics*
 John L. Harer (1993), Ph.D., *Professor of Mathematics*
 Charles M. Harman (1961), Ph.D., *Professor of Mechanical Engineering and Materials Science*
 Elizabeth H. Harris (1972), Ph.D., *Associate Professor of Botany*
 William Hart (1994), Ph.D., *Assistant Professor of Religion*
 Gary S. Hartshorn (1997), Ph.D., *Adjunct Professor of Botany*
 Campbell Harvey (1986), Ph.D., *J. Paul Sticht Professor of Business Administration*

Lynn Hasher (1986), Ph.D., *Professor of Psychology: Social and Health Sciences and Professor of Psychology: Experimental*

Diane L. Hatchell (1983), Ph.D., *Professor of Cell Biology*

Stanley Hauerwas (1984), Ph.D., *Gilbert T. Rowe Professor of Religion, Theological Ethics*

Brian Hayes (1997), Ph.D., *Assistant Research Professor of Mathematics*

Barton Ford Haynes (1980), M.D., *Professor of Immunology and Professor of Microbiology*

Richard Hays (1991), Ph.D., *Professor of Religion*

Robert G. Healy (1985), Ph.D., *Professor of Environment and Professor of Public Policy Studies*

Chip Heath (1997), Ph.D., *Associate Professor of Business Administration*

Joseph Heitman (1992), Ph.D., *Associate Professor of Genetics and Associate Professor of Microbiology*

Richard P. Heitzenrater (1993), Ph.D., *Professor of Religion*

Homme Hellinga (1993), Ph.D., *Associate Professor of Biochemistry and Associate Professor of Pharmacology and Cancer Biology*

Craig S. Henriquez (1991), Ph.D., *Associate Professor of Biomedical Engineering*

Cynthia B. Herrup (1984), Ph.D., *Professor of History*

Michael Steven Hershfield (1976), M.D., *Assistant Professor of Biochemistry*

David Higdon (1994), Ph.D., *Assistant Professor, Statistics and Decision Sciences*

Antony Higgins (1999), Ph.D., *Assistant Professor of Romance Studies*

Nancy Hill (1996), Ph.D., *Assistant Professor of Psychology: Social and Health Sciences*

Robert L. Hill (1961), Ph.D., *James B. Duke Professor of Biochemistry*

Van Hillard (1994), Ph.D., *Assistant Professor of the Practice, University Writing Program*

Hans Hillerbrand (1959-1970; 1988), Ph.D., *Professor of Religion*

Robert M. Hochmuth (1978), Ph.D., *Professor of Mechanical Engineering and Materials Science and Professor of Biomedical Engineering*

Richard Earl Hodel (1965), Ph.D., *Associate Professor of Mathematics*

Maureane R. Hoffman (1992), M.D., Ph.D., *Associate Professor of Pathology and Assistant Professor of Immunology*

Peter C. Holland (1986), Ph.D., *James B. Duke Professor of Psychology: Experimental*

Karla Holloway (1992), Ph.D., *William R. Kenan, Jr. Professor of English and African American Literature*

Donald L. Horowitz (1980), LL.M., Ph.D., *James B. Duke Professor of Political Science*

Jerry F. Hough (1973), Ph.D., *James B. Duke Professor of Political Science and Professor of Public Policy Studies*

Peter A. Howd (1991), Ph.D., *Adjunct Assistant Professor of the Environment*

Calvin R. Howell (1984), Ph.D., *Associate Professor of Physics*

Laurens Howle (1993), Ph.D., *Associate Professor of Mechanical Engineering and Materials Science*

David Arthur Hsieh (1989), Ph.D., *Professor of Business Administration*

Tao-shih Hsieh (1981), Ph.D., *Professor of Biochemistry*

Edward Hsu (1998), Ph.D., *Assistant Professor of Biomedical Engineering*

Joel C. Huber (1978), Ph.D., *Professor of Business Administration*

Tomasz A. Hueckel (1986), Ph.D., Sc.D., *Associate Professor of Civil and Environmental Engineering*

Reinhard Huetter (1998), Th.M., *Associate Professor of Religion*

Claude L. Hughes (1997), M.D., Ph.D., *Professor of Toxicology*

Mary E. Hughes (1999), Ph.D., *Assistant Professor of Sociology*

Margaret Humphreys (1998), Ph.D., *Associate Professor of History*

William L. Hylander (1971), Ph.D., *Professor of Biological Anthropology and Anatomy*

J. Dirk Iglehart (1975), Ph.D., *Associate Professor of Pathology*

Pamela Braboy Jackson (1993), Ph.D., *Assistant Professor of Sociology*

Robert Jackson (1998), Ph.D., *Assistant Professor of Botany*

Stephen Jaffe (1983), A.M., *Mary D.B.T. and James H. Semans Professor of Music Composition*

Daniel M. James (1991), Ph.D., *Associate Professor of History*

Fredric R. Jameson (1985), Ph.D., *William A. Lane, Jr., Professor of Comparative Literature and Professor of Romance Studies*

Micaela W. Janan (1990), Ph.D., *Associate Professor of Classical Studies*

Ronald Jaszczak (1989), Ph.D., *Professor of Biomedical Engineering and Professor of Statistics*

Robert B. Jennings (1975), M.D., *James B. Duke Professor of Pathology*

Willie J. Jennings (1990), Ph.D., *Assistant Professor of Religion*

Randy L. Jirtle (1977), Ph.D., *Associate Professor of Pathology*

G. Allan Johnson (1995), Ph.D., *Professor of Biomedical Engineering*

Valen Johnson (1990), Ph.D., *Professor of Statistics and Decision Sciences*

William Thomas Joines (1966), Ph.D., *Professor of Electrical and Computer Engineering*

Jean Jonassaint, (1996), Ph.D., *Andrew Mellon Assistant Professor of Romance Studies*

Buford Jones (1962), Ph.D., *Associate Professor of English*

L. Gregory Jones (1997), Ph.D., *Professor of Religion*

Phillip L. Jones (1977), Ph.D., *Associate Professor of Mechanical Engineering and Materials Science*

Kathleen Joyce (1995), Ph.D., *Andrew W. Mellon Assistant Professor of Religion*

Burke Judd (1992), Ph.D., *Adjunct Professor of Genetics*
 Zbigniew J. Kabala (1994), Ph.D., *Associate Professor of Civil and Environmental Engineering*
 William H. Kane (1992), M.D., Ph.D., *Associate Professor of Pathology*
 Alice Yaeger Kaplan (1986), Ph.D., *Professor of Romance Studies and Professor of Literature*
 Jeffrey A. Karson (1985), Ph.D., *Professor of Earth and Ocean Sciences*
 Prasad Kasibhatla (1997), Ph.D., *Associate Professor of the Environment and Assistant Professor of Civil and Environmental Engineering*
 Gabriel G. Katul (1993), Ph.D., *Associate Professor of the Environment and Associate Professor of Civil and Environmental Engineering*
 David Katz (1993), Ph.D., *Professor of Biomedical Engineering*
 Lawrence C. Katz (1990), Ph.D., *Professor of Neurobiology*
 Richard F. Kay (1973), Ph.D., *Professor of Biological Anthropology and Anatomy and Professor of Earth and Ocean Sciences*
 Gershon Kedem (1985), Ph.D., *Associate Professor of Computer Science*
 Francis J. Keefe (1978), Ph.D., *Professor of Psychology: Social and Health Sciences*
 Jack D. Keene (1979), Ph.D., *Professor of Microbiology*
 Paul Keineg (1994), Ph.D., *Research Associate Professor of Romance Studies*
 Thomas F. Keller (1959), Ph.D., *R. J. Reynolds Industries Professor of Business Administration*
 Allen C. Kelley (1972), Ph.D., *James B. Duke Professor of Economics*
 Garnett Kelsoe (1998) D.Sc., *Professor of Immunology*
 Daniel Kenan (1998), Ph.D., *Assistant Professor of Pathology*
 Robert Keohane (1995), Ph.D., *James B. Duke Professor of Political Science*
 Alexander Keyssar (1986), Ph.D., *Professor of History and Professor of Public Policy Studies*
 Daniel Kiehart (1992), Ph.D., *Associate Professor of Cell Biology*
 Kent P. Kimbrough (1980), Ph.D., *Professor of Economics*
 William Kirby-Smith (1990), Ph.D., *Associate Professor of the Practice of Environment*
 Elizabeth Kiss (1997), Ph.D., *Associate Professor of the Practice of Political Science and Associate Professor of the Practice of Philosophy*
 Joseph Weston Kitchen, Jr. (1962), Ph.D., *Associate Professor of Mathematics*
 Herbert P. Kitschelt (1984), Ph.D., *Professor of Political Science*
 Emily M. Klein (1988), Ph.D., *Associate Professor of Earth and Ocean Sciences*
 John A. Klingensmith (1997), Ph.D., *Assistant Professor of Cell Biology*
 Gordon K. Klintworth (1964), M.D., Ph.D., *Professor of Pathology*
 Josiah D. Knight (1985), Ph.D., *Associate Professor of Mechanical Engineering and Materials Science*
 Kenneth R. Knoerr (1961), Ph.D., *Professor of the Environment and Associate Professor of Botany*
 Walter Koch, (1997), Ph.D., *Assistant Research Professor of Pharmacology and Cancer Biology*
 Bruce D. Kohorn (1987), Ph.D., *Associate Professor of Botany*
 Claudia Koonz (1988), Ph.D., *Professor of History*
 Allan Kornberg (1965), Ph.D., *Professor of Political Science*
 Sally A. Kornbluth (1996), Ph.D., *Assistant Professor of Pharmacology and Cancer Biology*
 Laura Kornish (1998), Ph.D., *Assistant Professor of Business Administration*
 Robert R. Korstad (1991), *Assistant Professor of Public Policy Studies and Assistant Professor of History*
 Ashutosh Kotwal (1998), *Assistant Professor of Physics*
 Wesley A. Kort (1965), Ph.D., *Professor of Religion*
 David Paul Kraines (1970), Ph.D., *Associate Professor of Mathematics*
 Randall A. Kramer (1988), Ph.D., *Professor of the Environment*
 Michael Steven Krangel (1990), Ph.D., *Associate Professor of Immunology*
 Wanda Krassowska (1988), Ph.D., *Associate Professor of Biomedical Engineering*
 Virginia B. Kraus (1993), Ph.D., *Assistant Professor of Pathology*
 William E. Kraus (1983), Ph.D., *Assistant Professor of Cell Biology*
 Nicholas Michael Kredich (1968), M.D., *Professor of Biochemistry*
 John Kress (1992), Ph.D., *Adjunct Associate Professor of Botany*
 Kenneth N. Kreuzer (1984), Ph.D., *Associate Professor of Microbiology*
 Jeffrey L. Krolik (1992), Ph.D., *Associate Professor of Electrical and Computer Engineering*
 Meta Kuehn (1998), Ph.D., *Assistant Professor of Biochemistry and Assistant Professor of Microbiology*
 Cynthia Moreton Kuhn (1978), Ph.D., *Professor of Pharmacology and Cancer Biology and Professor of Psychology: Experimental*
 Bruce R. Kuniholm (1977), Ph.D., *Professor of Public Policy Studies and Professor of History*
 Thomas A. Kunkel (1986), Ph.D., *Adjunct Professor of Genetics*
 Madan Kwatra (1989), Ph.D., *Assistant Professor of Pharmacology and Cancer Biology*
 Albert S. Kyle (1992), Ph.D., *Associate Professor of Business Administration*
 Kevin LaBar (1999), Ph.D., *Assistant Professor of Psychology: Experimental*
 Helen F. Ladd (1986), Ph.D., *Professor of Public Policy Studies and Professor of Economics*
 Thomas C. Lahusen (1989), Ph.D., *Professor of Slavic Languages and Literatures and Professor of Literature*
 Kenneth C. Land (1985), Ph.D., *John Franklin Crowell Professor of Sociology*

Peter Lange (1982), Ph.D., *Professor of Political Science*
 Daniel Laughhunn (1968), D.B.A., *Professor of Business Administration*
 Cathy C. Laurie (1986), Ph.D., *Professor of Zoology*
 Tod A. Laursen (1992), Ph.D., *Yoh Associate Professor of Civil and Environmental Engineering and Associate Professor of Mechanical Engineering and Materials Science*
 Michael Lavine (1990), Ph.D., *Associate Professor of Statistics and Decision Sciences*
 Gregory F. Lawler (1979), Ph.D., *Professor of Mathematics*
 Bruce B. Lawrence (1971), Ph.D., *Professor of Religion*
 Harold E. Layton (1988), Ph.D., *Associate Professor of Mathematics*
 Alvin Lebeck (1996), Ph.D., *Assistant Professor of Computer Science*
 Robert Lefkowitz (1973), M.D., *James B. Duke Professor of Biochemistry*
 E. Ann LeFurgey (1976), Ph.D., *Research Associate Professor of Cell Biology*
 Patricia Leighten (1998), Ph.D., *Professor of Art and Art History*
 Frank Lentricchia (1984), Ph.D., *Katharine Everett Gilbert Professor of Literature*
 Warren Lerner (1961), Ph.D., *Professor of History*
 Edward D. Levin (1989), Ph.D., *Associate Professor of Psychology: Experimental and Associate Professor of Pharmacology and Cancer Biology*
 Carolyn Levine (1996), Ph.D., *Assistant Professor of Business Administration*
 Daniel J. Lew (1996), Ph.D., *Assistant Professor of Pharmacology and Cancer Biology*
 Arie Y. Lewin (1974), Ph.D., *Professor of Business Administration and Professor of Sociology*
 James Grier Lewis (1991), Ph.D., *Associate Professor of Pathology*
 Virginia Ann Lightner (1989), M.D., Ph.D., *Assistant Research Professor of Cell Biology*
 Haifan Lin (1994), Ph.D., *Assistant Professor of Cell Biology*
 Nan Lin (1989), Ph.D., *Professor of Sociology*
 E. Allan Lind (1996), Ph.D., *Thomas A. Finch Jr. Professor of Business Administration*
 Karl Linden (1999), Ph.D., *Assistant Professor of Civil and Environmental Engineering*
 Scott A. Lindroth (1991), D.M.A., *Associate Professor of Music*
 Elwood A. Linney (1984), Ph.D., *Professor of Microbiology, Professor of the Environment and Professor of Pharmacology and Cancer Biology*
 Patricia Linville (1990), Ph.D., *Associate Professor of Business Administration and Associate Professor of Psychology: Social and Health Sciences*
 Vladimir N. Litvinenko (1991), Ph.D., *Associate Professor of Physics*
 Ralph Litzinger (1994), Ph.D., *Assistant Professor of Cultural Anthropology*
 Jie Liu (1999), Ph.D., *Assistant Professor of Chemistry*
 Qing H. Liu (1999), Ph.D., *Associate Professor of Electrical and Computer Engineering*
 Daniel A. Livingstone (1956), Ph.D., *James B. Duke Professor of Zoology and Professor of Earth and Ocean Sciences*
 Donald C. Lo (1992), Ph.D., *Associate Professor of Neurobiology*
 Joseph Lo (1995), Ph.D., *Assistant Research Professor of Biomedical Engineering*
 David Lobach (1992), Ph.D., *Assistant Research Professor of Biomedical Engineering*
 John E. Lochman (1984), Ph.D., *Professor of Psychology: Social and Health Sciences*
 Charles H. Lochmüller (1969), Ph.D., *Professor of Chemistry and Professor of Biomedical Engineering*
 Gregory R. Lockhead (1965), Ph.D., *Professor of Psychology: Experimental*
 Michèle Farrell Longino (1989), Ph.D., *Associate Professor of Romance Studies*
 Donald W. Loveland (1973), Ph.D., *Professor of Computer Science*
 M. Susan Lozier (1991), Ph.D., *Associate Professor of Earth and Ocean Sciences and Associate Professor of Mechanical Engineering and Materials Science*
 Wahneema Lubiano (1997), Ph.D., *Associate Professor of Literature*
 John G. Lynch (1996), Ph.D., *Hanes Corporation Foundation Professor of Business Administration*
 Thomas R. Lynch (1996), Ph.D., *Assistant Clinical Professor of Psychology: Social and Health Sciences*
 John M. McCann (1978), Ph.D., *Professor of Business Administration*
 Gregory McCarthy (1999), Ph.D., *Professor of Psychology: Experimental and Professor of Neurobiology*
 David R. McClay (1973), Ph.D., *Professor of Zoology, Professor of Immunology, and Professor of Neurobiology*
 Patricia McClellan-Green (1996), Ph.D., *Adjunct Assistant Professor of the Environment*
 John H. McCusker (1995), Ph.D., *Assistant Professor of Microbiology*
 Donald P. McDonnell (1994), Ph.D., *Professor of Pharmacology and Cancer Biology*
 Marjorie McElroy (1970), Ph.D., *Professor of Economics*
 Linda McGown (1987), Ph.D., *Professor of Chemistry*
 Michael McHeyzer-Williams (1996), Ph.D., *Assistant Professor of Immunology*
 Thomas J. McIntosh (1977), Ph.D., *Professor of Cell Biology*
 Peter McIsaac (1999), Ph.D., *Assistant Professor of Germanic Languages and Literature*
 Margaret A. McKean (1974), Ph.D., *Associate Professor of Political Science*
 Ross E. McKinney (1996), Ph.D., *Professor of Civil and Environmental Engineering*
 James O. McNamara (1969), M.D., *Professor of Neurobiology and Professor of Pharmacology and Cancer Biology*

Andrew T. McPhail (1968), Ph.D., *Professor of Chemistry*
 Daniel W. McShea (1995), Ph.D., *Assistant Professor of Zoology*
 James MacFall (1989), Ph.D., *Associate Professor of Biomedical Engineering*
 Richard A. MacPhail (1984), Ph.D., *Associate Professor of Chemistry*
 David J. Madden (1990), Ph.D., *Associate Research Professor of Psychology: Social and Health Sciences*
 George L. Maddox, Jr. (1960), Ph.D., *Professor of Sociology and Professor of Psychology: Social and Health Sciences*
 Lynn A. Maguire (1982), Ph.D., *Associate Professor in the Practice of the Environment*
 Edward P. Mahoney (1965), Ph.D., *Professor of Philosophy*
 Peter E. Malin (1991), Ph.S., D.Sc., *Professor of Earth and Ocean Sciences and Professor of Civil and Environmental Engineering*
 Melissa Malouf (1990), Ph.D., *Assistant Professor of the Practice of English*
 Paul S. Manos (1994), Ph.D., *Assistant Professor of Botany*
 Carol Mansfield (1994), Ph.D., *Adjunct Assistant Professor of the Environment and Assistant Professor of Economics*
 Kenneth G. Manton (1977), Ph.D., *Research Professor of Sociology*
 Douglas Marchuk (1994), Ph.D., *Associate Professor of Genetics*
 Peter N. Marinos (1968), Ph.D., *Professor of Electrical and Computer Engineering and Professor of Computer Science*
 Mary Louise Markert (1990), M.D., Ph.D., *Assistant Professor of Immunology*
 Jeffrey R. Marks (1996), Ph.D., *Assistant Professor of Pathology*
 Gail R. Marsh (1969), Ph.D., *Associate Professor of Psychology: Experimental*
 Hisham Z. Massoud (1983), Ph.D., *Professor of Electrical and Computer Engineering and Associate Professor of Biomedical Engineering*
 William D. Matthew (1990), Ph.D., *Associate Professor of Neurobiology*
 Seymour H. Mauskopf (1964), Ph.D., *Professor of History*
 Frederick W. Mayer (1988), Ph.D., *Associate Professor of Public Policy Studies and Associate Professor of Political Science*
 Reiko Mazuka (1989), Ph.D., *Associate Professor of Psychology: Social and Health Sciences and Associate Professor of Psychology: Experimental*
 Sucheta Muzumdar (1998), Ph.D., *Associate Professor of History*
 Anthony R. Means (1991), Ph.D., *Nanaline H. Duke Professor of Pharmacology and Cancer Biology*
 Warren H. Meck (1994), Ph.D., *Associate Professor of Psychology: Experimental*
 Miguel A. Medina, Jr. (1976), Ph.D., *Professor of Civil and Environmental Engineering*
 Louise Meintjes (1996), Ph.D., *Assistant Professor of Music and Assistant Professor of Cultural Anthropology*
 Carl Mela (1999), Ph.D., *Associate Professor of Business Administration*
 Enrique Mendoza (1997), Ph.D., *Associate Professor of Economics*
 Tobias Meyer (1991), Ph.D., *Associate Professor of Cell Biology and Assistant Professor of Pharmacology and Cancer Biology*
 Carol L. Meyers (1979), Ph.D., *Professor of Religion*
 Eric M. Meyers (1969), Ph.D., *Bernice-Morton Lerner Professor of Religion*
 Denis Mickiewicz, (1994), Ph.D., *Research Scholar of Slavic Languages and Literature*
 Ellen Mickiewicz (1993), Ph.D., *Professor of Public Policy Studies and Professor of Political Science*
 Walter D. Mignolo (1993), Ph.D., *William H. Wannamaker Professor of Romance Studies, Professor of Literature, and Professor of Cultural Anthropology*
 Martin A. Miller (1970), Ph.D., *Professor of History*
 Sara Elizabeth Miller (1973), Ph.D., *Associate Research Professor of Microbiology and Associate Clinical Professor of Pathology*
 Elliott Mills (1968), Ph.D., *Professor of Pharmacology and Cancer Biology and Associate Professor of Cell Biology*
 Marie Lynn Miranda (1990), Ph.D., *Associate Professor of the Practice of Environmental Policy*
 Thomas G. Mitchell (1974), Ph.D., *Associate Professor of Microbiology*
 Paul L. Modrich (1976), Ph.D., *James B. Duke Professor of Biochemistry*
 Toril Moi (1989), (Ph.D.), *James B. Duke Professor of Literature and Professor of Romance Studies*
 Richard D. Mooney (1994), Ph.D., *Assistant Professor of Neurobiology*
 Lawrence C. Moore, Jr. (1966), Ph.D., *Associate Professor of Mathematics*
 Marian Chapman Moore (1982), Ph.D., *Associate Professor of Business Administration*
 Michael Moore (1984), Ph.D., *Associate Professor of Business Administration*
 Christine Moorman (1999), Ph.D., *Professor of Business Administration*
 Alberto Moreiras (1992), Ph.D., *Associate Professor of Romance Studies and Associate Professor of Literature*
 Jairo Moreno, (1996), Ph.D., *Assistant Professor of Music*
 S. Philip Morgan (1998), Ph.D., *Professor of Sociology*
 Scott Morgenstern (1997), Ph.D., *Assistant Professor of Political Science*
 James Morizio (1995), Ph.D., *Adjunct Assistant Professor of Biomedical Engineering*
 William F. Morris (1991), Ph.D., *Associate Professor of Zoology*

David R. Morrison (1986), Ph.D., *James B. Duke Professor of Mathematics*
 Michael M. Morton (1985), Ph.D., *Associate Professor of Germanic Languages and Literature*
 Michael Moses (1987), Ph.D., *Associate Professor of English*
 Mico Mrkaic (1998), Ph.D., *Assistant Professor of Business Administration*
 Valentin Mudimbe (1987), Ph.D., *Professor of Literature and Professor of Cultural Anthropology*
 Berndt Müller (1990), Ph.D., *James B. Duke Professor of Physics*
 Peter Müller (1991), Ph.D., *Associate Professor of Statistics and Decision Sciences*
 Michael C. Munger (1997), Ph.D., *Professor of Political Science*
 Brad Murray (1998), Ph.D., *Assistant Professor of Earth and Ocean Sciences*
 Barry S. Myers (1991), Ph.D., *Associate Professor of Biomedical Engineering and Assistant Professor of Biological Anthropology and Anatomy*
 Joseph C. Nadeau (1996), Ph.D., *Assistant Professor of Civil and Environmental Engineering*
 J. Victor Nadler (1978), Ph.D., *Professor of Pharmacology and Cancer Biology and Professor of Neurobiology*
 Sydney Nathans (1966), Ph.D., *Associate Professor of History*
 Robert F. Nau (1985), Ph.D., *Associate Professor of Business Administration*
 Pierre Ndilikilikisha (1992), Ph.D., *Assistant Professor of Business Administration*
 Thomas Nechyba (1999), Ph.D., *Associate Professor of Economics*
 Amy Needham (1992), Ph.D., *Assistant Professor of Psychology: Experimental and Assistant Professor of Psychology: Social and Health Sciences*
 David Needham (1987), Ph.D., *Professor of Mechanical Engineering and Materials Science and Professor of Biomedical Engineering*
 Kristen B. Neuschel (1982), Ph.D., *Associate Professor of History*
 Joseph Nevins (1987), Ph.D., *James B. Duke Professor of Genetics and Professor of Microbiology*
 Christopher V. Nicchitta (1994), Ph.D., *Associate Professor of Cell Biology*
 Robert Bruce Nicklas (1965), Ph.D., *Arthur S. Pearse Professor of Zoology and Professor of Cell Biology*
 Laura Niklason (1998), M.D., Ph.D., *Assistant Professor of Biomedical Engineering*
 Miguel Nicolelis (1994), Ph.D., *Associate Professor of Neurobiology*
 Frederik Nijhout (1977), Ph.D., *Professor of Zoology*
 Mary M. Nijhout (1982), Ph.D., *Adjunct Associate Professor of Zoology*
 Emerson Niou (1988), Ph.D., *Associate Professor of Political Science*
 Loren W. Nolte (1966), Ph.D., *Professor of Electrical and Computer Engineering and Professor of Biomedical Engineering*
 Gabriela Nouzeilles (1995), Ph.D., *Mellon Assistant Professor of Romance Studies*
 Stephen Nowicki (1989), Ph.D., *Associate Professor of Zoology, Associate Professor of Neurobiology, and Assistant Professor of Psychology: Experimental*
 Terrence G. Oas (1990), Ph.D., *Associate Professor of Biochemistry and Assistant Professor of Chemistry*
 John F. Oates (1967), Ph.D., *Professor of Ancient History in Classical Studies*
 Jean Fox O'Barr (1969), Ph.D., *Adjunct Professor of Political Science*
 William M. O'Barr (1969), Ph.D., *Professor of Cultural Anthropology and Professor of Sociology*
 Seog Hwan Oh (1984), Ph.D., *Associate Professor of Physics*
 Theresa Joyce O'Halloran (1991), Ph.D., *Assistant Professor of Cell Biology*
 Angela O'Rand (1979), Ph.D., *Professor of Sociology*
 Michael K. Orbach (1991), Ph.D., *Professor of the Environment*
 Ram Oren (1986), Ph.D., *Associate Professor of the Environment*
 Linda Orr (1980), Ph.D., *Professor of Romance Studies*
 Thomas Ortel (1991), M.D., Ph.D., *Assistant Professor of Pathology*
 George M. Padilla (1965), Ph.D., *Professor of Cell Biology*
 David L. Paletz (1967), Ph.D., *Professor of Political Science*
 Richard A. Palmer (1966), Ph.D., *Professor of Chemistry*
 Richard G. Palmer (1977), Ph.D., *Professor of Physics, Professor of Psychology: Experimental, and Professor of Computer Science*
 William Leslie Pardon (1977), Ph.D., *Professor of Mathematics*
 Robert Parkins (1990), D.M.A., *Professor of the Practice of Music*
 Giovanni Parmigiani (1991), Ph.D., *Associate Professor of Statistics and Decision Sciences*
 Simon Partner (1999), Ph.D., *Assistant Professor of History*
 Emilio A. Parrado (1999), Ph.D., *Assistant Professor of Sociology*
 Ares D. Pasipoularides (1989), M.D., Ph.D., *Associate Professor of Biomedical Engineering*
 Dhaval Kumar Patel (1998), M.D., Ph.D., *Assistant Professor of Immunology*
 Sarah Patterson (1997), Ph.D., *Assistant Professor of Business Administration*
 Charles Payne (1998), Ph.D., *Professor of History*
 John W. Payne (1977), Ph.D., *Joseph J. Ruvane, Jr., Professor of Business Administration, Professor of Psychology: Experimental, and Professor of Psychology: Social and Health Sciences*
 George W. Pearsall (1964), Sc.D., *Professor of Mechanical Engineering and Materials Science and Professor of Public Policy Studies*
 J. Jeffrey Peirce (1981), Ph.D., *Associate Professor of Civil and Environmental Engineering*

Aleksandar Pekec (1998), Ph.D., *Assistant Professor of Business Administration*
 Ann Marie Pendergast (1992), Ph.D., *Associate Professor of Pharmacology and Cancer Biology*
 Pietro Peretto (1994), Ph.D., *Assistant Professor of Economics*
 Gustavo Pérez-Firmat (1978), Ph.D., *Professor of Romance Studies and Professor of Literature*
 Margaret Pericak-Vance (1981), Ph.D., *Associate Research Professor of Genetics*
 Pietro Peretto (1996), Ph.D., *Assistant Professor of Economics*
 Melvin K. H. Peters (1983), Ph.D., *Associate Professor of Religion*
 Henry J. Petroski (1980), Ph.D., *Aleksandar S. Vesic Professor of Civil and Environmental Engineering and Professor of History*
 Arlie O. Petters (1998), Ph.D., *William and Sue Gross Associate Professor of Mathematics*
 Catherine Peyroux (1995), Ph.D., *Assistant Professor of History*
 Thomas Pfau (1991), Ph.D., *Associate Professor of English and Associate Professor of Germanic Languages and Literature*
 Thomas Phillips (1986), Ph.D., *Assistant Research Professor of Physics*
 David J. Pickup (1984), Ph.D., *Associate Professor of Microbiology*
 Charles Piot (1997), Ph.D., *Associate Professor of Cultural Anthropology*
 Michael C. Pirrung (1991), Ph.D., *Professor of Chemistry*
 David Stephen Pisetsky (1978), M.D., Ph.D., *Associate Professor of Immunology*
 Salvatore V. Pizzo (1976), M.D., Ph.D., *Professor of Pathology*
 Jeffrey L. Platt (1992), M.D., *Professor of Immunology*
 Michael Platt (2000), Ph.D., *Assistant Professor of Neurobiology*
 Deborah Pope (1979), Ph.D., *Professor of English*
 Theresa Pope (1993), Ph.D., *Assistant Professor of Biological Anthropology and Anatomy*
 Joseph A. Porter (1980), Ph.D., *Professor of English*
 Richard J. Powell (1988), Ph.D., *John Spencer Bassett Professor of Art History*
 Leela Prasad (1999), Ph.D., *Assistant Professor of Religion*
 Lincoln Pratson (1999), Ph.D., *Assistant Professor of Earth and Ocean Sciences*
 David Eugene Price (1973), Ph.D., *Professor of Political Science and Professor of Public Policy Studies*
 Reynolds Price (1958), B.Litt., *Professor of English*
 Michael Prisant (1988), Ph.D., *Assistant Research Professor of Chemistry and Assistant Professor of Computer Science*
 Alan Proia (1989), Ph.D., *Professor of Pathology*
 Devavrat Purohit (1988), Ph.D., *Associate Professor of Business Administration*
 Dale Purves (1990), M.D., *George B. Geller Professor of Neurobiology and Professor of Psychology: Experimental*
 Martha Putallaz (1983), Ph.D., *Professor of Psychology: Social and Health Sciences and Associate Professor of Psychology: Experimental*
 Alicia V. Quinlan (1983), Ph.D., *Associate Professor of Mechanical Engineering and Materials Science*
 Naomi Quinn (1972), Ph.D., *Professor of Cultural Anthropology and Professor of Psychology: Social and Health Sciences*
 Mazin Qumsiyeh (1994), Ph.D., *Associate Clinical Professor of Genetics*
 Janice A. Radway (1985), Ph.D., *Professor of Literature*
 Christian R. H. Raetz (1993), Ph.D., *George B. Geller Professor of Biochemistry*
 K. V. Rajagopalan (1966), Ph.D., *James B. Duke Professor of Biochemistry*
 Dietolf Ramm (1971), Ph.D., *Associate Professor of the Practice of Computer Science*
 Joseph S. Ramus (1978), Ph.D., *Professor of the Environment and Professor of Botany*
 Ann Marie Rasmussen (1988), Ph.D., *Associate Professor of Germanic Languages and Literature*
 William Raspberry (1995), Ph.D., *Professor of the Practice of Public Policy Studies*
 Mark D. Rausher (1978), Ph.D., *Professor of Zoology*
 Andrew J. Read (1995), Ph.D., *Assistant Professor of the Practice of the Environment*
 Kenneth H. Reckhow (1980), Ph.D., *Professor of the Environment and Associate Professor of Civil and Environmental Engineering*
 William M. Reddy (1977), Ph.D., *William T. Laprade Professor of History and Professor of Cultural Anthropology*
 Michael Charles Reed (1974), Ph.D., *Professor of Mathematics*
 Michael K. Reedy (1969), M.D., *Professor of Cell Biology*
 Michel Regenwetter (1997), Ph.D., *Assistant Professor of Business Administration*
 William Reichert (1987), Ph.D., *Professor of Biomedical Engineering*
 John H. Reif (1986), Ph.D., *Professor of Computer Science*
 Keith Arnold Reimer (1975), M.D., Ph.D., *Professor of Pathology*
 Peter H. Reinhart (1991), Ph.D., *Associate Professor of Neurobiology*
 Michael A. Resnick (1985), Ph.D., *Adjunct Professor of Genetics*
 James F. Reynolds (1991), Ph.D., *Professor of Botany*
 Louise Rice (1992), Ph.D., *Associate Professor of Art and Art History*
 John F. Richards (1977), Ph.D., *Professor of History*

Curtis J. Richardson (1977), Ph.D., *Professor of the Environment*
 David Claude Richardson (1969), Ph.D., *Professor of Biochemistry*
 Jane Richardson (1970), D.Sc., *Professor of Biochemistry*
 Russell Richey (1987), Ph.D., *Professor of Religion*
 Daniel D. Richter (1987), Ph.D., *Associate Professor of the Environment*
 Gregory Riggins (1997), Ph.D., *Assistant Professor of Pathology*
 Kent J. Rigsby (1971), Society of Fellows (Harvard), *Professor of Classical Studies*
 Daniel Rittschof (1985), Ph.D., *Associate Professor of the Environment*
 Clive J. Robins (1987), Ph.D., Ph.D., *Associate Clinical Professor of Psychology: Social and Health Sciences*
 Thomas Robisheaux (1984), Ph.D., *Associate Professor of History*
 Susan Rodger (1996), Ph.D., *Associate Professor of the Practice of Computer Science*
 Stuart Rojstaczer (1990), Ph.D., *Associate Professor of Earth and Ocean Sciences and Associate Professor of Civil and Environmental Engineering*
 Alex Roland (1981), Ph.D., *Professor of History*
 James L. Rolleston (1975), Ph.D., *Professor of Germanic Languages and Literature and Professor of Literature*
 Donald J. Rose (1984), Ph.D., *Professor of Computer Science and Professor of Mathematics*
 Allen D. Roses (1968), M.D., *Professor of Neurobiology*
 Nathalie Rossiensky (1998), Ph.D., *Assistant Professor of Business Administration*
 Susan Roth (1973), Ph.D., *Professor of Psychology: Social and Health Sciences and Professor of Psychology: Experimental*
 Virginia Louise Roth (1983), Ph.D., *Associate Professor of Zoology and Associate Professor of Biological Anthropology and Anatomy*
 David C. Rubin (1978), Ph.D., *Professor of Psychology: Experimental*
 Johannes Rudolph (1999), Ph.D., *Assistant Professor of Biochemistry*
 Jerome Sacks (1992), Ph.D., *Professor of Statistics and Decision Sciences*
 Patricia M. Saling (1991), Ph.D., *Assistant Professor of Cell Biology*
 Ed Parish Sanders (1991), Th.D., *Professor of Religion*
 David H. Sanford (1970), Ph.D., *Professor of Philosophy*
 Leslie D. Saper (1986), Ph.D., *Associate Professor of Mathematics*
 Marcella Sarzotti-Kelsoe (1998), Ph.D., *Assistant Research Professor of Immunology*
 Frederick H. Schachat (1977), Ph.D., *Associate Professor of Cell Biology*
 David G. Schaeffer (1978), Ph.D., *James B. Duke Professor of Mathematics*
 Saul M. Schanberg (1967), M.D., Ph.D., *Professor of Pharmacology and Cancer Biology*
 Susan S. Schiffman (1972), Ph.D., *Professor of Psychology: Experimental*
 Katherine Schipper (1999), Ph.D., *L. Palmer Fox Professor of Business Administration*
 William H. Schlesinger (1980), Ph.D., *James B. Duke Professor of Botany, Professor of Earth and Ocean Sciences, and Professor of the Environment*
 Nestor Schmajuk (1993), Ph.D., *Associate Professor of Psychology: Experimental and Associate Professor of Electrical and Computer Engineering*
 Tad M. Schmaltz (1989), Ph.D., *Associate Professor of Philosophy*
 Daniel Schmitt (1998), Ph.D., *Assistant Professor of Biological Anthropology and Anatomy*
 Emmett Buchanan Schmitt (2000), Ph.D., *Assistant Professor of English*
 Chadmark L. Schoen (1982), Ph.D., *Professor of Mathematics*
 David W. Schomberg (1968), Ph.D., *Associate Professor of Cell Biology*
 Andrew Schuler (2000), Ph.D., *Assistant Professor of Civil and Environmental Engineering*
 Rochelle D. Schwartz (1986), Ph.D., *Associate Professor of Pharmacology and Cancer Biology and Associate Professor of Neurobiology*
 Debra Anne Schwinn (1986), M.D., *Professor of Pharmacology and Cancer Biology*
 Matt Serra (1993), Ph.D., *Assistant Professor of Psychology: Social and Health Sciences*
 Lori A. Setton (1995), Ph.D., *Assistant Professor of Biomedical Engineering and Assistant Professor of Mechanical Engineering and Materials Science*
 Suzanne E. Shanahan (1998), Ph.D., *Assistant Professor of Sociology*
 Laurie Shannon (1996), Ph.D., *Assistant Professor of English*
 Joseph Shatzmiller (1994), Ph.D., *Smart Family Professor of History*
 Edward J. Shaughnessy (1975), Ph.D., *Professor of Mechanical Engineering and Materials Science*
 A. Jonathan Shaw (1996), Ph.D., *Associate Professor of Botany*
 Barbara Ramsay Shaw (1975), Ph.D., *Professor of Chemistry*
 Michael P. Sheetz (1990), Ph.D., *Professor of Cell Biology*
 John Shelburne (1973), M.D., Ph.D., *Professor of Pathology*
 Shirish Shenolikar (1992), Ph.D., *Associate Professor of Pharmacology and Cancer Biology*
 Blair Sheppard (1981), *Professor of Business Administration and Professor of Psychology: Social and Health Sciences*
 Tianjian Shi (1993), Ph.D., *Associate Professor of Political Science*
 Stephanie Sieburth (1987), Ph.D., *Associate Professor of Romance Studies*
 James N. Siedow (1976), Ph.D., *Professor of Botany*
 Holger Sieg (1996), Ph.D., *Assistant Professor of Economics*

Lewis M. Siegel (1968), Ph.D., *Professor of Biochemistry*
 Ilene C. Siegler (1980), Ph.D., M.P.H., *Professor of Psychology: Social and Health Sciences*
 John T. Sigmon (1991), Ph.D., *Adjunct Associate Professor of the Practice of Environment*
 Alexander Silbiger (1984), Ph.D., *Professor of Music*
 Irene M. Silverblatt (1992), Ph.D., *Associate Professor of Cultural Anthropology*
 John Simon (1998), Ph.D., *Professor of Chemistry and Professor of Biochemistry*
 Sidney Arthur Simon (1973), Ph.D., *Professor of Neurobiology*
 Elwyn L. Simons (1977), Ph.D., D.Phil., *James B. Duke Professor of Biological Anthropology and Anatomy and Professor of Zoology*
 Ida Harper Simpson (1959), Ph.D., *Professor of Sociology*
 Sim Sitkin (1994), *Associate Professor of Business Administration*
 David Skatrud (1990), Ph.D., *Adjunct Professor of Physics*
 J. H. Pate Skene (1991), Ph.D., *Associate Professor of Neurobiology*
 Frank Sloan (1996), Ph.D., *Professor of Economics and Alexander McMahan Professor of Health Policy Management*
 Theodore Alan Slotkin (1971), Ph.D., *Professor of Pharmacology and Cancer Biology and Professor of Neurobiology*
 Barbara Herrnstein Smith (1987), Ph.D., *Braxton Craven Professor of Comparative Literature and English*
 D. Moody Smith (1965), Ph.D., *George Washington Ivey Professor of Religion, New Testament Interpretation*
 David A. Smith (1962), Ph.D., *Associate Professor of Mathematics*
 James E. Smith (1990), Ph.D., *Associate Professor of Business Administration*
 Kathleen K. Smith (1980), Ph.D., *Professor of Biological Anthropology and Anatomy and Associate Professor of Zoology*
 Michael Smith (1998), Ph.D., *Assistant Professor of Business Administration*
 Stephen William Smith (1990), Ph.D., *Professor of Biomedical Engineering*
 Joshua E. S. Socolar (1992), Ph.D., *Associate Professor of Physics*
 Helen Solterer (1986), Ph.D., *Associate Professor of Romance Studies*
 George G. Somjen (1964), M.D., *Professor of Cell Biology and Professor of Neurobiology*
 Marcy Speer (1992), M.D., *Assistant Professor of Genetics*
 Kenneth I. Spenner (1984), Ph.D., *Professor of Sociology and Professor of Psychology: Social and Health Sciences*
 Leonard Spicer (1984), Ph.D., *Professor of Biochemistry*
 Thomas Arthur Spragens, Jr. (1967), Ph.D., *Professor of Political Science*
 Roxanne P. Springer (1992), Ph.D., *Associate Professor of Physics*
 Herman Staats (1996), Ph.D., *Assistant Research Professor of Pathology*
 John E. R. Staddon (1967), Ph.D., *James B. Duke Professor of Psychology: Experimental, Professor of Neurobiology, and Professor of Zoology*
 Richard Staelin (1982), Ph.D., *Edward and Rose Donnell Professor of Business Administration*
 Dalene K. Stangl (1992), Ph.D., *Assistant Professor of the Practice of Statistics and Decision Sciences and Assistant Professor of Public Policy Studies*
 Dennis Keith Stanley (1961), Ph.D., *Professor of Classical Studies*
 Orin Starn (1991), Ph.D., *Associate Professor of Cultural Anthropology*
 Nancy Staudenmayer (1997), Ph.D., *Assistant Professor of Business Administration*
 Deborah A. Steege (1977), Ph.D., *Professor of Biochemistry*
 David Curtis Steinmetz (1971), Th.D., *Amos Ragan Kearnes Professor of Religion, Church History and Doctrine*
 Mark Andrew Stern (1985), Ph.D., *Professor of Mathematics*
 Philip Stewart (1972), Ph.D., *Professor of Romance Studies and Professor of Literature*
 Gary Stiles (1981), M.D., *Professor of Pharmacology and Cancer Biology*
 Kristine Stiles (1988), Ph.D., *Associate Professor of Art History*
 Victor H. Strandberg (1966), Ph.D., *Professor of English*
 John Strohhahn (1994), Ph.D., *Professor of Biomedical Engineering*
 Warren James Strittmatter (1991), M.D., *Professor of Neurobiology*
 Norman C. Strole (1986), Ph.D., *Adjunct Assistant Professor of Electrical and Computer Engineering*
 Richard Stubbing (1993), Ph.D., *Professor of the Practice of Public Policy Studies*
 Bruce Sullenger (1994), Ph.D., *Assistant Professor of Genetics*
 Tai-ping Sun (1991), Ph.D., *Associate Professor of Botany*
 Xiaobai Sun (1995), Ph.D., *Assistant Professor of Computer Science*
 Kenneth Surin (1987), Ph.D., *Professor of Literature and Professor of Religion*
 Richard S. Surwit (1977), Ph.D., *Professor of Psychology: Social and Health Sciences*
 Tamara Swaab (1999), Ph.D., *Assistant Professor of Psychology: Experimental*
 H. Scott Swartzwelder (1996), Ph.D., *Professor of Psychology: Experimental and Professor of Toxicology*
 Katherine Ilene Swenson (1991), Ph.D., *Assistant Research Professor of Pharmacology and Cancer Biology and Assistant Research Professor of Cell Biology*
 Teh Y. Tan (1986), Ph.D., *Professor of Mechanical Engineering and Materials Science*

George E. Tauchen (1977), Ph.D., *Professor of Economics*
 Thomas F. Tedder (1993), *Alter Geller Professor of Immunology*
 Stephen W. Teitsworth (1988), Ph.D., *Associate Professor of Physics and Assistant Professor of Electrical and Computer Engineering*
 Marilyn J. Telen (1996), Ph.D., *Associate Professor of Pathology*
 John Terborgh (1989), Ph.D., *James B. Duke Professor of Environmental Science, Professor of Biological Anthropology and Anatomy, and Professor of Zoology*
 Julie Andresen Tetel (1986), Ph.D., *Professor of English and Associate Professor of Cultural Anthropology*
 Jean-Jacques Thomas (1981), Doctorat de 3e Cycle, *Professor of Romance Studies and Professor of Literature*
 John E. Thomas (1987), Ph.D., *Professor of Physics*
 John H. Thompson (1991), Ph.D., *Professor of History*
 Robert J. Thompson, Jr. (1984), Ph.D., *Adjunct Professor of Psychology*
 Jennifer Thorn (1993), Ph.D., *Andrew W. Mellon Assistant Professor of English*
 Susan Thorne (1991), Ph.D., *Associate Professor of History*
 Patricia H. Thornton (1993), Ph.D., *Assistant Professor of Sociology*
 Edward A. Tiryakian (1965), Ph.D., *Professor of Sociology*
 Margaret A. Titus (1990), Ph.D., *Assistant Professor of Cell Biology*
 R. Larry Todd (1978), Ph.D., *Professor of Music*
 Eric J. Toone (1991), Ph.D., *Associate Professor of Chemistry and Associate Professor of Biochemistry*
 Marianna Torgovnick (1981), Ph.D., *Professor of English*
 Werner Tornow (1988), Ph.D., *Research Professor of Physics*
 Edward Tower (1974), Ph.D., *Professor of Economics*
 Gregg E. Trahey (1985), Ph.D., *Professor of Biomedical Engineering*
 John A. Trangenstein (1991), Ph.D., *Professor of Mathematics*
 Kishor S. Trivedi (1975), Ph.D., *Professor of Electrical and Computer Engineering and Professor of Computer Science*
 George Truskey (1987), Ph.D., *Associate Professor of Biomedical Engineering*
 Vance Tucker (1964), Ph.D., *Professor of Zoology*
 Clare Tufts (1987), Ph.D., *Associate Professor of the Practice of Romance Studies*
 Jerry J. Tulis (1993), Ph.D., *Adjunct Associate Professor of the Environment*
 William Turner (1987), Ph.D., *Associate Professor of Religion, Theology and Black Church Studies*
 E. Lee Tyrey (1970), Ph.D., *Professor of Neurobiology*
 Dean Urban (1994), Ph.D., *Assistant Professor of the Environment*
 Bisulay Utku (1987), Ph.D., *Adjunct Associate Professor of Civil and Environmental Engineering*
 Senol Utku (1970), Sc.D., *Professor of Civil and Environmental Engineering and Professor of Computer Science*
 Marcy K. Uyenoyama (1982), Ph.D., *Professor of Zoology*
 Antonius M. VanDongen (1992), Ph.D., *Associate Professor of Pharmacology and Cancer Biology and Associate Professor of Neurobiology*
 Hans J. Van Miegroet (1988), Ph.D., *Associate Professor of Art History*
 Luke Van Rompay (2001), Ph.D., *Professor of Religion*
 Carel van Schaik (1989), Ph.D., *Professor of Biological Anthropology and Anatomy, Professor of Environment, and Associate Professor of Zoology*
 Jeffrey Vance (1988), Ph.D., *Associate Professor of Genetics*
 John Jay Vandenberg (1992), Ph.D., *Adjunct Assistant Professor of the Environment*
 Dharni Vasudevan (1997), Ph.D., *Assistant Professor of the Environment and Assistant Professor of Civil and Environmental Engineering*
 Stephanos Venakides (1986), Ph.D., *Professor of Mathematics*
 John M. Vernon (1966), Ph.D., *Professor of Economics*
 Nikolaos Vettas (1994), Ph.D., *Associate Professor of Business Administration and Assistant Professor of Economics*
 Antonio Viego (1999), Ph.D., *Assistant Professor of Romance Studies*
 Steven Vigna (1987), Ph.D., *Associate Professor of Cell Biology*
 Teresa Maria Vilarós (1992), Ph.D., *Associate Professor of Romance Studies*
 Rytas J. Vilgalys (1986), Ph.D., *Associate Professor of Botany and Associate Professor of Microbiology*
 Lawrence N. Virgin (1989), Ph.D., *Associate Professor of Mechanical Engineering and Materials Science and Associate Professor of Civil and Environmental Engineering*
 S. Viswanathan (1986), Ph.D., *Professor of Business Administration*
 Jeffrey Vitter (1993), Ph.D., *Gilbert, Louis, and Edward Lehrman Professor of Computer Science*
 Steven Vogel (1966), Ph.D., *Professor of Zoology*
 Olaf T. von Ramm (1974), Ph.D., *Thomas Lord Professor of Biomedical Engineering*
 James Voyvodic (1999), Ph.D., *Assistant Professor of Neurobiology*
 Grant A. Wacker (1992), Ph.D., *Associate Professor of Religion*
 Robert A. Wagner (1978), Ph.D., *Associate Professor of Computer Science*
 Geoffrey Wainwright (1983), Dr.Theol., *Robert Earl Cushman Professor of Religion*

Wendy Wall (1996), Ph.D., Assistant Professor of History
 Maurice Wallace (1998), Ph.D., Assistant Professor of English
 Lise Wallach (1970), Ph.D., Research Professor of Psychology: Experimental and Research Professor of Psychology: Social and Health Sciences
 Michael A. Wallach (1962-72: 1973), Ph.D., Professor of Psychology: Experimental and Professor of Psychology: Social and Health Sciences
 Richard L. Walter (1962), Ph.D., Professor of Physics
 Ingeborg Walther (1994), Ph.D., Assistant Professor of Germanic Languages and Literature
 Hua Wang (1996), Ph.D., Assistant Professor of Electrical and Computer Engineering
 Paul P. Wang (1968), Ph.D., Professor of Electrical and Computer Engineering
 Xiao-Fan Wang (1992), Ph.D., Associate Professor of Pharmacology and Cancer Biology
 Benjamin Ward (XXX), Ph.D., Adjunct Associate Professor of Philosophy
 Frances Ellen Ward (1969), Ph.D., Professor of Immunology
 Russell Ware (1998), Ph.D., Associate Professor of Pathology
 Robert E. Webster (1970), Ph.D., Professor of Biochemistry
 E. Roy Weintraub (1970), Ph.D., Professor of Economics
 Gennifer Weisenfeld (1998), Ph.D., Assistant Professor of Art and Art History
 Henry R. Weller (1978), Ph.D., Professor of Physics
 Karen Wells (1990), Ph.D., Associate Professor of Psychology: Social and Health Sciences
 Richard L. Wells (1962), Ph.D., Professor of Chemistry
 Michael West (1990), Ph.D., Arts and Sciences Professor of Statistics and Decision Sciences
 Robert E. Whaley (1986), Ph.D., T. Austin Finch Foundation Professor of Business Administration
 Annabel Wharton (1979), Ph.D., Professor of Art History
 Robin P. Wharton (1992), Ph.D., Assistant Professor of Genetics and Assistant Professor of Microbiology
 Frances J. White (1987), Ph.D., Assistant Professor of Biological Anthropology and Anatomy
 Richard A. White (1963), Ph.D., University Distinguished Professor of Botany
 Richard Whorton (1979), Ph.D., Associate Professor of Pharmacology
 Ross Widenhoefer (1997), Ph.D., Assistant Professor of Chemistry
 Karen Wigen (1990), Ph.D., Jack H. Neely Associate Professor of History
 Robert L. Wilbur (1957), Ph.D., Professor of Botany
 Christina L. Williams (1994), Associate Professor of Psychology: Experimental
 Kenny J. Williams (1977), Ph.D., Professor of English
 Redford B. Williams (1991), M.D., Professor of Psychology: Social and Health Sciences
 Richard Willis (1998), Ph.D., James B. Duke Assistant Professor of Business Administration
 Susan Willis (1989), Ph.D., Associate Professor of English and Associate Professor of Literature
 John Wilson (1968), D.Phil., Professor of Sociology
 Wilkie Andrew Wilson, Jr. (1974), Ph.D., Medical Research Professor of Pharmacology and Cancer Biology
 William Wilson (1995), Ph.D., Assistant Professor of Zoology
 Robert L. Winkler (1984), Ph.D., James B. Duke Professor of Business Administration and Professor of Statistics and Decision Sciences
 Thomas Witelski (1999), Ph.D., Assistant Professor of Mathematics
 Ronald G. Witt (1971), Ph.D., Professor of History
 Myron L. Wolbarsht (1968), Ph.D., Professor of Ophthalmology in the Department of Psychology and Professor of Biomedical Engineering
 Patrick Wolf (1993), Ph.D., Assistant Professor of Biomedical Engineering
 Robert L. Wolpert (1984), Ph.D., Professor of Statistics and Decision Sciences and Associate Professor of the Environment
 Fulton Wong (1989), Ph.D., Associate Professor of Neurobiology
 Peter H. Wood (1975), Ph.D., Professor of History
 Clare Woods (1999), Ph.D., Assistant Professor of Classical Studies
 Donald Wright (1967), Ph.D., Associate Professor of Mechanical Engineering and Materials Science
 Jo Rae Wright (1993), Ph.D., Associate Professor of Cell Biology
 Duncan Yaggy (1980), Ph.D., Professor of Public Policy Studies
 Dennis Yang (1994), Ph.D., Assistant Professor of Economics
 Weitao Yang (1989), Ph.D., Professor of Chemistry
 Tso-Pang Yao (1998), Ph.D., Assistant Professor of Pharmacology and Cancer Biology
 William E. Yarger (1971), M.D., Assistant Professor of Cell Biology
 Gary Ybarra (1994), Ph.D., Assistant Research Professor of Electrical and Computer Engineering
 John York (1996), Ph.D., Assistant Professor of Pharmacology and Cancer Biology and Assistant Professor of Biochemistry
 John G. Younger (1974), Ph.D., Professor of Classical Studies
 Fan Yuan (1996), Ph.D., Assistant Professor of Biomedical Engineering
 Michael Rod Zalutsky (1985) Ph.D., Assistant Professor of Pathology
 Donna Zapf (1999) M.A., Director, Master of Arts in Liberal Studies Program
 Weiguozhang (1999) Ph.D., Assistant Professor of Immunology

Pei Zhong (1994), Ph.D., *Associate Research Professor of Mechanical Engineering and Materials Science*
 Lin Zhou (1996), Ph.D., *Associate Professor of Economics*
 Xin Zhou (1993), Ph.D., *Professor of Mathematics*
 Xueguang Zhou (1994), Ph.D., *Associate Professor of Sociology*
 Yuan Zhuang (1996), Ph.D., *Assistant Professor of Immunology*
 Paul H. Zipkin (1995), Ph.D., *T. Austin Finch, Sr., Professor of Business Administration*
 Peter Zwadyk, Jr. (1971), Ph.D., *Associate Professor of Pathology and Associate Professor of Microbiology*

Professors Emeriti

Irving E. Alexander (1963), Ph.D., *Professor Emeritus of Psychology*
 A. Tito Alt (1961-65; 1967), Ph.D., *Professor Emeritus of Germanic Languages and Literature*
 D. Bernard Amos (1962), M.D., *James B. Duke Professor Emeritus of Immunology*
 Carl L. Anderson (1955), Ph.D., *Professor Emeritus of English*
 Lewis Edward Anderson (1936), Ph.D., *Professor Emeritus of Botany*
 Roger Fabian Anderson (1950), Ph.D., *Professor Emeritus of Entomology*
 Edward M. Arnett (1980), Ph.D., *R. J. Reynolds Professor Emeritus of Chemistry*
 Kurt W. Back (1959), Ph.D., *James B. Duke Professor Emeritus of Sociology*
 Joseph Randle Bailey (1946), Ph.D., *Professor Emeritus of Zoology*
 Katharine May Banham (1946), Ph.D., *Associate Professor Emeritus of Psychology*
 James David Barber (1972), Ph.D., *James B. Duke Professor Emeritus of Political Science and Professor of Public Policy Studies*
 William Waldo Beach (1946), Ph.D., *Professor Emeritus of Christian Ethics*
 Mary L. C. Bernheim (1930), Ph.D., *Professor Emeritus of Biochemistry*
 William Dwight Billings (1952), Ph.D., *James B. Duke Professor Emeritus of Botany*
 Edward George Bilpuch (1962), Ph.D., *Henry W. Newson Professor Emeritus of Physics*
 John O. Blackburn (1959), Ph.D., *Professor Emeritus of Economics*
 Jacob J. Blum (1962), Ph.D., *James B. Duke Professor Emeritus of Cell Biology*
 Cazlyn Green Bookhout (1935), Ph.D., *Professor Emeritus of Zoology*
 Lloyd J. Borstelmann (1953), Ph.D., *Professor Emeritus of Psychology*
 Benjamin Boyce (1950), Ph.D., *James B. Duke Professor Emeritus of English*
 Charles Kilgo Bradsher (1939), Ph.D., *James B. Duke Professor Emeritus of Chemistry*
 Ralph Braibanti (1953), Ph.D., *James B. Duke Professor Emeritus of Political Science*
 Eleanor F. Branch (1953), Ph.D., *Associate Professor Emeritus of Physical Therapy*
 Earl Ivan Brown II (1960), Ph.D., *J. A. Jones Professor Emeritus of Civil and Environmental Engineering*
 Louis J. Budd (1952), Ph.D., *James B. Duke Professor Emeritus of English*
 Frances Campbell Brown (1931), Ph.D., *Professor Emeritus of Chemistry*
 Edwin H. Cady (1973), Ph.D., *Andrew W. Mellon Professor Emeritus in the Humanities*
 Clark R. Cahow (1960), Ph.D., *Arts and Sciences Professor Emeritus of History*
 Peter F. Carbone (1966), Ed.D., *Professor Emeritus of the Practice of Education*
 Robert C. Carson (1960), Ph.D., *Professor Emeritus of Psychology: Social and Health Sciences*
 William H. Cartwright (1951), Ph.D., *Professor Emeritus of Education*
 Jack B. Chaddock (1966), Sc.D., *Professor Emeritus of Mechanical Engineering and Materials Science*
 Donald B. Chesnut (1965), Ph.D., *Professor Emeritus of Chemistry*
 Howard G. Clark (1968), Ph.D., *Professor Emeritus of Biomedical Engineering, Professor of Mechanical Engineering and Materials Science, and Professor of Biochemical Engineering*
 Frederic N. Cleaveland (1971), Ph.D., *Professor Emeritus of Political Science*
 Kalman J. Cohen (1974), Ph.D., *Distinguished Bank Research Professor Emeritus*
 John D. Coie (1968), Ph.D., *Professor Emeritus of Psychology: Social and Health Sciences*
 Joel Colton (1947), Ph.D., *Professor Emeritus of History*
 Robert Merle Colver (1953), Ed.D., *Associate Professor Emeritus of Education*
 Thomas Howard Cordle (1950), Ph.D., *Professor Emeritus of Romance Studies*
 Roger Corless (1970), Ph.D., *Professor Emeritus of Religion*
 Sheila J. Counce (1968), Ph.D., *Professor Emeritus of Cell Biology*
 Christopher Counter (1999), Ph.D., *Assistant Professor of Pharmacology and Cancer Biology*
 William Louis Culberson (1955), Ph.D., *Hugo L. Blomquist Professor Emeritus of Botany*
 Robert E. Cushman (1945), Ph.D., *Research Professor Emeritus of Systematic Theology*
 Bingham Dai (1943), Ph.D., *Professor Emeritus of Psychology*
 David G. Davies (1961), Ph.D., *Professor Emeritus of Economics*
 William D. Davies (1966), D.D., F.B.A., *George Washington Ivey Professor Emeritus of Advanced Studies and Research in Christian Origins*
 Lucy T. Davis (1969), Ed.D., *Associate Professor Emeritus of Education*
 Irving T. Diamond (1958), Ph.D., *James B. Duke Professor Emeritus of Psychology*
 Neal Dow (1934), Ph.D., *Professor Emeritus of Romance Languages*
 Francis George Dressel (1929), Ph.D., *Professor Emeritus of Mathematics*
 Kenneth Lindsay Duke (1940), Ph.D., *Associate Professor Emeritus of Biological Anthropology and Anatomy*

Robert F. Durden (1952), Ph.D., *Professor Emeritus of History*
 George F. Dutrow (1976), Ph.D., *Professor Emeritus of Forestry and Environmental Studies*
 Howard Easley (1930), Ph.D., *Associate Professor Emeritus of Education*
 Ernest Elsevier (1950), M.S., *Associate Professor Emeritus of Mechanical Engineering and Materials Science*
 Robert P. Erickson (1961), Ph.D., *Professor Emeritus of Psychology: Experimental*
 Henry A. Fairbank (1962), Ph.D., *Professor Emeritus of Physics*
 Oliver W. Ferguson (1957), Ph.D., *Professor Emeritus of English*
 Donald J. Fluke (1958), Ph.D., *Professor Emeritus of Zoology*
 Wallace Fowlie (1964), Ph.D., *James B. Duke Professor Emeritus of Romance Languages*
 John Hope Franklin (1981), Ph.D., *James B. Duke Professor Emeritus of History*
 Irwin Fridovich (1958), Ph.D., *James B. Duke Emeritus Professor of Biochemistry*
 Ernestine Friedl (1973), Ph.D., *James B. Duke Professor Emeritus of Anthropology*
 William J. Furbish (1954), M.S., *Associate Professor Emeritus of Earth and Ocean Sciences*
 Thomas M. Gallie, Jr. (1954-55; 1956), Ph.D., *Professor Emeritus of Computer Science*
 W. Scott Gehman, Jr. (1954), Ph.D., *Professor Emeritus of Psychology in Education*
 Gerald E. Gerber (1962), Ph.D., *Associate Professor Emeritus of English*
 Robert F. Gleckner (1978), Ph.D., *Professor Emeritus of English*
 John R. Gregg (1957), Ph.D., *Professor Emeritus of Zoology*
 Samson R. Gross (1960), Ph.D., *Professor Emeritus of Biochemistry*
 Kazimierz Grzybowski (1967), S.J.D., *Professor Emeritus of Political Science*
 John W. Gutknecht (1969), Ph.D., *Professor Emeritus of Environment*
 Herbert Hacker, Jr. (1965), Ph.D., *Associate Professor Emeritus of Electrical Engineering*
 Hugh Marshall Hall, Jr. (1952), Ph.D., *Professor Emeritus of Political Science*
 John Hamilton Hallowell (1942), Ph.D., *James B. Duke Professor Emeritus of Political Science*
 Jerome S. Harris (1936), M.D., *Professor Emeritus of Biochemistry*
 William S. Heckscher (1966), Ph.D., *Benjamin N. Duke Professor Emeritus of Art*
 Henry Hellmers (1965), Ph.D., *Professor Emeritus of Botany and Professor Emeritus of Forestry*
 Robert William Henkens (1968), Ph.D., *Associate Professor Emeritus of Chemistry*
 Duncan Heron (1950), Ph.D., *Professor Emeritus of Earth and Ocean Sciences*
 Marcus Edwin Hobbs (1935), Ph.D., *University Distinguished Service Professor Emeritus of Chemistry*
 Irving B. Holley, Jr. (1947), Ph.D., *Professor Emeritus of History*
 Everett H. Hopkins (1961), M.A., LL.D., *Professor Emeritus of Education*
 Alexander Hull (1962), Ph.D., *Associate Professor Emeritus of Romance Studies*
 Wanda S. Hunter (1947), Ph.D., *Associate Professor Emeritus of Zoology*
 Allan S. Hurlburt (1956), Ph.D., *Professor Emeritus of Education*
 Wallace Jackson (1969), Ph.D., *Professor Emeritus of English*
 B. Jon Jaeger (1972), Ph.D., *Professor Emeritus of Health Administration*
 Benjamin A. Jayne (1976), Ph.D., *Professor Emeritus of Forestry*
 Bronislas de Leval Jezierski (1958), Ph.D., *Associate Professor Emeritus of Slavic Languages and Literatures*
 Frans F. Jöbsis (1964), Ph.D., *Professor Emeritus of Cell Biology*
 Sheridan Johns III (1970), Ph.D., *Associate Professor Emeritus of Political Science*
 Charles B. Johnson (1956), Ed.D., *Associate Professor Emeritus of Education*
 Edward A. Johnson (1963), M.D., *James B. Duke Professor Emeritus of Cell Biology*
 Terry W. Johnson, Jr. (1954), Ph.D., *Professor Emeritus of Botany*
 Bernard Kaufman (1968), Ph.D., *Associate Professor Emeritus of Biochemistry*
 Alan C. Kerckhoff (1958), Ph.D., *Professor Emeritus of Sociology*
 Robert B. Kerr (1965), Ph.D., *Professor Emeritus of Electrical Engineering*
 Gregory A. Kimble (1952-68; 1977), Ph.D., *Professor Emeritus of Psychology*
 Peter H. Klopfer (1958), Ph.D., *Professor Emeritus of Zoology*
 John A. Koepke (1979), M.D., *Professor Emeritus of Pathology*
 Irwin Kremen (1963), Ph.D., *Assistant Professor Emeritus of Psychology*
 Juanita Kreps (1957), Ph.D., *James B. Duke Professor Emeritus of Economics*
 Wladyslaw W. Kulski (1963), Ph.D., LL.D., *James B. Duke Professor Emeritus of Russian Affairs*
 Weston LaBarre (1946), Ph.D., *James B. Duke Professor Emeritus of Anthropology*
 Leon Lack (1965), Ph.D., *Professor Emeritus of Pharmacology*
 Creighton Lacy (1953), Ph.D., *Professor Emeritus of World Christianity*
 Martin Lakin (1958), Ph.D., *Professor Emeritus of Psychology: Social and Health Sciences*
 Richard H. Leach (1955), Ph.D., *Professor Emeritus of Political Science*
 Harold Walter Lewis (1946), Ph.D., *University Distinguished Service Professor Emeritus of Physics*
 C. Eric Lincoln (1976), Ph.D., *William R. Kenan, Jr. Professor Emeritus of Religion*
 L. Sigfred Linderoth, Jr. (1965), M.E., *Professor Emeritus of Mechanical Engineering and Materials Science*
 Kenneth S. McCarty (1959), Ph.D., *Professor Emeritus of Biochemistry*
 James H. McElhaney (1973), Ph.D., *Hudson Professor Emeritus of Biomedical Engineering*
 Thomas J. McManus (1961), M.D., *Professor Emeritus of Cell Biology*
 John Nelson Macduff (1956), M.M.E., *Professor Emeritus of Mechanical Engineering and Materials Science*

Sidney David Markman (1947), Ph.D., *Professor Emeritus of Art History and Professor Emeritus of Archaeology*

Elgin W. Mellown, Jr. (1965), Ph.D., *Associate Professor Emeritus of English*

Richard S. Metzgar (1962), Ph.D., *Professor Emeritus of Immunology*

Johannes Horst Max Meyer (1959), Ph.D., *Professor Emeritus of Physics*

John W. Moore (1961), Ph.D., *Professor Emeritus of Neurobiology*

Montrose J. Moses (1959), Ph.D., *Professor Emeritus of Cell Biology*

Earl George Mueller (1945), Ph.D., *Professor Emeritus of Art*

Roland E. Murphy (1967-68; 1971), S.T.D., *George Washington Ivey Professor Emeritus of Old Testament*

Francis Joseph Murray (1960), Ph.D., *Professor Emeritus of Mathematics*

George C. Myers (1968), Ph.D., *Professor Emeritus of Sociology*

Aubrey Willard Naylor (1952), Ph.D., *James B. Duke Professor Emeritus of Botany*

Thomas H. Naylor (1964), Ph.D., *Professor Emeritus of Economics*

Francis Newton (1967), Ph.D., *Professor Emeritus of Latin in Classical Studies*

Yasuhiko Nozaki (1966), Ph.D., *Associate Professor Emeritus of Biochemistry*

Holger O. Nygard (1968), Ph.D., *Professor Emeritus of English*

Robert T. Osborn (1954), Ph.D., *Professor Emeritus of Religion*

James G. Osborne (1961), B.S., *Professor Emeritus of Forest Biometry*

Suydam Osterhout (1959), M.D., Ph.D., *Professor Emeritus of Microbiology and Immunology*

Athos Ottolenghi (1959), M.D., *Professor Emeritus of Pharmacology*

Harry Ashton Owen, Jr. (1951), Ph.D., *Professor Emeritus of Electrical Engineering*

Erdman B. Palmore (1967), Ph.D., *Professor Emeritus of Sociology*

Harold Talbot Parker (1939), Ph.D., *Professor Emeritus of History*

William Bernard Peach (1951), Ph.D., *Professor Emeritus of Philosophy*

Ronald D. Perkins (1968), Ph.D., *Professor of Emeritus of Geology*

Olan Lee Petty (1952), Ph.D., *Professor Emeritus of Education*

Leland R. Phelps (1961), Ph.D., *Professor Emeritus of Germanic Languages and Literature*

Orrin Pilkey (1965), Ph.D., *James B. Duke Professor Emeritus of Earth and Ocean Sciences and Professor Emeritus of Environmental Studies*

Jacques C. Poirier (1955), Ph.D., *Professor Emeritus of Chemistry*

William H. Poteat (1960), Ph.D., *Professor Emeritus of Religion*

Philip Pratt (1966), M.D., *Professor Emeritus of Pathology*

Jack J. Preiss (1959), Ph.D., *Professor Emeritus of Sociology*

Richard A. Preston (1965), Ph.D., *William K. Boyd Professor Emeritus of History*

Louis DuBose Quin (1957), Ph.D., *James B. Duke Professor Emeritus of Chemistry*

Dale B. J. Randall (1957), Ph.D., *Professor Emeritus of English*

Jacqueline A. Reynolds (1969), Ph.D., *Professor Emeritus of Cell Biology*

Lawrence Richardson, Jr. (1966), Ph.D., *James B. Duke Professor Emeritus of Classical Studies*

Hugh G. Robinson (1964), Ph.D., *Professor Emeritus of Physics*

Theodore Ropp (1938), Ph.D., *Professor Emeritus of History*

Mabel F. Rudisill (1948), Ph.D., *Associate Professor Emeritus of Education*

Harvey J. Sage (1964), Ph.D., *Associate Professor Emeritus of Biochemistry*

Charles Richard Sanders (1937), Ph.D., *Professor Emeritus of English*

Lloyd Saville (1946), Ph.D., *Professor Emeritus of Economics*

Harold Schiffman (1963), Ph.D., *Professor Emeritus of Psychology*

Knut Schmidt-Nielsen (1952), D.Ph., *James B. Duke Professor Emeritus of Physiology and Zoology*

Anne Firor Scott (1961), Ph.D., *William K. Boyd Professor Emeritus of History*

Richard A. Scoville (1961), Ph.D., *Associate Professor Emeritus of Mathematics*

Richard B. Searles (1965), Ph.D., *Professor Emeritus of Botany*

Joseph R. Shoenfield (1952), Ph.D., *Professor Emeritus of Mathematics*

William H. Simpson (1930), Ph.D., *Professor Emeritus of Political Science*

Donald S. Smith II (1961), M.H.A., *Assistant Professor Emeritus of Health Administration*

Grover C. Smith (1952), Ph.D., *Professor Emeritus of English*

Joel Smith (1958), Ph.D., *Professor Emeritus of Sociology*

Peter Smith (1959), Ph.D., *Professor Emeritus of Chemistry*

Joachim R. Sommer (1957), M.D., *Professor Emeritus of Pathology*

Madison S. Spach (1958), M.D., *Professor Emeritus of Cell Biology*

William J. Stambaugh (1961), Ph.D., *Professor Emeritus of Environmental Studies*

Charles Franklin Starmer, Jr. (1966), Ph.D., *Professor Emeritus of Computer Science*

William Franklin Stinespring (1936), Ph.D., *Professor Emeritus of Old Testament and Semitics*

Donald E. Stone (1963), Ph.D., *Professor Emeritus of Botany*

Boyd R. Strain (1969), Ph.D., *Professor Emeritus of Botany*

Howard Austin Strobel (1948), Ph.D., *Professor Emeritus of Chemistry*

Charles Tanford (1960), Ph.D., *James B. Duke Professor Emeritus of Physiology*

John J. TePaske (1967), Ph.D., *Professor Emeritus of History*

Marcel Tetel (1960), Ph.D., *Professor Emeritus of Romance Studies*
 Fredrick L. Thurstone (1967), Ph.D., *Professor Emeritus of Biomedical Engineering*
 Richard L. Tuthill (1953), Ed.D., *Professor Emeritus of Economic Geography*
 Patrick R. Vincent (1954), Ph.D., *Associate Professor Emeritus of Romance Languages*
 F. Stephen Vogel (1961), M.D., *Professor Emeritus of Pathology*
 Stephen A. Wainwright (1964), Ph.D., *James B. Duke Professor Emeritus of Zoology*
 William D. Walker (1971), Ph.D., *Professor Emeritus of Physics*
 Bruce W. Wardropper (1962), Ph.D., *William Haynes Wannamaker Professor Emeritus of Romance Studies*
 Seth L. Warner (1955), Ph.D., *Professor Emeritus of Mathematics*
 Richard Lyness Watson, Jr. (1939), Ph.D., *Professor Emeritus of History*
 Morris Weisfeld (1967), Ph.D., *Professor Emeritus of Mathematics*
 Henry Weitz (1950), Ed.D., *Professor Emeritus of Education*
 Paul Welsh (1948), Ph.D., *Professor Emeritus of Philosophy*
 Robert W. Wheat (1958), Ph.D., *Professor Emeritus of Microbiology*
 Pelham Wilder, Jr. (1949), Ph.D., *University Distinguished Professor Emeritus of Chemistry*
 Hilda Pope Willett (1948), Ph.D., *Professor Emeritus of Microbiology*
 George W. Williams (1957), Ph.D., *Professor Emeritus of English*
 Peter Fredric Williams (1985), Ph.D., *Arts and Sciences Professor Emeritus of Music*
 William Hailey Willis (1963), Ph.D., *Professor Emeritus of Greek in Classical Studies*
 Thomas George Wilson (1959), Sc.D., *Professor Emeritus of Electrical Engineering*
 Cliff W. Wing, Jr. (1965), Ph.D., *Professor Emeritus of Psychology*
 Orval S. Wintermute (1958), Ph.D., *Professor Emeritus of Religion*
 Max A. Woodbury (1966), Ph.D., *Professor Emeritus of Computer Science*
 William P. Yohe (1958), Ph.D., *Professor Emeritus of Economics*
 James G. Yoho (1984), Ph.D., *Professor Emeritus of Forestry*
 Charles R. Young (1954), Ph.D., *Professor Emeritus of History*
 Franklin W. Young (1944-50; 1968), Ph.D., *Amos Ragan Kearns Professor Emeritus of New Testament and Patristic Studies*

TO THE PROSPECTIVE GRADUATE STUDENT

A graduate school is where excellence in scholarship is established in a university. At Duke, the Graduate School is where the two essential functions of a university, teaching and research, truly come together. Over the years Duke's strength at the graduate level has grown in all the main fields of knowledge. The 1980s were particularly fruitful years for recruitment of faculty, establishment of new programs, and attraction of outstanding students. The international distinction of the faculty continues to grow in the late 1990s. The laboratories, libraries, and computer facilities, already among the very best, are targets of major enhancements in the next decade. Yet the Graduate School remains small enough so that personal contact is a central feature of our programs, and fruitful interaction across disciplines is a common experience, both for faculty and students.

For the student in search of a strong graduate education, Duke University has much to offer. This is a community in which minds and ideas grow. We provide training for many careers, but we seek also to foster personal creativity and to provide stimulating yet congenial surroundings for productive education and research.

The following pages provide the information you require in making the important choice of the course of your graduate education. We look forward to welcoming you to the Duke community of scholars.

Lewis Siegel

Dean of the Graduate School

Academic and Cooperative Programs



Department or Program	Degrees Offered	Page
African and African-American Studies	certificate	65
Art and Art History	Ph.D.	66
Asian-Pacific Studies	—	267
Biochemistry	Ph.D.	74
Biological Anthropology and Anatomy	Ph.D.	76
Biological Chemistry	certificate	79
Biology	Ph.D.	79
Business Administration	Ph.D.	86
Canadian Studies	certificate	88
Cell and Molecular Biology	certificate	89
Cell Biology	Ph.D.	90
Cellular and Biosurface Engineering	certificate	93
Chemistry	Ph.D.	94
Classical Studies	Ph.D.	97
Computer Science	M.S., Ph.D.	100
Computational Science and Engineering	certificate	105
Cultural Anthropology	Ph.D.	106
Democracy, Institutions, and Political Economy	certificate	109
Earth and Ocean Sciences	M.S., Ph.D.	109
East Asian Studies	A.M., certificate	114
Ecology	Ph.D., certificate	116
Economics	A.M., Ph.D.	117
Engineering:		
Biomedical	Ph.D.	126
Civil and Environmental	M.S., Ph.D.	131
Electrical and Computer	M.S., Ph.D.	137
Mechanical and Materials Science	M.S., Ph.D.	143
English	Ph.D.	149
Environment	A.M., Ph.D.	151
Genetics	Ph.D.	158
University Program in Genetics	Ph.D.	159
German Studies	Ph.D.	160
Health Policy	certificate	164
History	Ph.D.	166
Humanities	A.M.	173
Hydrology	certificate	174
Immunology	Ph.D.	174
International Development Policy	A.M.	176
Latin American Studies	certificate	176
Liberal Studies	A.M.	179
Literature	Ph.D.	180
Marine Sciences	—	183
Mathematics	Ph.D.	185
Medical History	—	190
Medical Science	—	190
Medieval and Renaissance Studies	certificate	191
Microbiology	Ph.D.	194
Molecular Biophysics	certificate	195
Molecular Cancer Biology	Ph.D.	196
Music	A.M., Ph.D.	198
Neurobiology	Ph.D.	201
Nonlinear and Complex Systems	certificate	202
Pathology	Ph.D.	205

Department or Program	Degrees Offered	Page
Pharmacology	Ph.D.	207
Philosophy	Ph.D.	209
Physics	Ph.D.	212
Political Science	A.M., Ph.D.	216
Psychology	Ph.D.	223
Public Policy Studies	M.P.P.	230
Religion	Ph.D.	235
Romance Studies	Ph.D.	244
Slavic, Eurasian, and East European Studies	certificate	250
Slavic Languages and Literatures	A.M.	251
Sociology	A.M., Ph.D.	257
Statistics and Decision Sciences	M.S., Ph.D.	261
Teaching	M.A.T.	265
Toxicology	certificate	265
Women's Studies	certificate	266



31 Degrees Offered

Admission



Degree and Nondegree Admission

Students who wish to undertake graduate work at Duke University, whether for degree or nondegree purposes, must be formally admitted to the Graduate School by the dean. Prerequisites for admission include a bachelor's degree (or the equivalent to a four-year U.S. bachelor's degree) from an accredited institution and, for degree programs, satisfactory scores on the Graduate Record Examination. Individual departments may specify additional prerequisites, which can be found in the chapter on "Courses of Instruction."

Students who do not intend to earn an advanced degree at Duke, but who wish to take graduate courses, may apply for nondegree admission. Such admission is granted in three different categories: (1) admission as a regular nondegree student with a particular department; (2) admission as a special nondegree student without departmental affiliation through the Office of Continuing Education; and (3) admission as an unclassified student in the summer session only.

Credits earned by nondegree students in graduate courses taken at Duke before full admission to the Graduate School may be carried over into a graduate degree program if (1) the action is recommended by the student's director of graduate studies and approved by the dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed one semester at full-time tuition, and (4) the work has received grades of G or better.

Students who have discontinued a program of degree work at Duke must apply for readmission to the Graduate School. Those who discontinue study prior to completing a degree must, by letter, request permission of the dean to be readmitted to the degree program; those who discontinue study after earning a master's degree must file a new application for the doctoral program.

Admission Procedures*

A student seeking admission to the Graduate School should obtain application information from the Graduate School Admissions Office, including the necessary forms and detailed instructions on how to apply. All of this information, including an electronic application, is available from the Graduate School web site at <http://www.gradschool.duke.edu>. All parts of the application form must be filled out completely, signed, and returned to the Graduate School Admissions Office. The necessary supporting documents and a nonrefundable application fee must follow immediately. This fee is \$75** in U.S. currency (check or money order payable to Duke University through a U.S. bank). However, if the application is postmarked and completed by December 1, the fee is reduced to \$65. The required supporting documents are: (1) one copy of an official, confidential transcript from each institution (undergraduate or graduate) attended, sealed in a confidential envelope and signed-across-the-seal by the registrar at the institution; (2) three letters of evaluation, written on the forms provided and returned by the applicant in the confidential envelopes that have been sealed-then-signed by the evaluators; (3) official scores on the Graduate Record Examination General Test for applicants to all departments; and (4) official scores on the Graduate Record Examination Subject Test for applicants to certain specified departments. Please consult the current application bulletin for more detailed information on all requirements.

Materials submitted in support of an application are not released for other purposes and cannot be returned to the applicant.

Students applying for fall admission and award should take the Graduate Record Examination in time for official scores to reach the Graduate School by the December 31 deadline. Information on the times and places of the Graduate Record Examinations can be obtained from the applicant's college or the Educational Testing Service, P.O. Box 6000, Princeton, New Jersey 08541-6000, telephone (609) 771-7670, web site <http://www.gre.org>.

Additional Procedures for Foreign Students. Fully qualified students from outside the United States are invited to apply for admission to full-time study in the Graduate School. The foreign student must, in addition to the information required of all students, submit with the application materials:

1. If the student's native language is not English, certification of English proficiency demonstrated by official scores from the Test of English as a Foreign Language (TOEFL), administered through the Educational Testing Service, P.O. Box 6151, Princeton, New Jersey, 08541-6151 USA, web site <http://www.toefl.org>. The Graduate School requires a minimum TOEFL score of 550.
2. A statement showing financial arrangements for the proposed term at Duke (estimated costs per calendar year are about \$39,000).

English Language Requirements for Foreign Students. All international students whose native language is not English must enroll in two sections of intensive English language instruction during their initial year at Duke, unless formally waived from this requirement by the Graduate School upon certification of competency in English.

Part-Time Graduate Study. Many graduate departments will consider applications from students wishing to pursue degree study on a full-time or part-time basis. (Consult application materials for listing of departments.) Admission requirements, procedures, and deadlines are the same in either case. Visa restrictions do not allow nonimmigrant students to pursue graduate study on a part-time basis.

*This chapter is a brief summary of, and brief supplement to, information contained in the current Graduate School application bulletin, available both in print, and electronically via the World-Wide Web at <http://www.gradschool.duke.edu>. Either of these publications should be consulted for more comprehensive information on all aspects of the process of applying for admission and award.

**All fees are based on current charges and are subject to change without notice.

Master of Arts in Liberal Studies Procedures. Students seeking admission to MALS should contact that program directly for information, requirements, and special application materials.

Summer Session Procedures. Students who wish to begin graduate work during the summer must check first with the department of interest concerning available courses or research work, as well as funding possibilities; some departments have summer offerings and others do not. Applications should be submitted according to the fall deadline schedule, since summer files will be reviewed along with others who plan to begin in late August.

In addition to the application for regular admission to the Graduate School, students must also apply directly to the summer session. Application forms and catalogues may be obtained from Summer Session, Duke University, Box 90059, Durham, North Carolina 27708-0059, telephone (919) 684-2621, email learn@acpub.duke.edu.

Students who wish to take graduate courses in the summer but not pursue a graduate degree may be admitted to the summer session under the following categories. Duke Students: current students in good standing may attend the summer session without formal application. Non-Duke Students: other persons may seek admission to the summer session provided they are (or were) in good standing at a fully accredited college or university.

Continuing Education Procedures. A student seeking admission as a nondegree continuing education graduate student at Duke must have received a bachelor's degree and must either reside in the area or be moving to the area with the intention of residing here for a substantial period of time. Application materials and additional information may be obtained from the Office of Continuing Education, Duke University, Box 90700, Durham, North Carolina 27708-0700, telephone (919) 684-6259, email learn@acpub.duke.edu.

Review of Application and Notification of Status. All applications are considered without regard to race, color, religion, national origin, handicap, veteran status, sexual orientation or preference, sex, or age.

Application files are assembled in the Graduate School Admissions Office, where all official record-keeping is maintained. Applications, once processed, are sent to the departments. A departmental admissions committee, usually headed by the director of graduate studies, reviews the applications and makes recommendations to the dean. Formal admission to the Graduate School is offered only by the dean, who will send the official letter of admission and an acceptance form. The process of admission is not complete until the student returns the acceptance form.

Admission may not be deferred from one term to another; an admission offer is only for the semester specified in the letter of admission.

Immunizations. North Carolina Statute G.S.: 130A-155.1 states that no person shall attend a college or university, public, private, or religious, excluding students attending night classes only and students matriculating in off-campus courses, unless a certificate of immunizations against diphtheria, tetanus, whooping cough, poliomyelitis, red measles (rubeola), and rubella is presented to the college or university on or before the first day of matriculation. The required forms and instructions are provided to students in the packet of materials sent with the letter of admission.

Deadlines for Application

It is the applicant's responsibility to make certain that the Graduate School Admissions Office has received all required materials by the appropriate deadlines. Only complete applications can be considered. To ensure that the admissions office will have adequate time to assemble all items submitted on an applicant's behalf, applications should be sent at least two weeks before the stated deadlines.



Consult current application materials for a more detailed explanation of deadlines and their enforcement.

FOR FALL SEMESTER

December 1. Deadline for postmark and completion of applications eligible to pay the reduced application fee of \$65. All applications postmarked after this date must be accompanied by a fee of \$75 or they will not be processed.

December 31. Final deadline for postmark of applications for admission and award to all programs for the fall semester. (Note: Applications must arrive in the Graduate School within fourteen days of the December 31 postmark date.)

Applications postmarked and completed by this date are guaranteed a review; those postmarked/completed after this date are not guaranteed consideration. Late applications may be considered for admission only if all spaces have not been filled, and for financial aid, only if funds are still available. All students seeking fall admission should meet the December 31 deadline, since it is likely that enrollment in many departments will be filled soon after this date.

The final cut-off date for processing new applications is July 15. Few departments, however, continue to review applications this late. No applications for fall received after this date will be processed.

FOR SPRING SEMESTER

November 1. Final date for completion of applications for admission to the spring semester, space permitting. Not all departments accept new students for the spring semester, nor is financial aid readily available for spring matriculants.

FOR SUMMER SESSION

Students seeking admission to the Graduate School for study in the summer session should apply for Graduate School admission according to the fall deadline schedule. In addition to applying to the Graduate School, students must also apply to the Summer Session at least 30 days in advance of each Summer Session. (There are two Summer Sessions, typically running from mid-May to late June, and early July to mid-August.)

Financial Information



Fellowships and Scholarships

The Duke University Graduate School and its graduate programs offer a wide array of financial support. Funding is available from annually allocated awards funds, instruction, endowed fellowships, foundation and other private support, as well as federal research and training grants. A student who wishes to be considered for any of the fellowships or assistantships mentioned in this section should so indicate on the application form for admission and award. Selection of award recipients is made on the basis of academic merit and departmental recommendations.

(While personal financial need may not be the basis for the granting of many graduate awards, the Graduate School requests that all matriculating students complete the Free Application for Federal Student Aid. This application will be mailed to you upon acceptance.)

In addition to those awards available through the university, applicants are urged to compete for national and foundation awards available for graduate study. The following list provides a few of the awards available, from these sources, and from within the university.

NATIONAL, REGIONAL, AND FOUNDATION AWARDS

National Science Foundation Graduate Fellowships and Minority Fellowships: predoctoral fellowships for students in the physical, biological, and social sciences. Applications are available from the National Science Foundation, 4201 Wilson Blvd., Arlington, Virginia 22230.

Howard Hughes Fellowships: predoctoral fellowships in biological sciences. Applications are available from the Hughes Fellowship Program, The Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington, D.C., 20148. (202) 334-2872.

Andrew W. Mellon Fellowships: predoctoral fellowships for students who aspire to teaching and scholarship in the humanities. For information write to Fellowships in Humanistic Studies, The Woodrow Wilson National Fellowship Foundation, P.O. Box 288 (300 Alexander Street), Princeton, N.J. 08542-0288. (609) 452-7007.

Ford Foundation Predoctoral Fellowship for Minorities: c/o Fellowship Office National Research Council, 2101 Constitution Avenue, Washington, D.C., 20418. (202) 334-2872.

Frederick K. Weyerhaeuser Forest History Fellowship. This fellowship is available campus-wide to students who wish to study broadly in the area of forest and conservation history. Inquiries should be made to the Forest History Society, 701 Vickers Avenue, Durham, North Carolina 27701.

COMPETITIVE GRADUATE SCHOOL FELLOWSHIPS

These competitive fellowships are offered through the Graduate School. Normally, students will not make direct application to these awards, but are nominated by their department.

Fellowships for Incoming Students

James B. Duke Fellowships. The James B. Duke One-Hundredth Anniversary Fund provides fellowships for students who wish to pursue a program leading to the Ph.D. degree in the Graduate School at Duke University. Its objective is to aid in attracting and developing outstanding scholars at Duke. Selection of recipients is made by a faculty committee upon nomination by the appropriate department. These fellowships provide a \$3,000 stipend supplement for four years to any other award the student receives from the department, the Graduate School, or national fellowships.

Julian Price Fellowship provides competitive stipend and tuition for students in the humanities.

The University Scholars Program was created in 1998 with a gift from Duke University Trustee Melinda French Gates and her husband Bill Gates, through the William H. Gates Foundation. The program is designed to stimulate an interdisciplinary, intergenerational, and diverse community of scholars. Each year the University Scholars Program provides tuition and a stipend for up to six incoming graduate students, who participate in bimonthly University Scholars Program seminars, and act as informal intellectual leaders and mentors (not advisors) to the program's undergraduates. For more information, see the University Scholars Program web site at: <http://www.usp.duke.edu>.

Fellowships for Advanced Students

Katherine Stern Fellowship: dissertation-year fellowships provided for advanced graduate students.

Named Instructorships in Arts and Sciences. Five of these awards are provided jointly by the Graduate School and Trinity College. Students are required to teach one course during the academic year in which they hold the award.

Aleane Webb Dissertation Research Fellowships provide support for miscellaneous research projects associated with the dissertation.

Conference Travel Awards fund advanced students who are presenting papers at national conferences.

International Research Opportunities

The Graduate School works to secure funding for advanced students who need to do research overseas. Below are a few of the programs currently available. Information on other fellowship opportunities may be obtained from the Office of Research Support.

Advanced International Fellowship. The Graduate School offers several research awards to students who must travel overseas. This fellowship carries a stipend of \$11,000.

Predissertation/Dissertation Travel Awards are provided for overseas research travel.

Organization for Tropical Studies. The Graduate School provides limited funding for students to travel to Costa Rica to participate in this important program.

Sigma Xi. Both the national and local chapters of this scientific honorary society offer research grants to graduate students. The Graduate School currently provides matching funding for these awards.

Exchange Programs. The Graduate School has developed exchange programs with a number of foreign universities, including the Free University of Berlin, and Potsdam, Saltzburg, and Humbolt universities.

Social Science Research Council—Predissertation Fellowships offers important international fellowships at the early stages of research. Graduate School participation in this program also includes workshops treating problems and opportunities students may encounter while in the field.

GRADUATE FELLOWSHIPS FOR MINORITY STUDENTS

Duke Endowment Fellowships. The Duke Endowment fellowship provides four years of graduate support. Its objective is to attract and develop outstanding minority scholars. A stipend of \$12,000 for each academic year, plus payment of tuition and registration and health fees for the fall and spring semesters is provided. Support for years one and two is provided by the Graduate School. Support for years three and four is provided by the department and may include service in the form of a research or teaching assistantship. In addition, in the fifth or final year, fellows are eligible to compete for dissertation support.

Presidential Fellowships. The Presidential Fellowship provides four years of graduate support. Its objective is to attract and develop outstanding minority scholars. A stipend of \$12,000 for each academic year, payment of tuition and registration and health fees for the fall, spring, and summer semesters, plus a summer supplement of \$2,000 for the first two summers is provided. Support for years one and two is provided by the Graduate School. Support for years three and four is provided by the department and may include service in the form of a research or teaching assistantship. In addition, in the fifth or final year, fellows are eligible to compete for dissertation support.

National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM). The National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc., is a tax-exempt, nonprofit corporation. GEM is jointly sponsored through a membership arrangement between employer and university members. GEM offers fellowships to minority students pursuing the M.S. or Ph.D. degrees in engineering, and Ph.D.'s in science. For application and other information email gem.1@nd.edu with your complete mailing address or call GEM at (219) 631-7771.

DEPARTMENTAL FELLOWSHIPS, ENDOWMENTS, RESEARCH AND INSTRUCTIONAL ASSISTANTSHIPS

The majority of funding available for graduate study is provided by the student's department. Below are listed some of the ways a student may be supported. For specific information, contact the program director of graduate studies.

Fellowships and Scholarships: various departments offer fellowship stipends (ranging up to \$15,000), and tuition scholarships to students pursuing graduate studies. Information may be obtained from the individual departments.

Endowed Fellowships: Many departments offer endowed fellowship support. These include the Gurney Harris Kearns and the Gertrude Weil Fellowships in

Religion, the Frank T. de Vyver and the Calvin Bryce Hoover Fellowships in Economics, the Clare Hamilton Memorial Endowed Fellowship in Clinical Psychology, the Charles R. Hauser Fellowship in Organic Chemistry, the Robert R. Wilson Fellowship in English, and the Anne McDougall Memorial Award in Women's Studies. Selection for these fellowships is made through faculty committees.

Research Assistantships. Appointments are available for graduate students whose special training and qualifications enable them to serve as assistants to individual staff members in certain departments. Stipends may be up to \$15,000 depending on the nature of the assistance and the assisting time required.

Part-time Instruction. Several departments offering graduate work have exceptionally qualified graduate students work as part-time instructors, tutors, and teaching assistants. Amounts of these assistantships vary and interested applicants should contact their departments directly.

PAYMENT OF AWARDS

The payment of stipends for graduate assistantships and fellowships starts on September 25 and is made in equal payments on the twenty-fifth day of each month thereafter. Fellowship stipends are paid on the last working day of the month, beginning in September. Under the Tax Reform Act of 1986, for US citizens the only graduate student financial assistance exempt from taxation are amounts paid for tuition, fees, books, supplies, and equipment required for course instruction. For foreign students, stipend payments are subject to withholding of federal and state income taxes, based on the existing tax treaty between the student's country and the USA. In addition there is an IRS requirement that tuition payments for foreign students must be reported to the federal government. Tax treaties can be viewed on the web (lower part of the page) at http://www.irs.ustreas.gov/prod/forms_pubs/pubs/p90102.htm. Each student's tax situation is unique, and the Payroll Office at Duke provides assistance to enrolled students regarding tax and withholding requirements.

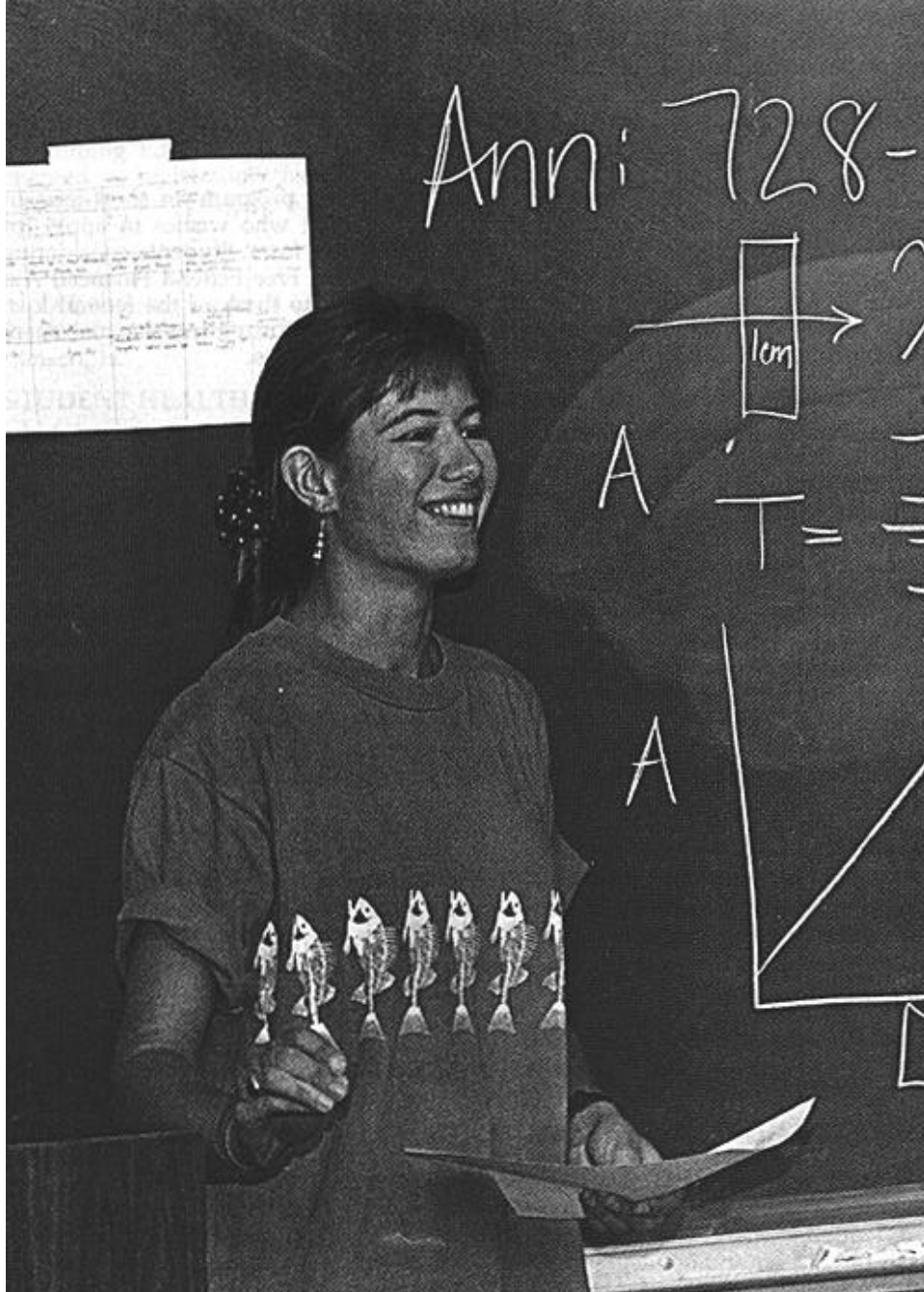
It is the responsibility of the student to be sure that tuition and fees are paid or that arrangements have been made with the appropriate office or department for submission of tuition payment notices to the bursar (101 Allen Building). Graduate students should contact either the director of graduate studies in their department or the Graduate School financial aid coordinator (03 Allen Building) depending upon the type of award. Faculty, senior administrative staff, employees, and eligible spouses not in degree programs should contact Jennifer Frazier (705 Broad Street) regarding tuition benefits.

Satisfactory Progress. Graduate students are expected to make satisfactory progress in their programs in order to remain enrolled in the Graduate School or to receive financial aid. Qualitative and quantitative requirements regarding formal coursework are detailed under the chapter of this bulletin entitled "General Academic Regulations," including regulations and regarding unsatisfactory or failing grades in major or related courses. Additional requirements may be imposed by individual departments, which are responsible for certifying at the conclusion of each academic year the satisfactory progress of all enrolled students. Finally, the Graduate School has established normative time requirements for completion of various stages of graduate degree work. Failure to meet expected time frames requires a review of the student's situation by the dean of the Graduate School, as specified in the chapter on "General Academic Requirements." See also the section below on "Restrictions" under Payment of Accounts (page 45).

LOANS

Students who anticipate a need to supplement their financial resources through loans or college work-study employment must obtain and complete Free Application for Federal Student Aid. These forms are available at most financial aid offices or

from the Financial Aid Coordinator, Graduate School, Duke University, Durham, North Carolina 27708. A student seeking a loan should contact his or her state lending agency, or request an application from the Financial Aid Office.



Students who are enrolled at least half time, who are U.S. citizens at permanent residents, and who meet the federal criteria for need are eligible for loans. Loan funds are provided through the Carl Perkins Student Loan Program after a student has borrowed the maximum from the Federal Stafford Loan Program. Generally, loans made from these funds, as is the case with loans from state agencies, bear no interest charge to qualified borrowers while they maintain student status and for a short period thereafter. Interest during the repayment period is at a favorable rate.

Inquiries concerning loans should indicate the department of intended matriculation and include all pertinent information concerning application to a state agency. These inquiries should be addressed to the Financial Aid Coordinator, Box 90061, Graduate School, Duke University, Durham, North Carolina 27708-0061.

WORK-STUDY PROGRAM EMPLOYMENT

Funds are available through the college work-study program for short-term or part-time employment of graduate students. A student who wishes to apply for work-study must complete a Free Federal Financial Aid form. Students considering the possibility of work-study for the fall should submit Free Federal Financial Aid forms by April 15. Eligibility requirements are similar to those of the federal loan programs. In addition to departmental employment opportunities, the placement office maintains a listing of employment openings for students.

SUMMER FINANCIAL AID

A limited amount of financial aid is available to students in summer study. Summer financial aid, determined according to demonstrated need, may consist of a departmental award, institutional grant funds, instruction, and/or low interest loans from the Stafford Student Loan program and the Carl Perkins Student Loan program. To qualify for summer school aid, a student must be enrolled or accepted for enrollment at Duke during the academic year immediately preceding the summer for which aid is requested. Students must be registered for summer school in order to receive summer support. (Students enrolled only for the summer may be eligible to borrow from outside lenders under the Stafford program in their home states or from the schools at which they are regularly enrolled. They should contact their college's financial aid office or the state's department of higher education for information and applications.) The college work-study aid is determined by the financial aid office based upon the student's financial need and the availability of funds. Graduate awards are determined by departments depending on usual criteria and availability of funds.

Student Expenses

Although many students will receive financial assistance for their graduate education, students are responsible for ensuring that they have the means to support themselves, and the ability to pay tuition and fees due the university. Below is a summary of expected costs.

COST OF LIVING

For a specific estimate of the cost of education for need-based awards or loan certification, contact the Graduate School Financial Aid Office. Cost may also differ for international students; contact Graduate Admissions for further information.

TUITION AND FEES

Tuition

The following figures are estimates for 2000-01, and are subject to change.

Tuition is charged on a per semester basis for Ph.D. students, and on a per unit basis for masters and nondegree students. (The tuition rate for the masters program in international development policy is set separately from other graduate programs;

information concerning these rates can be obtained from the program director.)

For new Ph.D. students entering in 2000-01, the charge for tuition is \$9,120 per semester. A charge for tuition is levied for six semesters of graduate study. One semester of credit may be granted for those entering with a previous graduate degree or for nondegree work done at Duke prior to matriculation.

For masters and nondegree students, the tuition for 2000-01 is \$760 per unit or semester hour.

REGISTRATION FEE

All graduate students, with the exception of students registered through Continuing Education or the Master of Arts in Liberal Studies Program, will be charged a registration fee for every semester of residence. For 2000-01, the registration fee charge is \$1,300 per semester. Registration for summer 2000 is also \$1,300.

TRANSCRIPT FEE

All entering students will be charged in the fall semester a one-time mandatory fee of \$30 for transcripts. This fee entitles the student to an unlimited number of Duke transcripts.

STUDENT HEALTH FEE

All full-time students and part-time degree candidates are assessed a fee each semester for the use of the Student Health Service. For fall and spring, the fee is estimated at \$444 (\$222 each semester). For summer, the fee is estimated at \$125. This fee is distinct from health insurance, and does not provide major medical coverage. For the services covered by this fee see the chapter "Student Life".

HEALTH INSURANCE

Students will be charged for health insurance in the fall semester, unless proof of other health insurance is provided. For 1999-00, the Student Health Insurance was \$667 for the full year. Information on the coverage provided by this insurance is available from the Office of the Bursar.

STUDENT GOVERNMENT DUES

All graduate students will be charged student government dues of \$9.50 per semester.

RECREATION FEE

All graduate students will be charged a recreation fee for the use of on-campus facilities. The fee is \$25 per semester.

OTHER FEES

Thesis or Dissertation Fees. Fees incurred in connection with a thesis or dissertation are currently as follows:

Binding fee, three university copies of thesis or dissertation	\$25
Microfilming fee (doctoral degree only) upon final submission	\$55
Copyright fee (doctoral degree only), optional	\$45

Marine Laboratory Fee. For Marine Laboratory investigators' research table fee, see the publication *Marine Laboratory 1995*.

Audit Fee. Auditors are permitted on a space available basis with the consent of the instructor. Students registered full time during fall and spring may audit courses without charge. Audit fees are \$160 per course for other students.

Vehicle Fee. Students should contact the University Parking Services Office (2010 Campus Drive) regarding parking fees.

PAYMENT OF ACCOUNTS FOR FALL AND SPRING

The Office of the Bursar will issue invoices to registered students for tuition, fees, and other charges approximately four to six weeks prior to the beginning of classes each semester. The total amount due on the invoice is payable by the invoice late payment date which is normally one week prior to the beginning of classes. Inquire at the Bursar's Office, (919) 684-3531, if an invoice has not been received three weeks prior to the first day of classes, so that payment can be forwarded while a duplicate invoice is issued to document the balance owed. As part of the admission agreement to Duke University, a student is required to pay all invoices as presented. If full payment is not received, a late payment charge as described below will be assessed on the next invoice and certain restrictions as stated below will be applied. Failure to receive an invoice does not warrant exemption from the payment of tuition and fees nor from the penalties and restrictions. Nonregistered students will be required to make payment for tuition, fees, required deposits, and any past due balance at the time of registration.

Monthly Payment Option. The Monthly Payment Option Plan allows students to pay all or part of the academic years' expenses in ten equal monthly payments from July 1 to April 1. The only cost is an annual, nonrefundable fee of \$95. The participation fee can be paid by Visa or Mastercard. Payments may be made by check or by bank draft. Questions regarding this plan should be directed to Tuition Management Systems, 1-800-722-4867 or 401-849-1550. At renewal, the plan can be extended to twelve months. The monthly payments can be increased or decreased without additional costs.

Late Payment Charge. If the total amount due on an invoice is not received by the invoice late payment date, the next invoice will show a penalty charge of 1 1/4 percent per month assessed on the past due balance regardless of the number of days past due. The past due balance is defined as the previous balance less any payments and credits received on or before the late payment date and also any student loans or scholarship memo credits related to the previous balance which appear on the invoice.

Restrictions. An individual will be in default if the total amount is not paid in full by the due date. A student in default will not be allowed to receive a transcript of academic records, have academic credits certified, go on leave of absence, or receive a diploma at graduation. In addition, an individual in default may be subject to withdrawal from school and have the account referred to a collection agency.

Reduction in Registration and Tuition. Full refunds are granted students who reduce registration on the drop/add date at the beginning of each semester.

Refunds for Withdrawal from School during Fall and Spring Semesters. For students who withdraw from school or who are withdrawn by the university, refunds of tuition are governed by the following policy.

1. In the event of death, refund of full tuition and fees will be granted.
2. In all other cases of withdrawal from the university, students may have tuition refunded according to the following schedule:
 - a. Withdrawal before classes begin: full refund;
 - b. Withdrawal during the first or second week of classes: 80 percent refund (fees will not be refunded);
 - c. Withdrawal during the third, fourth, or fifth week of classes: 60 percent refund (fees will not be refunded);
 - d. Withdrawal during the sixth week: 20 percent refund (fees will not be refunded);
 - e. Withdrawal after the sixth week: no refund.

- f. Tuition charges paid from grants or loans will be restored to those funds on the same pro rata basis and will not be refunded or carried forward.
3. If a student has to drop a course for which no alternate registration is available, drops special fee courses (music, golf, etc.), or drops a paid audit during the first two weeks of the drop/add period, a full refund may be granted with the approval of the dean. (The student health fee will not be refunded.)

Special Tuition Benefits for Employees. The Graduate School recognizes a special obligation to encourage the professional and personal advancement of employees. The university thus grants reductions in tuition to eligible employees enrolling in courses offered by the university. Employees should consult the Benefits Office, 705 Broad Street, (919) 684-6723, for eligibility and payment requirements.

Registration



Registration

All students who enrolled prior to fall 1994 should consult the bulletin of their year of matriculation for registration procedures and requirements.

Registration Requirements. All students must register each fall and spring semester for "continuation" and pay a registration fee each semester until all degree requirements are completed, unless waived by an approved leave of absence granted by the dean. Failure to maintain "continuation" registration each fall and spring will result in administrative withdrawal from the university.

Leave of Absence. Students who have been on leaves of absence and who intend to resume a degree program must give the department and the dean notice of this intention two months before registration.

Doctoral Students. In addition to "continuation," doctoral students must also register for a total of 6 semesters of full-time tuition. For Ph.D. students, approved transfer of an earned graduate degree may reduce the number of semesters of full-time tuition required for the degree to five semesters. After the 6 semesters of tuition, doctoral students will be charged only the registration fee. Specific course requirements for doctoral students are set by the departments.

Master's Students. Master's students must register for a minimum of 30 units of degree credit, although some programs require more than 30 units. A registration fee and "continuation" registration for each semester are also required in all programs. Approved transfer course work into a master's program will not reduce the minimum registration of 30 units for a master's degree at Duke University.

Registration Periods. All students who are enrolled in the Graduate School and who have not been granted a leave of absence by the dean must register each fall and spring until all degree requirements are completed. New students will register immediately prior to the first day of classes in either term; continuing students register during the announced registration periods (set by the Registrar's Office) in November and March.

Late Registration. All students are expected to register at the times specified by the university. A late registration fee of \$25 is charged any student registering late, including a current student who delays registering until the registration for new students.



Change of Registration. During the first two weeks of the fall or spring semester, registration may be changed with the approval of the director of graduate studies if no reduction of fee is entailed. If fees are reduced, the approval of the dean of the Graduate School is required and must be received no later than the first week of the semester.

Summer Registration. Students who are in residence at Duke University during the spring and who plan to enroll for courses in the summer session may have their course programs approved by the director of graduate studies during the week of Graduate School registration in March. Summer session students may register at announced times beginning with the March registration period and up to the Wednesday preceding the start of the appropriate term. Graduate students who are in residence during the summer session, but not enrolled in any courses, pay only the "continuation" fee.

The university does not mail statements for summer session tuition and fees. All tuition and fees should be paid in the Office of the Bursar (101 Allen Building) at least

five full working days prior to the first day of class (see summer session calendar). Students who fail to register and pay all tuition and fees before this deadline will be assessed a late charge. Failure to pay tuition and fees by the end of the drop/add period will result in administrative withdrawal of the student.

Summer session students may add a course or courses before or during the first three days of the term. Courses may also be dropped before and during the first three days, but a 20 percent tuition fee will be charged (1) if the course is not dropped before the first day, and (2) the dropped course(s) results in a total tuition reduction. Courses dropped after the third day of classes are not eligible for tuition refund.

Additional Registration Requirements. It is necessary to be a fully registered student according to the regulations listed in the chapter on "Registration" in order to be eligible for library carrel and laboratory space, student housing, university and some outside loans, and the Student Health Service, including accident and sickness insurance. See the chapter on "Student Life."

Regulations



General Academic Regulations

Credits. The following regulations pertain to credits earned outside the Duke University Graduate School:

Graduate Credit Earned before the A.B. Degree Is Granted. Ordinarily no credit will be allowed for graduate courses taken before a student has been awarded the A.B. or B.S. degree. However, an undergraduate student at Duke University, who at the beginning of the final semester lacks no more than three courses in order to fulfill the requirements of the bachelor's degree, may apply for admission to the Graduate School for that final semester. If the student meets the requirements for admission, permission may be obtained from the dean of the Graduate School to enroll for graduate courses to bring the total program to no more than four courses. In addition to undergraduate registration, the student must register in and pay tuition for those courses to the Graduate School at the beginning of the semester in which graduate credit is to be earned in order for the courses to be credited toward a graduate degree program. (Only one semester of full-time tuition credit for the Ph.D. program will be granted to nondegree students.)

Transfer of Graduate Credits. For master's programs, the transfer of graduate credit does not reduce the required minimum registration of 30 units for a master's degree at Duke. For Ph.D. students, one semester of full-time tuition credit may be given if the student has completed a graduate degree at another institution. No credit will be given to those students who wish to receive a master's degree en route to the Ph.D. Up to one semester of tuition credit may be given to students who have completed graduate course work at Duke as nondegree students. Financial credit for the above programs will be given only after the student has completed one full-time semester in a degree-granting graduate program. (For Ph.D. students, departments are free to consider previous course work in determining further course requirements for the student—academic credit is distinct from financial credit or registration requirements for the degree.)

Grades. Grades in the Graduate School are as follows: *E*, *G*, *S*, *F*, and *I*. *E* (excellent) is the highest mark; *G* (good) and *S* (satisfactory) are the remaining passing marks; *F* (failing) is an unsatisfactory grade; and *I* (incomplete) indicates that some portion of the student's work is lacking, for an acceptable reason, at the time

the grades are reported. For students enrolled in the Graduate School, the instructor who gives an *I* for a course specifies the date by which the student must make up the deficiency. If a course is not completed within one calendar year from the date the course ended, the grade of *I* becomes permanent and may not be removed from the student's record. The grade of *Z* indicates satisfactory progress at the end of the first semester of a two-semester course. For unclassified graduate students enrolled in the summer session, a temporary *I* for a course may be assigned after the student has submitted a written request. If the request is approved by the instructor of the course, then the student must satisfactorily complete the work prior to the last day of classes of the subsequent summer term. A grade of *F* in a major course normally occasions withdrawal from a degree program not later than the end of the ensuing semester or term; a grade of *F* in any other course occasions at least academic probation.

Reciprocal or Interinstitutional Agreements with Neighboring Universities.

Under a plan of cooperation between Duke University and the University of North Carolina at Chapel Hill, North Carolina Central University in Durham, and North Carolina State University at Raleigh, full-time students properly enrolled in the Graduate School of Duke University during the regular academic year, and paying full tuition to this institution, may be admitted to a maximum of two courses per semester at one of the other institutions in the cooperative plan. Under the same arrangement, students in the graduate schools in the neighboring institutions may be admitted to course work at Duke University. Credit so earned is not defined as transfer credit. To take advantage of this arrangement during either summer session term, the student registers for 3 units of credit at the home institution and 3 units of credit at the other institution, for a total of 6 units. All interinstitutional registrations involving extra-fee courses or special fees required of all students will be made at the expense of the student and will not be considered a part of the Duke University tuition coverage. This reciprocal agreement does not apply to contract programs such as the American Dance Festival.

Identification Cards. Graduate students are issued identification cards which they should carry at all times. The card is a means of identification for library privileges, athletic events, and other university functions or services open to university students. Students will be expected to present their cards on request to any university official or employee. The card is not transferable, and fraudulent use may result in loss of student privileges or suspension from the Graduate School. A report of the loss of a card must be given immediately to the registrar's office. The cost of a new ID card is \$5.

Courses Primarily for Undergraduates. With the approval of their director of graduate studies, master's degree students may take a total of two courses below the 200 level and have them count toward the 30 units required for their degree, provided that two conditions are met:

1. that such courses be over and above the graduate course requirements set by the department; and
2. that a grade of *B* or better be earned.

At the master's level, only two such courses will be counted toward the 30 units. Ph.D. students may take undergraduate courses with the approval of their director of graduate studies.

Withdrawal from a Course. For permissible changes during the first two weeks of the fall or spring semester and during the first three days of summer session term, see the chapter on "Registration." If a course is dropped without the necessary approval, the permanent record will, at the discretion of the dean of the Graduate School and with the permission of the instructor, list the course as Withdrawal Error (*WE*). If a course is dropped after the two-week period during the fall or spring or after the first three days of classes during the summer, the status of the student at the

time of withdrawal from the course will be indicated on the permanent record as Withdrew Passing (*WP*) or Withdrew Failing (*WF*).

Interruption of Program and Withdrawal from the Graduate School. Students are expected to meet academic requirements and financial obligations, as specified elsewhere in this bulletin, in order to remain in good standing. Certain nonacademic rules and regulations must be observed also. Failure to meet these requirements may result in summary dismissal by the appropriate officer of the university.

The university reserves the right, and matriculation by the student is a concession to this right, to request the withdrawal of any student whose academic performance at any time is not satisfactory to the university. A student who wishes for any reason to withdraw from the Graduate School during the fall, spring, or summer session must notify in writing both the director of graduate studies in the major department and the dean of the Graduate School prior to the date of the expected withdrawal and no later than the published last day of classes for that semester or summer session. If students wish to withdraw from courses in the summer session, they must consult both the director of graduate studies in the major department and the director of the Summer Session. For refunds upon withdrawal, see the chapter on "Financial Information."

A student who, after successfully completing one semester of graduate study, must withdraw before completion of a graduate program may, with the approval of the major department, request the dean to issue a certificate of graduate study.

Leave of Absence. A leave of absence for a period of time no longer than one calendar year may be granted because of medical necessity, full-time employment, receipt of an external award, or other acceptable reasons. A request for a leave of absence should be originated by the student, endorsed by the student's major professor and director of graduate studies, and submitted to the dean of the Graduate School for consideration prior to the beginning of the semester for which the leave is requested. A student is eligible to request a leave of absence only after having completed at least one semester at Duke. Time limitations which pertain to the various degrees and the completion of courses on which a grade of I (incomplete) was earned are not waived.

See page 34 of this bulletin for further English proficiency requirements for foreign students.

Degree Regulations—The Master's Degrees

MASTER OF ARTS/MASTER OF SCIENCE

Prerequisites. As a prerequisite to graduate study in the major subjects, a student must have completed a minimum of 24 undergraduate semester hours—ordinarily 12 semester hours of approved college courses in the major subject and 12 semester hours in the major or in related work. Since some departments require more than 12 semester hours in the proposed field of study, students should read carefully the special requirements listed by their major departments in the chapter on "Courses of Instruction." If special master's requirements are not specified in this chapter and there is a question about prerequisites, prospective students should write directly to the appropriate director of graduate studies.

Language Requirements. The Graduate School requires no foreign language for the master's degree. Certain departments, however, do have language requirements and these must be satisfied before the master's examination can be taken. See the departmental listings in the chapter on "Courses of Instruction."

Major and Related Subjects. Thirty units of graduate credit at Duke constitutes minimum enrollment for the Master of Arts and the Master of Science degrees. Students must present acceptable grades for a minimum of 24 units of graded course work, 12 of which must be in the major subject. A minimum of 6 units of the required

24 is normally in a minor subject or in a related field which is approved by the student's major department. The remaining 6 units of the required 24 may be taken either in the major or in related fields approved by the major department and the dean of the Graduate School.

Individual departments decide whether the M.A./M.S. program may be completed by submission of an approved thesis or by other academic exercises (see requirements listed in the chapter on "Courses of Instruction"). In either case, a maximum of 6 units may be earned by the completion exercises and the final examination.

Thesis Requirements. The thesis should demonstrate the student's ability to collect, arrange, interpret, and report pertinent material on a research problem. The thesis must be written in an acceptable style and should exhibit the student's competence in scholarly procedures. Requirements of form are set forth in the *Duke University Guide for the Preparation of Theses and Dissertations*, copies of which are available in the Graduate School office.

The thesis must be submitted in an approved form to the Graduate School on or before April 15 for a May degree, ten days before the final day of the second summer term for a September degree, ten days before the final day of the fall semester for a December degree, and at least one week before the scheduled date of the final examination. The copies of the thesis will be distributed by the student to the several members of the examining committee. Two copies for the library and one copy for the adviser will be bound upon payment of the university binding fee of \$25.

The Examining Committee and the Examination. The department's director of graduate studies recommends an examining committee normally composed of three members of the graduate faculty, one of whom is usually from a department other than the major department or from an approved minor area within the major department. Nominations for membership on this committee are submitted for approval to the dean of the Graduate School at least one week before the final examination.

The committee will conduct the examination and certify the student's success or failure by signing the card provided by the Graduate School office. This card indicates completion of all requirements for the degree. If a thesis is presented, the committee members also sign all copies of the thesis, and the candidate then returns the original and first two copies to 013 Perkins Library.

MASTER OF PUBLIC POLICY

See page 230 for a description of the M.P.P. degree.

MASTER OF ARTS IN TEACHING

See page 265 for a description of the M.A.T. degree.

Additional Master's Regulations

Filing the Intention to Receive Degree. On or before January 25 for a May degree, on or before July 1 for a September degree, or on or before November 1 for a December degree, and at least one month prior to the final examination, the student must file online a declaration of intention to receive degree. The declaration of intention presents the title of the thesis or specifies alternative academic exercises on which the degree candidate will be examined. The declaration must have the approval of both the director of graduate studies in the major department and the chair of the student's advisory committee. The online address is: <http://www.gradschool.duke.edu/intent/degree.htm>.

Transfer of Credits. A maximum of 6 units of graduate credit may be transferred for graduate courses completed at other schools. Such units will be transferred only if the student has received a grade of B (or its equivalent) or better. The transfer of

graduate credit does not reduce the required minimum registration of 30 units for a master's degree at Duke. Requests for transfer should be submitted on the approved Graduate School form.

Nondegree Students. Credit for graduate courses taken at Duke by a student (not undergraduate) before degree admission to the Graduate School or while registered as a nondegree student through the Office of Continuing Education or the Graduate School may be carried over into a graduate degree program if (1) the action is recommended by the student's director of graduate studies and approved by the dean, (2) the amount of such credit does not exceed 12 units, (3) the work has received grades of G or better, (4) the work is not more than two years old, and (5) the student applies for and is granted formal admission into a degree program.

Time Limits for Completion of Master's Degrees. Master's degree candidates who are in residence for consecutive academic years should complete all requirements for the degree within two calendar years from the date of their first registration in the Graduate School. Candidates must complete all requirements within six calendar years of their first registration.

To be awarded a degree in May, the recording of transfer credit must be completed by the first day of the final examination period. If a thesis is one of the requirements, it must be submitted to the Graduate School office no later than April 15. Candidates desiring to have their degrees conferred on September 1 must have completed all requirements, including the recording of transfer of credit, by the final day of the Duke University summer session. Candidates completing degree requirements after that date and during the fall will have their degrees conferred on December 30.

Degree Regulations—The Doctoral Degree

Requirements. The formal requirements for the Ph.D. degree are as follows: (1) payment of 6 semesters of full-time tuition (or five if credit for previous graduate work has been approved), (2) major and related courses, (3) foreign language(s) in many departments, (4) a supervisory committee for the student's program of study, (5) residence, (6) preliminary examination, (7) dissertation, and (8) final examination.

Major and Related Work. The student's program of study normally demands substantial concentration on courses in the major department, plus coursework in related minor fields as determined by individual programs. If there are deficiencies in a student's undergraduate program, departments may also require certain undergraduate courses to be taken. In all cases the student's supervisory committee will determine if the student must meet requirements above the minimum.

Foreign Languages. The Graduate School has no foreign language requirement for the Ph.D., but individual departments may have language requirements. For specific departmental requirements, see the chapter on "Courses of Instruction" or contact the appropriate director of graduate studies.

English Language Proficiency. All international Ph.D. students are subject to the requirement described on page 34 of this bulletin.

Committee to Supervise the Program of Study. As early in a student's course of study as is practicable and not later than two months before the preliminary examination, the director of graduate studies in the major department will nominate for the approval of the dean a supervising committee consisting of at least four members, with one member designated as chair. This committee should include at least three graduate faculty members from the major department and, usually, at least one from outside the department. For programs in which approval has been granted for related work from a clearly differentiated division within the department, one member of the committee may be chosen from that division. This committee, with all members participating, will determine a program of study and administer

the preliminary examination.

Residence. The minimum residence requirement is one academic year of full-time registration at Duke (that is, two consecutive semesters of full-time tuition).

Time Limits. Ordinarily a student registered for full-time study should pass the preliminary examination by the end of the third year. A student who has not passed the examination by this time must file with the dean of the Graduate School a statement, approved by the director of graduate studies in the major department, explaining the delay and setting a date for the examination. Except under unusual circumstances, extensions will not be granted beyond the middle of the fourth year.

The doctoral dissertation should be submitted and accepted within two calendar years after the preliminary examination is passed. Should the dissertation not be submitted and accepted within four years after the examination, the candidate may, with the approval of the committee and the director of graduate studies, petition the dean of the Graduate School for an extension of up to one year. If this extension is granted and the dissertation is not submitted and accepted by the new deadline, the student may be dropped from candidacy. The student must then pass a second preliminary examination to be reinstated as a candidate for the degree. In such cases, the time limit for submitting the dissertation will be determined by the dean of the Graduate School and the candidate's committee.

Ordinarily, credit is not allowed for graduate courses (including transfers) or foreign language examinations that are more than six years old at the date of the preliminary examination. Similarly, credit will not be allowed for a preliminary examination that is more than five years old at the date of the final examination. In cases of exceptional merit, however, the dean of the Graduate School may extend these limits. Should either of these limits be exceeded, the student's department must submit to the dean specific requirements for revalidating credits or examination.

Preliminary Examination. A student is not accepted as a candidate for the Ph.D. degree until the preliminary examination has been passed. The examination ordinarily covers both the major field and related work, although some departments cover such field expertise in a separate qualifying examination. Please consult the chapter on "Courses of Instruction" for individual department procedures. In the summer a preliminary examination may be scheduled only between the opening and closing dates of the summer session.

Successful completion of the preliminary examination requires at least three affirmative votes and no more than one negative vote. The sole exception to this policy is that a negative vote cast by the chair of the examining committee will mean a failure on the examination. A student who fails the preliminary examination may apply, with the consent of the full supervisory committee and the dean of the Graduate School, for the privilege of a second examination to be taken no earlier than three months after the date of the first. Successful completion of the second examination requires the affirmative vote of all committee members. Failure on the second examination will render a student ineligible to continue a program for the Ph.D. degree at Duke University.

The Dissertation. The dissertation is expected to be a mature and competent piece of writing, embodying the results of significant and original research.

One month before the dissertation is presented and no later than January 25 preceding the May commencement, July 1 for a September degree, and November 1 for a December degree, the student must file online a declaration of intention to receive degree. This form should indicate the approved title of the dissertation and be approved by both the director of graduate studies of the student's major department and the professor who directs the dissertation. The online address is: <http://www.gradschool.duke.edu/intent/degree.htm>.

The basic requirements for preparing the dissertation (type of paper, form, and

binding) are prescribed in the *Guide for the Preparation of Theses and Dissertations*, copies of which are available in the Graduate School office.

The dissertation must be completed to the satisfaction of the professor who directs the dissertation, members of the student's advisory committee, and the dean of the Graduate School. A copy of the dissertation must be submitted to the dean of the Graduate School on or before April 1 preceding the May commencement, ten days before the end of the Duke summer session for a September degree, or ten days before the end of the fall semester for a December degree. The dissertation must be submitted to the Graduate School office at least seven days before the scheduled date of the student's examination.

All doctoral dissertations are published on microfilm through University Microfilms, Ann Arbor, Michigan. Authors may copyright them if they wish. Abstracts are published in *Dissertation Abstracts International*.

One extra copy of the abstract (not more than 350 words long) with signature page is submitted when the dissertation is presented at 013 Perkins (Photographic Services). A nonrefundable fee of \$55 is charged for microfilming. If copyright is desired, an additional fee of \$45 is charged. The original and two copies will be bound at a cost of \$25.

Final Examination. The final examination is administered by at least four members of the supervising committee. The final oral examination shall be primarily on the dissertation; however, questions may be asked in the candidate's major field. Except in unusual circumstances approved by the dean, a final examination will not be scheduled when the university is not in session.

Successful completion of the final examination requires at least three affirmative votes and no more than one negative vote. The sole exception to this policy is that a negative vote cast by the chair of the examining committee will mean a failure on the examination. A student who fails the final examination may be allowed to take it a second time, but no earlier than six months from the date of the first examination. Permission to take the second examination must be obtained from the professor who directed the dissertation and from the dean of the Graduate School. Failure to pass the second examination renders the student ineligible to continue work for the Ph.D. degree at Duke University.

Deposit of the Dissertation. After passing the examination, candidates return the original and the first two copies of the dissertation, properly signed to 013 Perkins Library. At this time they sign the microfilming agreement and present proof of payment of binding, microfilming, and, if applicable, copyright fees.

Commencement

Graduation exercises are held once a year, in May, when degrees are conferred on and diplomas are issued to those students who have completed requirements by the end of the spring. Those who complete degree requirements by the end of the fall or by the end of a summer term receive diplomas dated December 30 or September 1, respectively. There is a delay in the mailing of September and December diplomas because diplomas cannot be issued until they are approved by the Academic Council and the Board of Trustees.

Standards of Conduct

Duke University expects and will require of all its students cooperation in developing and maintaining high standards of scholarship and conduct.

Students are expected to meet academic requirements and financial obligations, as specified elsewhere in this bulletin, in order to remain in good standing. Certain nonacademic rules and regulations must be observed also. Failure to meet these requirements may result in summary dismissal by the appropriate officer of the

university.

The university wishes to emphasize its policy that all students are subject to the rules and regulations of the university currently in effect or which, from time to time, are put into effect by the appropriate authorities of the university. Students, in accepting admission, indicate their willingness to subscribe to and be governed by these rules and regulations and acknowledge the right of the university to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate for failure to abide by such rules and regulations or for conduct adjudged unsatisfactory or detrimental to the university.

Duke University, as a community of scholars, strongly relies upon the standard of academic integrity. Plagiarism and other forms of academic dishonesty represent a corruption of this integrity and, as such, cannot be tolerated within the community. Ignorance of what constitutes academic dishonesty is no excuse for actions which violate the integrity of the community. In a community which builds on the notion of academic integrity, the threat of academic dishonesty represents an intolerable risk. Students unsure about the university definition of plagiarism may wish to consult the *Bulletin of Duke University: Information and Regulations* (especially the chapter on "Academic Honesty").

DUKE UNIVERSITY HARASSMENT POLICY

- I. Duke University is committed to protecting the academic freedom and freedom of expression of all members of the university community. This policy against harassment shall be applied in a manner that protects the academic freedom and freedom of expression of all parties to a complaint. Academic freedom and freedom of expression include but are not limited to the expression of ideas, however controversial, in the classroom, residence hall, and, in keeping with different responsibilities, in workplaces elsewhere in the university community.
- II. Definition of harassment at Duke University:
 - A. Harassment is the creation of a hostile or intimidating environment, in which verbal or physical conduct, because of its severity and/or persistence, is likely to interfere significantly with an individual's work or education, or affect adversely an individual's living conditions.
 - B. Sexual coercion is a form of harassment with specific distinguishing characteristics. It consists of unwelcome sexual advances, requests for sexual favors, or other verbal or physical conduct of a sexual nature when:
 1. submission to such conduct is made, explicitly or implicitly, a term or condition of an individual's employment or education; or
 2. submission to or rejection of such conduct is used as a basis for employment or educational decisions affecting an individual.
 - C. The conduct alleged to constitute harassment under this policy shall be evaluated from the perspective of a reasonable person similarly situated to the complainant and considering all the circumstances.
- III. In considering a complaint under the Duke University Harassment Policy, the following understandings shall apply:
 - A. Harassment must be distinguished from behavior which, even though unpleasant or disconcerting, is appropriate to the carrying out of certain instructional, advisory, or supervisory responsibilities.
 - B. In so far as Title VII (Equal Employment Opportunity) of the Civil Rights Act of 1964 is applicable (i.e., in complaints concerning carrying out of noninstructional employment responsibilities), the university will use the definition of sexual harassment found in the Equal Employment Opportunity Commission (EEOC) Guidelines: "conduct of a sexual nature . . . when such conduct has the purpose or effect of unreasonably interfering

with an individual's work performance or creating an intimidating, hostile, or offensive working environment."

- C. Instructional responsibilities require appropriate latitude for pedagogical decisions concerning the topics discussed and methods used to draw students into discussion and full participation.
- IV. The following behaviors are also prohibited by the Harassment Policy:
- A. Reprisals.
 - 1. Against the Complainant: It is a violation of Duke's Harassment Policy to retaliate against a complainant for filing a charge of harassment. A complaint of retaliation may be pursued using the steps followed for a complaint of harassment. When necessary, the appropriate dean or other university officer may monitor student grading or faculty/staff reappointment, tenure, promotion, merit review, or other decisions to ensure that prohibited retaliation does not occur.
 - 2. Against the respondent: Lodging a complaint of harassment is not proof of prohibited conduct. A complaint shall not be taken into account during reappointment, tenure, promotion, merit, or other evaluation or review until a final determination has been made that the university's harassment policy has been violated.
 - B. Knowingly false or malicious complaints.

To file a knowingly false or malicious complaint of harassment or of retaliation is a violation of the harassment policy. Such conduct may be pursued using the steps followed for a complaint of harassment. A complaint under this provision shall not constitute prohibited retaliation.
 - C. Intentional breaches of confidentiality.

All participants in the harassment complaint resolution process, including the complainant and respondent, witnesses, advisors, mediators, members of hearing panels, and officers, shall respect the confidentiality of the proceedings. Breaches of confidentiality jeopardize the conditions necessary to the workings of internal procedures for resolution of claims of harassment. Participants are authorized to discuss the case only with those persons who have a genuine need to know.

A complaint alleging an intentional breach of confidentiality may be pursued using the steps followed for a complaint of harassment. Such a breach may also constitute an act of retaliation. A breach of confidentiality may void the outcome of any previously agreed-upon resolution to a complaint.
 - V. Individuals who believe they have been harassed, individuals charged with harassment, and individuals with knowledge of situations in which harassment may exist should consult Duke University's "Procedures for Resolution of Claims of Harassment."
 - VI. This harassment policy and the procedures for resolution of claims of harassment are only part of Duke University's effort to prevent harassment in our community. In addition to spelling out steps for making and resolving complaints, the university is also committed to programs of education to raise the level of understanding concerning the nature of harassment and ways to prevent its occurrence.

Student Grievance Procedures. It is the responsibility of the director of graduate studies to inform each graduate student of the appropriate channels of appeal. In normal circumstances, the director of graduate studies is the first to hear a complaint.

If the complaint cannot be resolved satisfactorily at this level, the student may address, in turn, the department chair, the associate dean of the Graduate School, the dean of the Graduate School, the provost, and as a last resort, the president of the university.

Judicial Code and Procedures. In the spring of 1971, the Graduate School community ratified and adopted an official judicial code and procedures. These procedures were subsequently amended in November 1998.

I. Graduate School Judicial Code and Procedures

- A. A student, by accepting admission to the Graduate School of Duke University, thereby indicates willingness to subscribe to and be governed by the rules and regulations of the University as currently are in effect or, from time to time, are put into effect by the appropriate authorities of the University, and indicates willingness to accept disciplinary action, if behavior is adjudged to be in violation of those rules or in some way unacceptable or detrimental to the University. However, a student's position of responsibility to the authorities and the regulations of the University in no way alters or modifies responsibilities in relation to civil authorities and laws.
- B. A graduate student at Duke University stands in a primary and unique relation of responsibility to the faculty in the major department, the faculty upon whose recommendation a graduate degree will or will not be awarded to the student. In matters which involve or may affect the student's intellectual or professional life, the student is directly responsible to this department and its representatives, and such matters should primarily be handled by the department.
- C. Actions which appear to conflict with University-wide rules and regulations will fall under the jurisdiction of the University Judicial Board.
- D. A student may elect to have the Dean of the Graduate School hear matters related to the student's conduct in addition to or instead of faculty members from the student's major department, or may elect to have such matters reviewed and judged by a judicial board instead of the Dean of the Graduate School or members of the faculty in the major department. (The constitution and procedure of the judicial board are detailed below.)
- E. The Director of Graduate Studies in the student's major department may request that a student's actions be reviewed by the Judicial Board or by the Dean of the Graduate School.

II. The Graduate School Judicial Board

- A. *Composition.* The Graduate School Judicial Board shall have five members, serving for a period of two years: two students selected from the student body, two members of the Graduate Faculty appointed by the Executive Committee of the Graduate School, and one Associate or Assistant Dean appointed by the Dean of the Graduate School. The Board shall elect one of its members as Chairman. The Board shall have at its service a recording secretary to keep minutes of the hearings and of the Board's actions in a permanent, confidential record book. The Board will be constituted in order to hear cases in which the accused is a student currently enrolled in the Graduate School and in cases in which the accused is a former student but which arise out of activities of the accused while a student enrolled in the Graduate School, and which have been referred to it by the Director of Graduate Studies in the student's department, by the Dean of the Graduate School, or by the student.
- B. *Preliminary Procedures.* If a student requests a hearing by the Judicial Board it must be done in writing, allowing its Chairman at least seventy-two hours to convene the Board. In addition, the Chairman shall not convene the Board until seventy-two hours after being asked to convene the Board. It is the responsibility of the Chairman of the Judicial Board fully to inform its members concerning the case and the reasons the case has been referred to the Board; and to prepare a written summary of this information for the Board, the Dean, and the student.
- C. *Procedural Safeguards for the Hearing.* The Accused has the right to challenge any member of the Judicial Board on grounds of prejudice. If the Board decides to excuse one or more of its members for reasons given by the Accused, it shall consult with the Dean about the need for replacements. The Accused may choose an Adviser to assist in the defense. The Accused may also produce witnesses (including no more than two character witnesses), introduce documents, and offer testimony. A person having direct knowledge relevant to a case being heard by the Board is a material witness. The Judicial Board may request the appearance of material witnesses. The Board shall also request, upon written request of the Complainant or the Accused, the appearance of material witnesses. Witnesses shall be notified of the time, place, and purpose of their appearance. The Accused has the right to examine the written statement of any witness relevant to the case at least seventy-two hours before the hearing. The Accused has the right to be faced with any witness who has given a statement relevant to the case at the hearing if the witness's attendance can be secured.
The hearing will be conducted in private unless the Accused requests an open hearing. If any objection is raised to conducting an open hearing in any particular case, the Judicial Board shall decide the issue by majority vote. If the decision is made not to hold an open hearing,

the Accused shall be informed in writing of the reasons for the decision.

The Judicial Board shall consider only the report of the Chairman, documents submitted into evidence, and the testimony of witnesses at the hearing in reaching its decisions.

- D. *Conduct of the Hearing.* The hearing of any case shall begin with a reading of the charge by the Chairman in the presence of the Accused. The Accused shall then plead guilty or not guilty or move to terminate or postpone the hearing. The Accused may qualify a plea, admitting guilt in part and denying it in part. The Accused may not be questioned for more than one hour without recess.

At any time during the hearing, the Accused or the Judicial Board may move to terminate or to postpone the hearing or to qualify the plea or to modify its charge.

Pending verdict on charges (including appeal) against the Accused, status as a student shall not be changed, nor the right to be on campus or to attend classes suspended, except that the Chancellor or Provost may impose an interim suspension upon any member of the University community who demonstrates, by conduct, that continued presence on the campus constitutes an immediate threat to the physical well-being or property of members of the University community or the property or orderly functioning of the University.

- E. *Sanctions and the Verdict.* The Graduate School Judicial Board shall have the power to impose the following penalties: expulsion, dismissal from the University with the recommendation that the person never be readmitted; suspension, dismissal from the University and from participation in all University activities for a specified period of time, after which the student may apply for readmission; disciplinary probation, placing the student on a probationary status for a specified period of time, during which conviction for violation of any regulation may result in more serious disciplinary action; restitution, payment for all, or a portion of property damage caused during the commission of an offense. Restitution may be imposed by itself or in addition to any of the other penalties. In the case of a student who is not currently at Duke or who has already graduated, such sanctions could include revocation of the degree. The Judgment shall consist of a finding of guilty or not guilty of the charge and, when the Accused is found guilty, a statement of the punishment assessed. On all questions, including the verdict and the finding of guilty or not guilty, the Board shall be governed by a majority vote. The Judicial Board may decide to rehear a case in which significant new evidence can be introduced. In addition, the defendant may request an appeal.

- F. *Appeals.* The appellant may submit to the Dean a written statement containing the grounds for appeal and arguments. In such cases, the Dean should determine if the appeal should be granted, and the Dean can hear the case, or refer it to the appropriate faculty in the student's department or to the Judicial Board.

An appeal shall be granted on the following grounds: procedural error substantially affecting the rights of the accused; incompatibility of the verdict with the evidence; excessive penalty not in accord with "current community standards;" new evidence of a character directly to affect the judgment but on which the original tribunal had refused a new hearing.

III. Amendment and Construction

This Judicial code and procedure and this constitution and procedure for the Graduate School Judicial Board may be amended at any time with due notice or publication by consent of the Dean, the Executive Committee, and the graduate students. Questions and problems not answered or anticipated by the foregoing may be resolved by the use of other existing institutions or by amendment.

Courses of Instruction



Course Enrollment

Courses numbered 200-299 are sometimes open to qualified undergraduate students who have received permission of the instructor and the director of graduate studies.

Undergraduate students are not permitted in any courses above 300. Double numbers separated by a hyphen indicate that credit is contingent upon completion of both courses. Double numbers separated by a comma indicate that although the course is a year-long course, credit may be received for either course or both courses.

The following symbols, suffixed to course numbers, identify the small group learning experiences: S, seminar; P, preceptorial; T, tutorial; D, discussion section. The L suffix indicates that the course includes laboratory experience. C-L: denotes a course that is cross-listed or a program under which a course is listed.

African and African-American Studies (AAAS)

Professor Gaspar, *Director* (408B Old Chemistry Building); Professors Holloway, Payne, and Powell; Associate Professor Lubiano; Assistant Professor Daniels; Assistant Professor of the Practice el Hamel; Research Professor Giddings

The African and African-American Studies Program (AAASP) offers a certificate in African and African-American studies. Students enrolled in doctoral programs and in the Master of Arts in Liberal Studies (MALS) program are eligible and may work concurrently with their departments to satisfy the requirements for a certificate in African and African-American studies. The curricular format is a trifold course of study that includes coursework, teaching, and research. The award of a graduate certificate is carried on the student's official transcript upon completion of the program. Students enrolled in the graduate program are eligible to apply for AAASP-sponsored teaching assistantships for an undergraduate course in their department or for the program's introductory course for undergraduates.

Graduate study leading to the certificate in African and African-American studies encourages research and scholarship in all dimensions of the African and African-American experience. The graduate program is designed to provide access for students and scholars to a broad range of information and research from the humanities and social sciences, and the arts and professions, while taking advantage of the university's distinctive resources in each of these areas of study. Approximately seventy-five faculty in nearly 34 university departments and programs participate in AAASP and are available to mentor graduate students. Graduate students enrolled in the program are encouraged to participate in all African and African-American Studies Program events, to audit the series lecture and symposia, and to join with the faculty at the dinner colloquia.

A brochure is available upon request giving detailed information about requirements for the graduate certificate. For further information regarding application and enrollment in the graduate certificate program in African and African-American studies, contact the program director's office.

200S. Seminar in Asian and African Cultural Studies. 3 units. C-L: Asian and African Languages and Literature Studies 200S, Cultural Anthropology 288S, Literature 200S.

209S. Race, Class, and Gender in Modern British History. 3 units. C-L: History 209S.

216S. Gender, Race, and Class. 3 units. C-L: Cultural Anthropology 216S, Women's Studies.

235S. The Antebellum South. 3 units. C-L: History 235S.

241. Classical Islamic Theology and Ethics. 3 units. C-L: Religion 241, Medieval and Renaissance Studies 244.

254. Justice, Law, and Commerce in Islam. 3 units. C-L: Religion 254, Medieval and Renaissance Studies 254.

255. Anthropology as Public Discourse. 3 units. C-L: Cultural Anthropology 255.

269S. Harlem Renaissance. 3 units. C-L: Art History 269S.

270S. Topics in African Art. 3 units. C-L: Art History 270S.

278S. Black Political Participation. 3 units. C-L: Political Science 278S.

279S. Race, Racism, and Democracy. 3 units. C-L: Cultural Anthropology 279S.

292S. Slavery and Freedom in Africa, to 1960. 3 units. C-L: History 295S.

293. Special Topics in Literature and History. Instructor: Staff. 3 units.

309S. Seminar in African-American History, 1870s to the Present. Historiography and research on the black experience and race relations after the general emancipation, in the age of segregation, during the Civil Rights Movement, and in the post-civil rights era. Instructor: Gavins. 3 units. C-L: History 309S.

310S. Seminar in African-American History, 1870s to the Present. Historiography and research on the black experience and race relations after the general emancipation, in the age of segregation, during the Civil Rights Movement, and in the post-civil rights era. Instructor: Gavins. 3 units.

330S. Selected Topics in Brazilian History. Instructor: French. 3 units. C-L: History 330S.

391. Special Topics. Topics vary from semester to semester. Instructor: Staff. 3 units.

399. Special Readings. Consent of instructor required. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

261. Islam in the African-American Experience

264S. Poverty and Social Policy: Life Course Human Resource Development

Art and Art History (ARTHIST)

Professor Powell, *Chair* (112A East Duke Building); Associate Professor Van Miegroet, *Director of Graduate Studies* (111B East Duke); Professors Bruzelius, Leighten, and Wharton; Associate Professors Antliff, Rice, and Stiles; Assistant Professors Abe, and Weisenfeld; Professor Emeritus Markman; Adjunct Professor Mezzatesta; Adjunct Assistant Professors Schroder and Schroth

The Department of Art and Art History offers graduate work leading to the Ph.D. degree in art history. The doctoral program in the history of art is competitive with the leading art history programs in the country. It is distinctive in its size and funding pattern, academic goals, and faculty interests. We are committed to full and equal funding of our students, despite their different and individualized curricula, teaching, or workloads during their residence at Duke. In addition, admission to the program is at present limited to three new students per year. We seek to maintain a critical mass of around ten students.

The Ph.D. program in the history of art has connected itself proactively with the many interdisciplinary, theoretical, and international initiatives in the humanities at Duke. The doctoral program is distinguished by its flexibility and cross-disciplinarity. It requires a thorough grounding in the formal and iconographic aspects of artworks, monuments, and visual culture, as well as in their theoretical, historical, and socioeconomic contexts. Course work has been designed to prepare students for careers in art and architectural criticism, research and teaching in the academy, museum, and art gallery. Faculty in the program cover the broad range of periods of art history, as

well as including more contemporary topics, such as cyberculture and hypermedia. Concurrent with their work toward a Ph.D., students may satisfy the requirements for a certificate of museology.

Students are required to have demonstrated their ability to read German and at least one other foreign language relevant to their chosen area of research before taking their preliminary examination. For further information on the program, prospective applicants may write to the director of graduate studies.

For Seniors and Graduates

202S. Topics in Roman Art. Selected topics in the art and architecture of late republican and imperial Rome. Subject varies from year to year. Consent of instructor required. Instructor: Staff. 3 units. C-L: Classical Studies 227S.

203A. Student-Curated Exhibition I. Preparation and execution of an exhibition in the Duke Museum of Art by a small group of Art History majors; selection of theme and works, planning, and execution of all aspects of the exhibition including the writing of text labels and catalogue. Two semester sequence. Prerequisites: status as Art History major and consent of instructor. Instructor: Staff. 3 units.

203B. Student-Curated Exhibition II. Continuation of Art History 203A. Prerequisites: status as Art History major and consent of instructor. Instructor: Staff. 3 units.

205S. Greek Architecture. 3 units. C-L: Classical Studies 233S.

217. Islam and Islamic Art in India. 3 units. C-L: Religion 217.

218S. Topics in Islamic Architecture and Art. Subject varies from year to year. Consent of instructor required. Instructor: Staff. 3 units.

227S. Roman Painting. 3 units. C-L: Classical Studies 236S.

236S. Topics in Romanesque and Gothic Art and Architecture. Analysis of an individual topic. Subject varies from year to year. Consent of instructor required. Instructor: Bruzelius. 3 units. C-L: Medieval and Renaissance Studies 237S.

237S. Greek Painting. 3 units. C-L: Classical Studies 232S.

238S. Greek Sculpture. 3 units. C-L: Classical Studies 231S.

241. History of Netherlandish Art and Visual Culture in a European Context. A contextual study of visual culture in the Greater Netherlands and its underlying historical and socioeconomic assumptions from the late medieval to early modern period, through immediate contact with urban cultures, such as Amsterdam, Leiden, Utrecht, Brussels, Ghent, Bruges, and Antwerp. Includes daily visits to major museums, buildings, and sites; hands-on research in various collections; discussion sessions with leading scholars in the field; and a critical introduction to various research strategies. (Taught in the Netherlands.) Not open to students who have taken Art History 158-159. Course credit contingent upon completion of Art History 242. Instructor: Van Miegroet. 3 units. C-L: Medieval and Renaissance Studies 241.

242. History of Netherlandish Art and Visual Culture in a European Context. Second half of Art History 241-242; required for credit for 241. (Taught in the Netherlands.) Not open to students who have taken Art History 158-159. Instructor: Van Miegroet. 3 units.

243S. Topics in Netherlandish and German Art. Specific problems in northern Renaissance or baroque art such as the Antwerp workshops of the sixteenth century or a critical introduction to major artists such as Van Eyck, Bosch, Dürer, and Rubens. An analytical approach to their lives, methods, atelier procedures and followers; drawings and connoisseurship problems; cultural, literary, social, and economic context; documentary and scientific research strategies. Subject varies from year to year. Consent of instructor required. Instructor: Van Miegroet. 3 units. C-L: Medieval and Renaissance Studies 243S.

247S. Topics in Italian Renaissance Art. Topics in art and/or architecture from c. 1300 to c. 1600. Subject varies from year to year. Consent of instructor required. Instructor: Rice. 3 units. C-L: Medieval and Renaissance Studies 248S.

256S. Inventing the Museum: Collecting and Cultural Discourses of the Nineteenth Century. 3 units. C-L: German 256S.

257S. Topics in Pre-Columbian Art and Culture. Selected topics in pre-Columbian art and archaeology with an emphasis on the political and cultural context of the artifact. Subject varies from year to year. Consent of instructor required. Instructor: Staff. 3 units.

268S. Black Visual Theory. Approaches to studying and theorizing African diasporal arts and black subjectivity in art historiography, iconology, and criticism, with focus on slavery, emancipation, freedom, cultural nationalism, as pertaining to peoples of African descent and as manifested in visual forms. Paintings, sculptures, graphics, and media arts from the early modern period to the present; the political edicts, philosophical tracts, autobiographies, and theoretical writings of individuals similarly preoccupied with these ideas. Instructor: Powell. 3 units.

269S. Harlem Renaissance. The art and culture that was produced by and about African Americans (largely in the western metropolises) during the period roughly between the two world wars. Chronological overview, a focus on individual figures, and study of the criticism and creative writings of this period. Other topics include black migrations to urban centers, performance-as-a-visual-paradigm, racial and cultural primitivism, and an alternative, African American stream of early twentieth century visual modernism. Instructor: Powell. 3 units. C-L: African and African American Studies 269S.

270S. Topics in African Art. Specific problems of iconography, style, connoisseurship, or a particular art tradition in African art. Subject varies from year to year. Consent of instructor required. Instructor: Powell. 3 units. C-L: African and African American Studies 270S.

271S. Topics in Art of the United States. Selected topics from colonial times to 1945, with emphasis on major cultural issues, movements, works, and/or artists. Consent of instructor required. Instructor: Powell. 3 units.

272S. Topics in Chinese Art. Problems and issues in a specific period or genre of Chinese art. Specific focus varies from year to year. Instructor: Abe. 3 units.

274S. Topics in Japanese Art. Problems and issues in a specific period or genre of Japanese art. Specific focus varies from year to year. Consent of instructor required. Instructor: Weisenfeld. 3 units.

288. Special Topics. Subjects, areas, or themes that embrace a range of disciplines or art historical areas. Instructor: Staff. 3 units.

291. Independent Study/Special Problems in Art History. Individual research and reading in a field of special interest, under the supervision of a faculty member, resulting in a substantive paper or written report containing significant analysis and interpretation of a previously approved topic. Consent of instructor required. Instructor: Staff. 3 units.

292. Independent Study/Special Problems in Art History. See Art History 291. Consent of instructor required. Instructor: Staff. 3 units.

296S. Methodology of Art History. American and European art historical methodologies and theoretical perspectives through analysis of selected classic texts in the field. Art history's relation to other disciplines. The invention of art and the rise of the elite object in the eighteenth and nineteenth century to the death of art with its collapse into popular culture in the late twentieth. Instructor: Staff. 3 units.

297S. Topics in Art since 1945. Historical and critical principles applied to present-day artists and/or movements in all media since World War II. Consent of instructor required. Instructor: Stiles. 3 units.

299S. Critical Theory. Understanding of the visual arts in terms of the theoretical developments in other disciplines (for example, literature, women's studies, Marxism, and anthropology). Focus on the writings of theory-centered art historians and critics. Consent of instructor required. Instructor: Stiles or staff. 3 units.

For Graduates

300. Pedagogy in Art History. Instruction and practice in the teaching of art history. Credit/no credit grading only. Instructor: Staff. 0 units.

301. Museum Studies. Introduction to the organization and functions of the museum in preparation for the presentation of a student-organized exhibition. Most of the semester spent in independent study researching scholarly, critical essays for the catalog. Instructor: Mezzatesta. 3 units.

302. Museum Studies. Completion of research and preparation of the catalog. Students actively participate in catalog design and production, and will be responsible for planning and installing the exhibition as well as interpreting it to the public through lectures and tours. Instructor: Mezzatesta. 3 units.

364. Primitivism, Art, and Culture. Seminar studies issues of primitivism in western culture, considering attitudes towards race and gender. Particular attention to the function of primitivism within modernist discourse—especially as regards such major figures as Gauguin, Matisse, and Picasso; and critical evaluations of the concept of primitivism in the fields of anthropology, literary criticism, cultural geography, and social history. Consent of instructor required. Instructor: Leighten. 3 units.

365. Italian Futurism. Seminar investigates the development of the futurist movement from its beginnings in 1909 through the 1920s. Studies the art of futurist painters Umberto Boccioni, Carlo Carrá, and Gino Severini in tandem with that of literary figures such as F. T. Marinetti, Ardengo Soffici, and Giovanni Papini. Special attention given to interdisciplinary debates over the role of futurism in the pre- and postwar development of fascism in Italy, as well as the relation of futurism to other European movements. Consent of instructor required. Instructor: Antliff. 3 units.

366. British Modernism in the Early Twentieth Century. A seminar focusing on the development of modernism in England, from the creation of a British fauvist movement in 1910 to the advent of vorticism during World War I. Topics include Roger Fry and the Omega Workshops, J. D. Fergusson and the British fauvists, the vorticism of Wyndham Lewis, Jacob Epstein and Henri Gaudier-Brzeska, and the criticism of vorticists T. E. Hulme and Ezra Pound. These movements studied in the light of political ideology, literary theory, and gender studies. Consent of instructor required. Instructor: Antliff. 3 units.

367. Cubism and Cultural Politics. Seminar studies the cubist movement in pre-World War I Paris, considering art theory and production within the matrix of cultural politics and current critical debates in the field. Focus on significant figures including Georges Braque, Robert and Sonia Delaunay, Marcel Duchamp, Raymond Duchamp-Villon, Albert Gleizes, Juan Gris, Marie Laurenein, Henri Le Fauconnier, Fernand Lèger, Jean Metzinger, Pablo Picasso, and others. Consent of instructor required. Instructor: Antliff or Leighten. 3 units.

368. Anarchism and Modernist Art. Studies the anarchist theories of Proudhon, Bakunin, Kropotkin, Reclus, Stimer, and others as they relate to the art of Courbet, Seurat, Signac, Pissarro, Cézanne, Kupka, Kandinsky, Picasso, Severini, and other artists involved in anarchist discourse. Attention paid to current interest in anarchism as an alternative to various forms of marxism within contemporary theoretical debate. Consent of instructor required. Instructor: Antliff or Leighten. 3 units.

369. Modernism and Cultural Politics. Issues of politics and art of the modernist period in Europe, focusing on movements significantly involved with and influenced

by political thought and activism—from anarchism and marxism to nationalism, neo-catholicism, royalism, and fascism—and/or subject to recent politicized art historical interpretation. Topics may include the neo-impressionism; symbolism; catalanisme and the early Picasso; fauvism; primitivism, cubism; futurism; purism; the Bauhaus; deStijl; Russian avant-gardism; dada; and surrealism. Consent of instructor required. Instructor: Antliff or Leighten. 3 units.

370. Art of the Courts in Thirteenth- and Fourteenth-Century Europe. Examination of the major courts of Europe in France, England, Germany, and Italy to study the development of court culture and the relationships and exchanges between the different courts through marriage alliances, exchanges of presents, and shifts in taste and style. Focus on the courts of Louis IX in France, Henry III and Edward II in England, and the court of Naples from 1266 onwards. Topics include patterns of spirituality, family relationships, and the role of women and books. Instructor: Bruzelius. 3 units.

371. Art and Culture in the Angevin Kingdom of Naples. A seminar on the importation of French culture to Italy after the conquest of Charles of Anjou in 1266. Focus on the shift within the Kingdom of Naples from models and styles derived from northern Europe to a focus on the environment of Rome, Tuscany, and the Mediterranean basin by the end of the thirteenth century. Topics include patterns of patronage, the production of books and manuscripts, the construction of civic and religious monuments, tomb sculpture, and city planning. Instructor: Bruzelius. 3 units.

372. Western Monasticism and Its Buildings. The development of monastic planning and space within the western tradition. The concept of the cloister and its position, the disposition of utilitarian buildings, and the relationships between decoration (painting, sculpture) and spiritual life; the rejection of the enclosed monastic life as a result of the founding of the mendicant orders. The monastic life and its spaces for men were reinforced for women with new types of regulations on barriers, grills, and access to the lay public and the sacraments, a process that for the Middle Ages culminates with the bull *Pericoloso* of Boniface VIII in 1297. Instructor: Bruzelius. 3 units.

373. Art and Allegory. Allegory is a symbolic mode of representation in which the thing figured is a metaphor for the thing signified; it is a system of encoding meaning, by which ideas or concepts, usually abstract in nature, are given material form. Exploration of the range and diversity of allegorical representation in the visual arts. Examination of the tools and methods of iconographic analysis, levels of symbolic language, problems of intention and interpretation, and the conceptual basis of allegory from antiquity through the baroque. Focus on the interactions between visual and literary forms of allegory. Instructor: Rice. 3 units.

374. Print Culture in Early Modern Europe. Investigation of the cultural impact of the printed image from its emergence around 1400 to the end of the eighteenth century, and exploration of the implications of print technology for the transmission of ideas in the era before photography. Topics include print collecting and the growth of the print industry; artistic innovation and the invention of new genres; prints and the world of knowledge; prints and propaganda; and the role of the reproductive print in the history of art history. Instructor: Rice. 3 units.

375. Landscape and Memory in the Later Middle Ages. A series of studies involving evidence both visual and verbal that reconstruct and assess the nature and significance of the *mis-en-scene* of late medieval life in both the country and the city. Topics include planning traditions, public monuments and public works, streets and thoroughfares, gardens and agriculture, and range from the medieval West to the Byzantine and Muslim worlds. Instructor: Staff. 3 units.

376. Through a Glass Diasporally: Photography, Film, and Video. This seminar examines photographic, cinematic, and other mass media images of people of African descent as a means of exploring questions that have recently been asked about racial and

cultural identities in the "black Atlantic," the "burden" of racial representations; and art produced during this era of "mechanical reproduction." Focus on images of blacks as seen in ethnographic, documentary, and fine art photography; silent and sound film; and broadcast television and video art, past and present, by both black and nonblack artists, along with assorted critical writings about mass media images of blacks. Instructor: Powell. 3 units.

377. Performing Gender/Exhibiting Race. Studying the intersections of race and gender in art since 1945 invites a host of visual subjects and methodological strategies. This seminar examines works by artists like Barkely Hendricks, David Hammons, Adrian Piper, Jean-Michel Basquiat, Faith Ringgold, and Kara Walker, and traces the theorizing of gender and race through historical documents and contemporary writings. Instructor: Powell. 3 units.

378. Outsiders and Insiders. An exploration of the phenomenon in Europe and the Americas during the nineteenth and twentieth centuries, when critics began to differentiate between art from learned, civilized communities and art from an uneducated, barbaric population. From the *Beaux-Arts* and *Völkerkunde*, to the debates surrounding primitivism, modernism, and popular culture. An examination of the idea of an art hierarchy and other concepts of artistic outsiders and insiders from a variety of positions, taking into account nationality, class, literacy, economics, race, and gender in the categorization and evaluation of art. Instructor: Powell. 3 units.

379. Fascism East and West: The Visual Culture of Japan, Germany, and Italy. Through a close analysis of cultural production and aesthetics, this course examines the relationship between the politics of fascism and its symbolic practices; how forms of rituals, myths, and images played a crucial role in the formation of the fascist regime's self-identity, and the formation of the national fascist subject. Materials include painting, sculpture, architecture, photography, graphic design, mass media, film, and forms of public spectacle and pageantry. Instructor: Weisenfeld. 3 units.

380. Art and Markets. New research that negotiates various possibilities in reuniting ideas, theories, and reception codes, different from those we currently identify. Various scenarios generated will focus on unexpected interplays between images and audiences within their local, timely, and particular socioeconomic frame. Instructor: De Marchi and Van Miegroet. 3 units.

381. Destinations. Consideration of architectures of play, escape, and healing. History and physical form of sites from antiquity to the present (for example, the Roman and Byzantine spa at Hieropolis, the pilgrimage shrine at Lourdes; DisneyWorld) studied through primary sources and theoretical texts. Instructor: Wharton. 3 units. C-L: Religion 381.

382. Architectural Otherness. Consideration of the space of communities disempowered and marginalized because of race, class, religion, or gender, and historical understanding of how structures or sites represent the groups who produce and destroy them, offer resistance to the dominant culture, and mark the repression of alterity. Theorists and architectural critics (Lefebvre, Foucault, Habermas, Tafuri, Vidler) provide a shared frame for students' work on particular spaces ranging from the vacant Temple Mount in Christian Jerusalem to the touristic presentation of destroyed Iraqi tanks in Kuwait, from little Cairo at the Chicago Columbian Exposition to the shelter of the street person in Durham. Instructor: Wharton. 3 units.

383. Art and Text. This seminar concerns ekphrasis, the problem of using verbal representation to describe visual representation. Study of the interrelation between artists' theoretical writings and visual productions. Students may work on art and texts in all traditional and experimental visual art media, as well as in photography, video, film, and electronic multimedia. Instructor: Stiles. 3 units.

384. Art and Memory. Art can be a form for the remembrance, construction, recapit-

ulation, and visualization of memory. This seminar considers theories of memory, cognition and perception, traumatic memory, dissociation, and recovered memory, flashbulb memory, as well as eidetic and other anomalous forms of memory as they are displayed in all traditional and experimental visual art media, including photography, video, film, and electronic multimedia. Instructor: Stiles. 3 units.

385. Art, Violence, and Taboo. Art provides an unparalleled liminal space for the presentation and representation of violence, destruction, sadism, masochism, and other breaches of moral code otherwise controlled and legislated against in civil society. This seminar considers theories and practices of violence and taboo, and students may work on this subject in all traditional and experimental visual art media, including photography, video, film, and electronic multimedia. Instructor: Stiles. 3 units.

386. Fascism, Art, and Ideology. A study of the cultural politics of European fascism, from its origins in the synthesis of nationalism and socialism before World War I, to its final eclipse in 1945. Analysis of art and architecture in Britain, France, Italy, and Germany in terms of contemporary debates over what constituted a fascist aesthetic. Consideration of the art and writing of the symbolists, futurists, vorticists, La Corbusier, German expressionists, and various German and Italian realists in light of theories of fascism. Instructor: Antliff. 3 units.

387. Art History and Representation. Seminar in the production of art history through various forms of representation, broadly construed, with special attention to issues of aesthetics, social context, historical location, and enunciative position. Consideration of practices of collecting, translation, display, and knowledge formation in order to explore the heterogeneous genealogy of art history. Instructor: Abe. 3 units.

388. Topics in Modern and Postmodern Architecture. The study of particular architects, movements, or building genres in their conceptual and political contexts. Subject varies from year to year. Instructor: Wharton. 3 units.

391. Individual Research in Art History. Directed research and writing in areas unrepresented by regular course offerings. Consent of instructor required. Instructor: Staff. 3 units.

392. Individual Research in Art History. Directed research and writing in areas unrepresented by regular course offerings. Consent of instructor required. Instructor: Staff. 3 units.

393. Colloquium in the History of Art. Topics of interest to art historians in every field, including "The Question of Originality," "Implications of the Frame (or its absence)," and "Art and Economy: The Impact of the Market on Visual Production." Faculty and students participate in the forum. Consent of instructor required. Instructor: Staff. 3 units.

394. Graduate Symposium. Graduate students deliver major research papers to their peers, faculty, and interested visitors. A one-day event organized by participating graduate students, supervised by a student-faculty committee, and scheduled annually sometime in April. Consent of instructor required. Instructor: Staff. 3 units.

395. Topics in Art History. In-depth consideration of a specific art historical problem of a formal, historical, or conceptual nature. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

201S. Topics in Greek Art

233S. Topics in Early Christian and Byzantine Art

244A. International Expressionism

244B. International Modernism

260S. Topics in Italian Baroque Art

265S. Topics in Nineteenth-Century Art

283S. Topics in Modern Art

298S. Topics in Modern and Postmodern Architecture

Asian and African Languages and Literature Studies (AALL)

Associate Professor Wang, *Chair*; Professor Cooke; Associate Professor of the Practice Khanna; Assistant Professors Ching, Yoda, and Zakim; Assistant Professors of the Practice Cornell, Endo, Kim, and Lee; Instructors Mutima, Uno, and Soo-Hoo; Lecturers Natavar and Yao-Lahusen. Affiliated faculty: Professor Lawrence (religion); Assistant Professors Cornell (religion), Jonassaint (Romance studies), and Nickerson (religion)

Courses in the following languages are taught currently and regularly in Asian and African languages and literature: Arabic, Chinese, modern Hebrew, Hindi, Japanese, Korean, and Swahili. In addition, courses in Persian are taught on an irregular basis. Some of the literature courses are taught in English translation.

The curriculum in Asian and African languages and literature (AALL) is based on intellectual perspectives that examine contemporary national and ethnic cultures of Asia and Africa within a global context. The mission of AALL is twofold: to equip students with advanced language proficiency in preparation for academic or career goals, and secondly, to foster a view of literature and culture at once indigenous and global, informed by local histories of internal development as well as by theories of cross-cultural influence. AALL has a faculty of nineteen whose interests range from language pedagogy to film, modernism, war and gender, colonialism and postcolonialism, and popular culture.

AALL's core courses and literature courses address such diverse topics as self and others, popular culture, rethinking the sixties, psychoanalysis and culture, war and women's literature, and the cultural politics of censorship. For a detailed listing of full course offerings, see the Asian and African Languages and Literature section in the Bulletin of Duke University: Undergraduate Instruction or contact our web site at www.duke.edu/web/aall.

ASIAN AND AFRICAN LANGUAGES AND LITERATURE

200S. Seminar in Asian and African Cultural Studies. Concentration on a theoretical problem or set of issues germane to the study of Asian and African cultures. Instructor: Staff. 3 units. C-L: African and African American Studies 200S, Cultural Anthropology 288S, Literature 200S.

205. Asian and African Languages and Literature. Graduate credit for a course in any of the following languages: Arabic, Chinese, Hebrew, Hindi, Korean, Persian, Swahili. Instructor: Staff. 3 units.

206. Asian and African Languages and Literature. Graduate credit for a course in any of the following languages: Arabic, Chinese, Hebrew, Hindi, Korean, Persian, Swahili. Prerequisite: Asian and African Languages and Literature 205. Instructor: Staff. 3 units.

250S. Chinese Modernism in Post-Mao Era. Mainland Chinese aesthetic modernity in the 1980s and 1990s examined through the study of narrative fiction and films. (Same as Asian and African Languages and Literature 150S but requires extra assignments.) Research paper required. Instructor: Wang. 3 units.

252. Special Topics in Asian and African Literature. Topics vary each semester. Instructor: Staff. 3 units.

253. East Asian Cultural Studies. East Asia as a historical and geographical category of knowledge emerging within the various processes of global movements

(imperialism, colonialism, economic regionalism). (Same as Asian and African Languages and Literature 153 but requires extra assignments.) Instructor: Ching or Yoda. 3 units. C-L: Cultural Anthropology 254.

262. Modern Japanese Literature and Culture. An examination of modern Japanese culture through a variety of media including literary texts, cultural representations, and films. Different material each year; may be repeated for credit. (Same as Asian and African Languages and Literature 162 but requires extra assignments.) Instructor: Ching or Yoda. 3 units. C-L: Cultural Anthropology 260.

280S. Intellectuals/Culture/History: Modern China in Transition. Debates over politics, ideology, high culture, and popular culture in China since the 1920s. Topics include: Marxism, the Cultural Revolution; the modernist narratives of 'world history'; the postmodern turn of debunking universal history; the 1990s' resurgence of Mao Zedong fever; the Chinese search for modernity; the revival of neo-nationalism and new conservatism; and state sponsorship and the new meanings of 'culture as leisure.' (Same as Asian and African Languages and Literature 180S but requires extra assignments.) Research paper required. Instructor: Staff. 3 units.

288S. Seminar on Modern Chinese Cinema. Films, documentaries, television series, and soap operas produced in mainland China in the post-Mao era. Topics include the history and aesthetics of the cinema, soap operas as the new forum for public debates on popular culture, the emerging film criticism in China, the relationship of politics and form in postrevolutionary aesthetics. (Same as Chinese 188S but requires extra assignments.) Research paper required. Prerequisite: Chinese 184S or advanced oral and written proficiency in Mandarin Chinese. Instructor: Wang. 3 units.

COURSES CURRENTLY UNSCHEDULED

203S. Gender and War

259. The Bestseller: Cultural Populism in the 1990s' China

HINDI (HINDI)

COURSES CURRENTLY UNSCHEDULED

200. Special Studies in South Asian Languages

201. Special Studies in South Asian Languages

JAPANESE (JPN)

205S. Seminar in Japanese. Topics vary each semester. Prerequisite: Japanese 184 or equivalent. Instructor: Yoda. 3 units.

206S. Seminar in Japanese. Topics vary each semester. Prerequisite: Japanese 184 or equivalent. Instructor: Yoda. 3 units.

291. Research Methods in Japanese. Introduction to various research approaches to literary, sociological, and historical studies of Japan. Emphasis on bibliographical sources that best serve needs in chosen area of specialization. Consent of instructor required. Instructor: Staff. 3 units. C-L: Cultural Anthropology 290, History 292, Political Science 291, Sociology 291.

Biochemistry (BIOCHEM)

Professor Raetz, *Chair* (255 Nanaline H. Duke); Associate Professor Oas, *Director of Graduate Studies* (436 Nanaline H. Duke); Professors Bennett, Greenleaf, Hammes, Hill, Hsieh, Kredich, Lefkowitz, Modrich, Rajagopalan, D. Richardson, J. Richardson, Siegel, Simon, Spicer, Stampler, Steege, and Webster; Associate Professors Been, Beese, Casey, Greene, Hellinga, R. Kaufman, and Toone; Assistant Professors Gewirth, Hershfield, Kuehn, Rudolph, and York; Professors Emeriti Bernheim, Fridovich, Gross, Guild, B. Kaufman, Kirshner, McCarty, and Sage; Adjunct Professors Bell and Blackshear

Graduate work in the Department of Biochemistry is offered leading to the Ph.D. degree. Preparation for such graduate study may take diverse forms. Undergraduate majors in chemistry, biology, mathematics, or physics are welcome, but adequate preparation in chemistry is essential. Graduate specialization areas include protein structure and function, crystallography and NMR of macromolecules, nucleic acid structure and function, lipid biochemistry, membrane structure and function, molecular genetics, and enzyme mechanisms. The recommended core requirements consist of courses 258, 259, and 268 (or equivalent training) and additional courses in the area of specialization. The Biochemistry Department, in cooperation with the University Programs in Genetics, Cell and Molecular Biology, Molecular Biophysics, and Biological Chemistry, offers biochemistry students the opportunity to pursue advanced research and study to fulfill the requirements for the Ph.D. degree related to these fields.

200. General Biochemistry. An introductory survey of fundamental aspects of biochemistry with emphasis on the structure of macromolecules, mechanism of enzyme action, metabolic pathways, biochemical genetics, and the structure and functions of special tissues. Designed for medical students; graduate students only with consent of instructor. Instructor: Staff. 4 units.

210. Independent Study. Designed for students interested in either a laboratory or a library project in biochemistry. One course for undergraduate students. One to twelve units for graduate students. Instructor: Staff

222. Structure of Biological Macromolecules. Computer graphics intensive study of some of the biological macromolecules whose three-dimensional structures have been determined at high resolution. Emphasis on the patterns and determinants of protein structure. Two-hour discussion session each week along with computer-based lessons and projects. Instructors: D. Richardson and J. Richardson. 2 units. C-L: Molecular Biophysics 222.

227. Introductory Biochemistry I: Intermediary Metabolism. Chemistry of the constituents of proteins, lipids, carbohydrates, and nucleic acids and their metabolic interrelationships. Prerequisite: two semesters of organic chemistry. Instructors: Hill and staff. 3 units.

228. Introductory Biochemistry II. Structure, function, and biosynthesis of biological macromolecules and regulation of their synthesis. Intermediary metabolism and metabolic utilization of energy. Biochemistry of biological membranes, receptors, and signal transduction via membrane receptors. Prerequisite: organic chemistry and Biochemistry 227. Instructors: Webster and staff. 3 units.

258. Structural Biochemistry I. Principles of modern structural biology. Protein-nucleic acid recognition, enzymatic reactions, viruses, immunoglobulins, signal transduction, and structure-based drug design described in terms of the atomic properties of biological macromolecules. Discussion of methods of structure determination with particular emphasis on macromolecular X-ray crystallography NMR methods, homology modeling, and bioinformatics. Students use molecular graphics tutorials and Internet databases to view and analyze structures. Prerequisites: organic chemistry and introductory biochemistry. Instructors: Beese and staff. 2 units. C-L: Cell Biology 258, Cell and Molecular Biology 258, University Program in Genetics 258, Immunology 258, Microbiology 258, Molecular Biophysics 258.

259. Structural Biochemistry II. Continuation of Biochemistry 258. Structure/function analysis of proteins as enzymes, multiple ligand binding, protein folding and stability, allostery, protein-protein interactions. Prerequisites: Biochemistry 258, organic chemistry, physical chemistry, and introductory biochemistry. Instructors: Hellinga and staff. 2 units. C-L: Cell Biology 259, University Program in Genetics 259, Immunology 259, Microbiology 259, Molecular Biophysics 259.

265S. Seminar. Topics and. Instructors announced each semester. 2 units or variable. Instructor: Staff. Variable credit.

266S. Biochemistry Seminar. Topics and. Instructors announced each semester. 2 units or variable. Instructor: Staff. Variable credit.

268. Nucleic Acids. Biochemistry of nucleic acids, with emphasis on their chemistry, structure, metabolism, and biological function in information transfer. Prerequisites: introductory biochemistry and equivalents of Biochemistry 258 and 259 and Cell and Molecular Biology 247 and 278. Instructors: Steege and staff. 3 units. C-L: Cell Biology 268, University Program in Genetics 268, Immunology 268, Microbiology 268.

270. Mechanistic Enzymology. Enzyme kinetics, enzyme mechanisms, and the experimental techniques of enzymology using selected important and well-characterized enzymes. Systems covered include proteases, kinases, carbon-carbon bond forming enzymes, as well as enzymes containing the cofactors pyridoxal phosphate, thiamin pyrophosphate, biotin, and flavins. Readings will come from the classical and current literature. Instructors: Rudolph and staff. 2 units.

291. Physical Biochemistry. Basic principles of physical chemistry as applied to biological systems. Topics include thermodynamics, kinetics, statistical mechanics, spectroscopy, and diffraction theory. Concepts discussed in the context of the biochemistry and behavior of biological macromolecules. Emphasis on quantitative understanding of biochemical phenomena, with extensive problem solving as an instructive tool. Prerequisite: undergraduate physical chemistry and one year of calculus. Instructors: Oas and staff. 3 units. C-L: Molecular Biophysics 291.

345. Biochemistry Seminar. Required of all second- and third-year biochemistry students. Credit/no credit grading only. Instructor: Staff. 1 unit.

346. Biochemistry Seminar. Required of all second- and third-year biochemistry students. Credit/no credit grading only. Instructor: Staff. 1 unit.

417. Cellular Signaling. Mechanism of action of hormones at the cellular level including hormone-receptor interactions, secondary messenger systems for hormones, mechanisms of regulation of hormone responsiveness, regulation of growth, differentiation and proliferation, mechanisms of transport and ion channels, stimulus sensing and transduction. Some lectures stress the clinical correlation of the basic course concepts. Instructors: Caron, Casey, Means, and invited lecturers. 3 units. C-L: Cell Biology 417, Molecular Cancer Biology 417, Pharmacology 417.

Biological Anthropology and Anatomy (BAA)

Professor Kay, *Chair* (267 Sands); Professor Smith, *Director of Graduate Studies* (270 Sands); Professors Cartmill, Glander, Hylander, Simons, Terborgh, and Van Schaik; Associate Professor Roth; Assistant Professors Bassett, Churchill, Drea, Pope, and Schmitt; Adjunct Associate Professor Wright

Admission to the Ph.D. program in biological anthropology and anatomy is not contingent on any particular course of study at the undergraduate level. The goal of the graduate program is to provide students with a broad-based background in organismal biology with which to study the behavior, ecology, and evolution of primates. The three general areas of specialization in the department are: (1) behavior, ecology, and genetics; (2) paleontology, systematics, and evolution; and (3) functional, comparative, and developmental morphology. Students are encouraged to define a course of study that crosses these boundaries and that extends beyond the strict limits of primatology. Research opportunities include behavioral research at the Duke University Primate Center; ecological and behavioral fieldwork in Africa, South America, Asia, and Madagascar; paleontological fieldwork in Africa, South America, North America, and Madagascar; and laboratories in experimental functional morphology and comparative embryology.

Courses of study are tailored to meet individual needs, but all students will be expected to take gross human anatomy, a course in statistics and experimental design, and at least one course in each of the subfields of the department.

Students are required to demonstrate a reading knowledge of at least one language other than English.

For more information, visit the departmental web site at <http://www.baa.duke.edu>, or send email to graduate_studies@baa.mc.duke.edu.

238S. Functional and Evolutionary Morphology of Primates. History and functional significance of locomotor and feeding adaptations, craniofacial morphology, sense organs, and reproductive systems in primates, including *Homo sapiens*. Consent of instructor required. Prerequisite: Biological Anthropology and Anatomy 172L or equivalent. Instructor: Cartmill, Kay, or staff. 3 units.

240S. Hominid Socioecology. Analysis of how socioecological studies of human foragers and nonhuman primates can inform the interpretation of the hominid fossil/archaeological record. Summary of documented historical changes during hominid evolution, and identification of approaches required to develop testable reconstructions. Models for the evolution in hominids of bipedalism, ranging and foraging, hunting, food sharing, intersexual relationships and sexual division of labor, communication (including language), culture, technology, life history, parental care, and social organization, as well as their mutual relationships. Prerequisite: Biological Anthropology and Anatomy 93(D) or 132. Instructor: van Schaik. 3 units.

244LS. Comparative Primate Ecology. Comparisons of the evolutionary ecology of prosimians, monkeys, and apes. Field methods. Prerequisite: Biological Anthropology and Anatomy 93; Biological Anthropology and Anatomy 143 recommended. Instructor: Glander. 3 units.

245S. Primate Social Evolution. Ecological determinants of, and biological constraints on, social strategies and systems, with an emphasis on primates. Prerequisite: Biological Anthropology and Anatomy 93; 143, 144L, or 146; or consent of instructor. Instructor: van Schaik. 3 units.

246. The Primate Fossil Record. A survey of fossil primates including early humans. The diversity, anatomy, and behavior of primates as related to the origin and spread of past primates. The radiation of each main group of primates in the succession leading to humans illustrated with slides, casts, and fossils. Topics include geochemical dating, timing of molecular clocks, and various procedures for classifying primates. Prerequisite: Biological Anthropology and Anatomy 93 or consent of instructor. Instructor: Simons. 3 units.

247. The Hominid Fossil Record. Origin and successive stages of development of human ancestors. Detailed analysis of adaptive types and cultural developments. Personalities and current controversies in the study of hominid paleontology. Prerequisite: Biological Anthropology and Anatomy 93, 132, or consent of instructor. Instructor: Simons. 3 units.

249S. Microevolution and Sociobiology. The relationship between resource distribution, social structure, and rate and direction of evolutionary change, including speciation. Mating systems, dispersal patterns, and mechanisms of new social group formation examined from the perspective of their effects on the genetic structure of populations and species radiations. Prerequisite: Biological Anthropology and Anatomy 93 or Biology 25L; Biology 120 recommended. Instructor: Pope. 3 units.

250. Biometry. A practically oriented overview of the statistical analysis of biological data. Topics include data collection and experimental design, methods and techniques of data organization, use of computing programs and packages, applications of appropriate parametric and nonparametric statistical techniques, assumptions and problems encountered with biological data analysis, and interpretation of results. Pre-

requisite: Mathematics 136, Psychology 117, Sociology 133, Statistics 10D, 110, 112, 114, 213, or equivalent, and consent of instructor required. Instructor: Staff. 3 units.

280L. Special Topics Laboratory. Special topics in methodology, theory, or area. Consent of instructor required. Instructor: Staff. 3 units.

280S. Seminar in Selected Topics. Special topics in methodology, theory, or area. Consent of instructor required. Instructor: Staff. 3 units.

281L. Special Topics Laboratory. Special topics in methodology, theory, or area. Consent of instructor required. Instructor: Staff. 3 units.

281S. Seminar in Selected Topics. Special topics in methodology, theory, or area. Consent of instructor required. Instructor: Staff. 3 units.

287S. Macroevolution. Evolutionary patterns and processes at and above the species level; species concepts, speciation, diversification, extinction, ontogeny and phylogeny, rates of evolution, and alternative explanations for adaptation and evolutionary trends. Prerequisite: Biology 25L, 31L, or 32L or other course in plant or animal diversity; recommended, Biology 120 or equivalent. Instructor: Roth. 3 units. C-L: Biology 287S.

289L. Comparative Mammalian Anatomy. A practical survey of anatomical diversity in mammals. An emphasis on dissections of a broad variety of mammals. A broader perspective on specific anatomical features provided in the lectures. Consent of instructor required. Instructor: Staff. 3 units.

290. Pattern and Process in Vertebrate Development. Research results on developmental processes applied to classic problems of comparative vertebrate biology. Specific focus to vary, but to include cell differentiation and migration, induction, cell-cell interaction and cell mechanics as well as craniofacial morphogenesis, development and evolution, developmental constraints and comparative embryology. Prerequisite: course in comparative or human anatomy and consent of instructor. Instructor: Smith. 3 units. C-L: Biology 290.

301. Anatomy of the Limbs. The musculoskeletal anatomy of the limbs and limb girdles. Emphasis is on detailed dissection of the extremities, with a minor focus on clinical applications. Course primarily intended for advanced graduate students in physical therapy. Consent of instructor required. Instructor: Staff. 1 to 3 units.

305. Gross Human Anatomy. Includes complete dissection of a cadaver; laboratory work is supplemented by conferences which emphasize biological and evolutionary aspects. Required of entering graduate students in anatomy; by arrangement, may extend into second semester. Prerequisites: adequate background in biology, including comparative anatomy and embryology and written Consent of instructor. Instructor: Staff. 3 units.

312. Research. Individual investigations in the various fields of biological anthropology and anatomy. Consent of instructor required. Credit to be arranged; maximum 6 units. Instructor: Staff. 1 to 6 units.

313. Anatomy Seminar. Regular meeting of graduate students and staff in which current research problems in anatomy will be presented. Instructor: Staff. 1 unit.

314. Biological Anthropology Seminar. Regular meeting of graduate students and staff in which current research problems in biological anthropology will be presented. Instructor: Staff. 1 unit.

334. Topics in Physical Anthropology. Instructor: Staff. 3 units.

340. Tutorial in Advanced Anatomy. Topics for intensive reading and discussion will be chosen according to the student's interests, related to basic problems in function of bone and muscle systems, development and differentiation, comparative anatomy at the gross and histological level and vertebrate evolution. Consent of instructor required. Instructor: Staff. 1 to 4 units.

354. Research in Biological Anthropology and Anatomy. A preceptorial course in various research methods in biological anthropology and anatomy. Consent of instructor required. Credit to be arranged. Instructor: Staff. 1 to 4 units.

393. Independent Study. Directed reading and research. Consent of instructor required. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

248S. Evolution of Mammals

292S. Topics in Morphology and Evolution

293. Evolutionary Theory

294. Evolutionary Theory

University Program in Biological Chemistry (BLC)

Michael Pirrung, Ph.D., *Director*; Eric Toone, Ph.D., *Director of Graduate Studies*

The University Program in Biological Chemistry is designed to provide training to students in synthetic and mechanistic aspects of the interface between chemistry and biology. Specializations include carbohydrate, lipid, nucleic acid, and protein synthesis; molecular recognition between biomolecules; and mechanisms of catalytic processes involving proteins and nucleic acids and their associated cofactors. Course offerings, including a core focusing on the synthesis of biological macromolecules and mechanisms of enzymatic cofactors, are aimed at providing significant cross-training between chemistry and biology and developing a common language among students in different disciplines. Intensive laboratory rotations begin in the fall and continue (in some cases) into the spring semesters of the first year of study. The research laboratories of program faculty are well funded and use state-of-the-art equipment for magnetic resonance, mass spectrometry, and computer graphics, among others.

The program offers a certificate of graduate studies, with the doctoral degree awarded by one of the three degree-granting departments. Prospective students may apply directly to the program or to one of the degree-granting departments (Chemistry, Biochemistry, Biology, Cell Biology). Students admitted to the University Program in Biological Chemistry have up to one year to affiliate with a degree program. For more information contact the director of graduate studies at University Program in Biological Chemistry, Duke University, Box 3567 DUMC, Durham, NC 27710 or at agw@biochem.duke.edu.

300. Case Studies in Drug Discovery. Recent projects from the pharmaceutical industry and literature. Prerequisite: Biochemistry 259. Instructor: Staff. 1 unit.

301S. Seminar in Biological Chemistry. Intensive independent study. Prerequisite: Chemistry 326. Instructor: Pirrung. 1 unit.

Biology (BIOLOGY)

Professors Barber, Brandon, Boynton, Christensen, Clark, Crowder, Forward, Gillham, Knoerr, Livingstone, McClay, Nicklas, F. Nijhout, Ramus, Rausher, Reynolds, Schlesinger, Siedow, Simons, Staddon, Terborgh, Tucker, Uyenoyama, Vilgalys, Vogel, White, and Wilbur; Associate Professors Dong, Fehon, Kohorn, Morris, Nowicki, Rittschof, Roth, Shaw, K. Smith, and Sun, Van Schaik, and Wray; Assistant Professors Alberts, Crenshaw, Cunningham, Jackson, Manos, McShea, and Wilson; Professors Emeriti Anderson, Bookhout, W. Culberson, Fluke, Gregg, Hellmers, Naylor, Schmidt-Nielsen, Stone, Strain, Wainwright, and Ward; Research Professors C. Culberson and Klopfer; Adjunct Professors Antonovics, DePriest, Funk, Hartshorn, Kress, Osmond, Peet, Rogers, Schmidt-Koenig, Swofford, Wagner, and Zimmer; Adjunct Associate Professors Lacey, and M. Nijhout; Adjunct Assistant Professor Wolfe; Associate Professor of the Practice Motten; Assistant Professor of the Practice Mercer

The Department of Biology offers a considerable variety in graduate programs leading to M.S. and Ph.D. degrees. Students in the department may specialize in a wide variety of areas including anatomy; animal behavior; animal physiology; cellular and molecular biology; community, ecosystem, physiological, and population ecology; evolution; functional morphology; developmental, ecological, molecular, organelle, and population genetics; marine biology, and the systematics of algae, fungi, lichens, bryophytes, ferns, and flowering plants.

There is a high level of interaction among the various areas of biology and other programs. Faculty members participate in the University Programs in Ecology, Genetics, Cellular and Molecular Biology, Integrative Biology, and Neurobiology; tropical research is facilitated through the University's membership in the Organization for Tropical Studies. There are also strong relationships with the departments of Biological Anthropology and Anatomy (primatology, phylogenetic systematics, macroevolution), Mathematics (theoretical biology), and Psychology (behavior); the Division of Earth and Ocean Sciences (limnology, paleontology); and the School of Engineering (biomechanics).

Students entering the program generally have a broad background in biological sciences supplemented with basic courses in chemistry, mathematics, and physics. Biochemistry and physical chemistry are strongly recommended for students interested in molecular areas, and advanced courses in mathematics are recommended for students in population genetics and ecology. While deficiencies may be corrected by taking appropriate courses during the first year of graduate study, it is advised that students search widely in both the *Bulletin of Duke University: Undergraduate Instruction* and the *Bulletin of Duke University: Graduate School* for information about the intellectual resources of the University. Special attention should be given to announcements of the departments listed above, as well as to those of Cultural Anthropology, History, Immunology, Microbiology, Pharmacology, Philosophy, and Sociology, and of the School of Engineering and the Nicholas School of the Environment.

201LS. Animal Behavior. Survey of past developments and current controversies in animal behavior. Extensive readings, followed by individual experimental or descriptive projects in the laboratory or field (or Primate Center). Recommended background: Biology 25L, Biology 151L, and statistics, or equivalents. Instructor: Alberts or Klopfer. 4 units.

201S. Animal Behavior. Nonlaboratory version of Biology 201L, S. Instructor: Alberts or Klopfer. 3 units.

203L. Marine Ecology. Factors that influence the distribution, abundance, and diversity of marine organisms. Course structure integrates lectures and field excursions. Topics include characteristics of marine habitats, adaptation to environment, species interactions, biogeography, larval recruitment, and communities found in rocky shores, tidal flats, beaches, mangrove, coral reefs, and subtidal areas. Not open to students who have taken Biology 203L. Open to undergraduates only under Biology 129L. (Given at Beaufort fall and summer and at Bermuda, spring.) Prerequisite: introductory biology. Instructors: Crowder or Kirby-Smith (Beaufort); Lipschultz, McKenna, and Smith (Bermuda). 4 units. C-L: Environment 219L, Marine Sciences.

206S. Controversies in Biology. A contentious theme for reading, discussion, and an individual or joint paper. Illustrative past topics: the nature of the creative process, causality in biological thought, the lack of political impact of many scientific developments. Open to nonmajors. Instructor: Klopfer. 3 units.

210L. Bryology and Peatland Ecology. Ecology, morphology, and systematics of mosses, liverworts, and hornworts. Emphasis on the identification of dominant species and on their habitat relationships. Special attention to peat mosses and the ecology of *Sphagnum*-dominated ecosystems. Involves a field trip during Fall break. Instructor: Shaw. 3 units.

211L. Microbial Ecology and Evolution. Survey of new advances in the field of environmental and evolutionary microbiology, based on current literature, discussion, and laboratory exercises. Topics to include bacterial phylogeny, molecular ecology, emerging infectious diseases, bacterial symbiosis, experimental evolution, evolution of drug resistance, and microbial genomics. Prerequisite: Biology 25L, 103L, 118, or consent of instructor. Instructor: Vilgalys. 4 units.

212LS. Phycology. Morphological and ecological characteristics of common freshwater and marine algae and principles of their classification. Instructor: Searles. 3 units.

213L. Behavioral Ecology. How ecological factors shape foraging, mating, aggressive, and social behavior. Laboratory experiments and field observations from the Outer Banks environment. Independent projects and seminars. Not open to undergraduates. (Given at Beaufort.) Prerequisite: introductory biology (Biology 25L). Instructor: Rubenstein (visiting summer faculty). 6 units. C-L: Environment 223L, Marine Sciences.

215. Tropical Ecology. 3 units. C-L: Environment 217.

216L. Limnology. Lakes, ponds, and streams; their origin, development, geochemistry, energy balance, productivity, and the dynamics of plant and animal communities. Laboratory includes field trips. Offered biennially. Prerequisite: Biology 25L, Chemistry 12L, Mathematics 32, and physics; or equivalents; or consent of instructor. Instructor: Livingstone. 4 units.

218L. Barrier Island Ecology. 4 units. C-L: Environment 218L, Marine Sciences.

219L. Coastal Ecosystem Processes. 3 units. C-L: Environment 224L, Marine Sciences.

220L. Mycology. Survey of the major groups of fungi with emphasis on life history and systematics. Field and laboratory exercises. Instructor: Vilgalys. 3 units.

221S. Topics in Advanced Mycology. Current research on fungal evolution, genetics, physiology, and ecology. Prerequisite: Biology 220L or consent of instructor. Instructor: Vilgalys. 3 units.

222L. Entomology. The biology of insects: diversity, development, physiology, and ecology. Field trips. Prerequisite: Biology 25L or equivalent. Instructor: H. Nijhout. 4 units.

229LS. Paleoecology. Global change over the last two million years. Prerequisite: two semesters of biology or geology; and one semester each of calculus, chemistry, and physics; or consent of instructors. Instructors: Clark and Livingstone. 3 units.

232. Microclimatology. 3 units. C-L: Environment 232.

234S. Problems in the Philosophy of Biology. 3 units. C-L: Philosophy 234S.

237L. Systematic Biology. Theory and practice of identification, species discovery, phylogeny reconstruction, classification, and nomenclature. Prerequisite: Biology 25L or equivalent. Instructor: Manos, Swofford, and Vilgalys. 3 units.

241L. Field Botany. Identification and recognition of the vascular flora of the Carolinas. Frequent field trips to representative habitats. Prerequisite: introductory plant identification course or consent of instructor. Instructor: Wilbur. 3 units.

242L. Field Botany of North Carolina's Wetlands. 3 units. C-L: Environment 237L.

243L. Evolution and Classification of Angiosperms. Characteristics and phylogenetic relationships of major flowering plant lineages. Emphasis on current literature, rigorous methods, modern controversies, and biological and biogeographic implications of relationships. Prerequisite: Biology 142L or equivalent. Instructor: Funk, Kress, and Manos. 3 units.

244. Principles of Immunology. 3 units. C-L: Immunology 244.

245L. Peat Mosses and Peatlands. Ecology of *Sphagnum*-dominated peatland habitats. Ecology, genetics, and systematics of peat mosses. Field trips to peatland habitats.

and identification of peat moss species. Prerequisite: one course in plant diversity or consent of instructor. Instructor: Shaw. 4 units.

253L. Physiology of Marine Animals. Environmental factors, biological rhythms, and behavioral adaptations in the comparative physiology of marine animals. Open to undergraduates only under Biology 150L. Four units (fall); six units (summer). (Given at Beaufort.) Prerequisite: introductory biology and chemistry. Instructor: Forward. Variable credit. C-L: Environment 228L, Marine Sciences.

255L. Biochemistry of Marine Animals. Functional, structural, and evolutionary relationships of biochemical processes of importance to marine organisms. Open to undergraduates only under Biology 155L. Four units (fall and spring); six units (summer). (Given at Beaufort.) Prerequisite: Biology 25L; and Chemistry 11L, 12L. Instructor: McClellan-Green (spring); Rittschof (fall and summer). Variable credit. C-L: Environment 229L, Marine Sciences.

256S. Speciation. Experimental and phylogenetic approaches to the origin of plant and animal species. Emphasis on current literature and modern approaches to evolutionary patterns and processes. Prerequisites: basic courses in systematics and genetics. Instructor: Shaw. 3 units.

257L. Molecular Systematics and Evolution. Descriptive and experimental procedures used to assess evolutionary diversity for analysis of population genetics and systematic relationships. Laboratory problems, discussion, and individual research projects. Prerequisite: basic course work in systematics, evolution, and genetics. Instructor: Vilgalys. 3 units.

258L. Introduction to Modern Microscopy. A hands-on approach to teach students how to use the new microscopy with an emphasis on the principles underlying their application. Instructor: Crenshaw. 3 units.

260L. Plant Anatomy. A comparative study of basic cell types, tissues, and organs of vascular plants. Correlation of anatomical information with pertinent literature, application of anatomy to problems in systematics and evolution, and the interrelationship between structure and function. Prerequisite: one year of biology or consent of instructor. Instructor: White. 4 units.

261. Photosynthesis. Principles of photosynthesis: developmental, mechanistic, regulatory, and ecological aspects of the photosynthetic process. Prerequisite: Biology 152 or equivalent. Instructor: Siedow. 3 units.

263. Molecular Genetics of Drosophila Development. Discussion of recent developments in the genetic and molecular analysis of Drosophila development. Topics include morphogenesis, neurogenesis, embryonic patterning, and cellular interactions. Student presentations are integral to the course. Consent of instructor required. Instructors: Fehon, Kiehart, and Wharton. 2 units. C-L: Cell Biology 263, University Program in Genetics 263.

264S. Advanced Topics in Marine Ecology. Theoretical concepts from population, community, and evolutionary ecology will be linked to observations and experiments to enhance understanding of the structure and function of marine systems. Current topics in marine ecology (for example, marine food web dynamics, species interactions, life history strategies, fisheries ecology, conservation biology). Discussions based on readings from the primary literature with emphasis on developing critical and synthetic skills. Each student will prepare a research proposal in NSF format. May be repeated. (Given at Beaufort.) Instructor: Crowder. 2 units. C-L: Environment 269S, Marine Sciences.

265. Physiological Plant Ecology. The physiological approach to interpreting adaptation in plants, with emphasis on terrestrial seed plants. Prerequisite: Biology 110L and 152 or equivalents. Instructor: Jackson. 3 units.

265L. Physiological Plant Ecology. The physiological approach to interpreting adaptation in plants, with emphasis on terrestrial seed plants. Prerequisite: Biology 110L and 152 or equivalents. Instructor: Staff. 3 units.

267L. Community Ecology. Mechanisms that determine the distribution and abundance of plants and animals: geology, climate, physiography, soils, competition, predation, and history. Lectures focusing on ecological principles developed through mathematical and quantitative methods. Seminars and weekend field trips. Prerequisite: an introductory ecology course. Instructor: Christensen or Clark. 3 units.

268. Ecological Theory and Data. Goals and contributions of ecological theory. Formulation of models and applications to data. Topics include demography, population growth, community interactions, food webs, metapopulations, disturbance, structure, stochasticity, chaos, and patchiness. Model development, analysis, and interpretation. Discussions focus on classical and current primary literature. Analysis of data using SPlus, making use of likelihood models, bootstrapping, and Bayesian approaches. Prerequisite: one year each of calculus and statistics. Instructor: Clark. 3 units.

269. Advanced Cell Biology. Structural and functional organization of cells and their components with emphasis on current research problems and prospects. Prerequisite: introductory cell biology or consent of instructor. Instructor: Siedow and staff. 3 units. C-L: Cell Biology 269, Immunology 269.

272. Biogeochemistry. 3 units. C-L: Earth and Ocean Sciences 272.

274L. Marine Invertebrate Zoology. Structure, function, and development of invertebrates collected from estuarine and marine habitats. Not open to students who have taken Biology 176L, Biology 274L, or Zoology 274L. Open to undergraduates only under Biology 176L. Four units (fall, spring, and Summer Term II); six units (Summer Term I). (Given at Beaufort fall and summer or at Bermuda, spring.) Prerequisite: Biology 25L. Instructors: Dimock (Beaufort) or Kirby-Smith (Beaufort); Barnes and Coates (Bermuda). Variable credit. C-L: Environment 295L, Marine Sciences.

279S. Developmental Biology Colloquium. Lectures, seminars, and discussion of current topics in developmental biology. Prerequisites: Biology 118 and/or 119 or equivalent. Instructor: McClay. 3 units.

280S. Genetic Engineering and Biotechnology. Applications of recombinant DNA in medicine and in agriculture. Topics include diagnosis of genetic diseases, gene therapy, drugs for AIDS and cancer, DNA fingerprinting, cloning of mammals, phytoremediation, crop improvement, and pharmaceutical protein production in transgenic plants and animals. Social and environmental impacts of biotechnology. Prerequisites: Biology 118 and 119 or consent of instructor. Instructor: Sun. 3 units.

281. DNA, Chromosomes, and History. Past and present research on evolution, genetics, and chromosome biology. The curious path to our present understanding of inheritance including how genes got put on chromosomes and the fluctuating fortunes of DNA. Implications of current research on chromosome and genome organization for evolutionary biology. Prerequisite: an introductory course in genetics or cell or molecular biology, or consent of instructor. Instructor: Nicklas. 3 units.

284. Molecular Population Genetics. Theoretical and computational basis of evolutionary biology at the sequence level. Models of nucleotide and amino acid substitution; distance measures; distance methods for phylogeny reconstruction; tests of neutrality, adaptive selection, and hitchhiking; methods for distinguishing between common ancestry and adaptation; case histories of molecular evolution. For graduate students and upper-level undergraduates with course work in genetics or evolution or mathematics. Instructor: Uyenoyama. 3 units.

285S. Ecological Genetics. Interaction of genetics and ecology and its importance in explaining the evolution, diversity, and distribution of plants and animals. Prerequisite: Biology 120 and consent of instructor. Instructor: Staff. 3 units.

286. Evolutionary Mechanisms. Population ecology and population genetics of plants and animals. Fitness concepts, life history evolution, mating systems, genetic divergence, and causes and maintenance of genetic diversity. Prerequisite: Biology 25L and 120 or equivalents. Instructor: Rausher and Uyenoyama. 3 units.

287S. Macroevolution. 3 units. C-L: Biological Anthropology and Anatomy 287S.

288. Mathematical Population Genetics. Principles of formulation and analysis of dynamic mathematical models of genetic evolution. Rotating topics include: mating systems, sex ratio, stochastic processes. Prerequisite: calculus; statistics and linear algebra recommended. Instructor: Uyenoyama. 3 units.

289L. Methods in Morphometrics. Techniques for the acquisition and analysis of quantitative data for describing and comparing biological form. Topics include: image-capture and analysis; two- and three-dimensional digitization; and multivariate and geometric techniques such as allometric analysis, outline and landmark-superposition methods, and deformation models. Background in statistics and linear algebra recommended. Instructor: Mercer. 4 units.

290. Pattern and Process in Vertebrate Development. 3 units. C-L: Biological Anthropology and Anatomy 290.

291. Mathematical Biology. A focus on special topics in mathematical biology drawn from molecular evolution, cell and molecular biology, time in biology, population biology, epidemiology, enzyme kinetics, chemotaxis, and developmental biology. Emphasis on robust methods for obtaining useful information from biological models. Methods include graphical, geometric, perturbation, and stability analysis. Prerequisites: calculus and linear algebra. Instructor: Mercer. 3 units.

292. Population Ecology. Explores key questions in population ecology from a theoretical perspective. Topics include demography and dynamics of structured populations, stochastic population dynamics, and life history characteristics. Prerequisite: Biology 110L or 112 and consent of instructor. Instructor: Morris and Wilson. 3 units.

293. Simulating Ecological and Evolutionary Systems. Computer programming using C within a UNIX environment applied to ecological and evolutionary problems. The relationship between simulation and analytic modeling. Knowledge of programming or work within the UNIX computer environment not expected. Consent of instructor required. Instructor: Wilson. 3 units.

294. Successes in Theoretical Ecology and Evolution. Case studies in theoretical ecology and evolution with direct application to empirical systems. Includes mating systems, life history strategies, population dynamics, and infectious diseases. Prerequisite: Biology 25L and 120 or equivalents. Instructor: Wilson. 3 units.

295S. Seminar. Instructor: Staff. Variable credit.

296S. Seminar. Instructor: Staff. Variable credit.

300. Tropical Biology: An Ecological Approach. Highly intensive, field-oriented course conducted in Costa Rica under auspices of the Organization for Tropical Studies. For additional information refer to the chapter "Special and Cooperative Programs." Instructor: Staff. 6 to 8 units.

303. Principles of Ecological Modeling. Design, implementation, analysis, and interpretation of ecological models. Combination of lectures, student-moderated discussions, and computer lab exercises. Prerequisite: Biology 110L or equivalent and Environment 251 or equivalent. Instructor: Reynolds and Urban. Variable credit. C-L: Environment 303.

304. Plant Growth Modeling. Design, implementation, analysis, and interpretation of models of plant growth processes, including leaf and canopy photosynthesis, transpiration, allocation, nutrient uptake, and phenology. Issues of hierarchy and scaling

emphasized. Lectures, student-moderated discussions and seminars, computer lab exercises. Prerequisite: Biology 110L or equivalent and Biology 265L or equivalent. Instructor: Reynolds. 3 units.

305S. Plant Systematics Seminar. Weekly presentation of current research in plant systematics by students, faculty, and invited speakers. Instructor: Vilgalys. 1 unit.

306S. Plant Systematics Seminar. Weekly presentation of current research in plant systematics by students, faculty, and invited speakers. Instructor: Vilgalys. 1 unit.

310S. Ecology Seminar. Discussion of current research and literature. Instructor: Staff. 1 unit.

311S. Ecology Seminar. Discussion of current research and literature. Instructor: Staff. 1 unit.

315S. Population Genetics Seminar. Discussion of recent developments in population genetics. Topics include population dynamics, forces affecting gene frequency change, molecular evolution, philosophy of evolutionary biology. Student presentations are integral to the course. Instructor: Staff. 1 unit.

316S. Population Genetics Seminar. Discussion of recent developments in population genetics. Topics include population dynamics, forces affecting gene frequency change, molecular evolution, philosophy of evolutionary biology. Student presentations are integral to the course. Instructor: Staff. 1 unit.

320S. Systematics Discussion Group. An informal discussion group. Topics vary from semester to semester; cover systematic and evolutionary biology in the broad sense. Instructor: Staff. 1 unit.

321S. Systematics Discussion Group. An informal discussion group. Topics vary from semester to semester; cover systematic and evolutionary biology in the broad sense. Instructor: Staff. 1 unit.

325S. Developmental, Cellular, and Molecular Biology Seminar. Weekly presentations in developmental, cellular, and molecular biology topics by students, faculty, and invited speakers. Consent of instructor required. Instructor: Staff. 1 unit.

326S. Developmental, Cellular, and Molecular Biology Seminar. Weekly presentations in developmental, cellular, and molecular biology topics by students, faculty, and invited speakers. Consent of instructor required. Instructor: Staff. 1 unit.

351. Tutorials. An approved academic exercise, such as writing an essay or learning a research skill, carried out under the direction of the appropriate staff members. Consent of instructor required. Hours and credit to be arranged. Instructor: Staff. Variable credit.

352. Tutorials. An approved academic exercise, such as writing an essay or learning a research skill, carried out under the direction of the appropriate staff members. Consent of instructor required. Hours and credit to be arranged. Instructor: Staff. Variable credit.

353. Research. To be carried on under the direction of the appropriate staff members. Consent of instructor required. Hours and credit to be arranged. Instructor: Staff. Variable credit.

354. Research. To be carried on under the direction of the appropriate staff members. Consent of instructor required. Hours and credit to be arranged. Instructor: Staff. Variable credit.

390. Seminar in Teaching Biology. Syllabus design, best practices, and instructional methods in biology for graduate students in Duke University's Preparing Future Faculty Program in Biology. Seminar discussions and projects guided by Duke faculty in conjunction with faculty from Elon, Guilford, and Meredith Colleges. Topics may include "Biological Literacy"; "Using Information Technology"; and "Different Learning Styles, Different Contexts." Consent of instructor required. Instructor: Staff. 3 units.

Business Administration (BA)

Professor Adams, *Chair* (219W Fuqua School of Business); Professor Bettman, *Director of Graduate Studies* (429E Fuqua School of Business); Professors R. Ashton, Baligh, Boulding, Bradley, Burton, Clemen, DeSanctis, Fischer, Forsyth, Harvey, Hsieh, Huber, Keller, Laughhunn, Lewin, Lind, Lynch, McCann, Moorman, Payne, Schipper, Sheppard, Staelin, Viswanathan, Whaley, Winkler, and Zipkin; Associate Professors Anton, A. Ashton, Bansal, Brodt, Carmon, Coleman, Desai, Edell, Fox, Francis, Graham, Heath, Kyle, Linville, Mela, M. Moore, M. C. Moore, Nau, Purohit, Sitkin, J. Smith, and Vettas; Assistant Professors Brav, Das Varma, Gigone, Kornish, Levine, Mrkaic, Patterson, Pekec, Regenwetter, Rossiensky, M. Smith, Staudenmayer, and Willis; Professor Emeritus Cohen; Research Professor Dumas; Associate Research Professor Gray

The Ph.D. in business administration program prepares candidates for research and teaching careers at leading educational institutions and for careers in business and governmental organizations where advanced research and analytical capabilities are required. The Ph.D. program places major emphasis on independent inquiry, on the development of competence in research methodology, and on the communication of research results. The school offers programs of research and training in the areas of decision sciences, finance, management, marketing, and operations management. The student and the faculty in his/her area determine the specific program of study. Each student takes a comprehensive examination at the end of the second year or at the beginning of the third year of residence. The final requirement is the presentation of a dissertation. The Ph.D. program usually requires four to five years of work. Refer to the Bulletin of Duke University: The Fuqua School of Business for a complete list of courses and course descriptions. For further information, email bobbiec@mail.duke.edu or jrb12@mail.duke.edu; or visit the web site accessible from <http://www.fuqua.duke.edu>.

510. Bayesian Inference and Decision. Methods of Bayesian inference and statistical decision theory, with emphasis on the general approach of modeling inferential and decision-making problems as well as the development of specific procedures for certain classes of problems. Topics include subjective probability, Bayesian inference and prediction, natural-conjugate families of distributions, Bayesian analysis for various processes, Bayesian estimation and hypothesis testing, comparisons with classical methods, decision-making criteria, utility theory, value of information, and sequential decision making. Instructor: Winkler. 3 units. C-L: Statistics and Decision Sciences 221.

513. Choice Theory. This seminar deals with the foundations and applications of the theory of rational choice, including expected and nonexpected utility theory, noncooperative game theory, and arbitrage theory. It will survey the classic literature in the field; dissect a variety of paradoxes, puzzles, and pathologies; and discuss recent advances and controversies. The goal of this seminar is to equip students with an understanding of both the power and the limits of rational choice theory, so that they can construct as well as critically analyze rational choice applications in a wide variety of social science contexts. It will also suggest some new directions for rational choice research. Instructor: Nau. 3 units. C-L: Statistics and Decision Sciences 234.

521. Organization Seminar: A Micro Focus. Individual and small-group behavior in organizations. Theories of motivation, decision making, interpersonal behavior, group processes, and leadership. A variety of research approaches and methods includes presentation of behavioral research by members of The Fuqua School of Business and other researchers. Instructor: Staff. 3 units.

522. Organization Seminar: A Macro Focus. The organization and the subunits which make up the organization. Topics include: contingency theory, institutional theory, and population ecology. Theories of organization, structure, decentralization,

divisionalization, functional area integration, task design, incentives and rewards, information systems, and decision rules are developed with an orientation toward their choice and design for high performance. Includes presentation of research by members of The Fuqua School of Business and other researchers. Instructor: Staff. 3 units.

525. Behavioral Decision Theory. Examines the development of research in individual and group decision behavior. Major emphasis is given to theoretical developments and empirical research, with a range of articles assigned for each topic. The basic topic areas include: (1) decision problem structuring, (2) thinking about uncertainties, (3) risk taking, (4) dealing with conflicting values, and (5) combining individual judgments into a group decision. Instructor: Payne. 3 units. C-L: Psychology 316, Statistics and Decision Sciences 231.

531. Financial Accounting Seminar. The nature of published financial statement information and its relationship with various economic variables. The list of related variables might include stock market data, bankruptcy filings, and the actions of various users of financial statement information, including management, investors, creditors, and regulators. The focus is on the current research methodologies and research efforts used to analyze the above relationships. A background in masters-level accounting and finance is assumed. Instructor: Staff. 3 units.

532. Management Accounting Seminar. Information systems and their use in facilitating management decision making and organizational control. Emphasis on the appropriate research methodologies and paradigms including information economics, decision theory, and organizational theory. Topics include budgeting, incentive systems/performance evaluation, variance investigation, and cost allocation. Instructor: Staff. 3 units.

551. Finance I. This course gives rigorous introduction to the foundations of finance. Most of the time is spent on theoretical work and very little on empirical work. The main subjects covered are: introduction to asset pricing (CAPM, APT), taxes and Modigliani-Miller theorems, foundational material in decision theory, and a variety of topics in information economics and asset markets. Prerequisite: basic mathematics background in calculus, statistics, matrix algebra, optimization, and dynamic programming. Instructor: Kyle. 3 units.

552. Finance II. The course covers the following topics: efficient markets and asset pricing, no arbitrage and asset prices, conditional and unconditional mean variance frontiers, capital asset pricing model and implications, dynamic economic models of asset prices, present value tests of market efficiency, term structure of interest rates, non-parametric bounds on asset pricing models, intertemporal CAPM and arbitrage pricing models, and option pricing. Prerequisite: Ph. D. level course in econometrics; recommended: Business Administration 551. Instructor: Bansal. 3 units.

553. Finance III. This course focuses on continuous time finance with applications to market microstructure and the term structure of interest rates. Students will have to do Monte Carlo simulations of continuous time models in order to receive a credit for this course. Prerequisite: basic mathematics background in calculus, statistics, matrix algebra, optimization, and dynamic programming. Instructor: Kyle. 3 units.

561. Seminar in Quantitative Research in Marketing. An overview of the quantitative techniques that are important in marketing research. Each model and technique will be examined in considerable detail so as to permit an understanding of its assumptions, structure, and usefulness. Topics covered will include the general data analysis techniques as well as models from advertising, new products, and pricing decisions. Instructor: Staff. 3 units.

562. Seminar in Consumer Behavior. Examines the development of research in consumer behavior. Major emphasis is given to theoretical developments and empirical research, with a range of articles assigned for each topic. Topics include motivation and

personality, perceptual processes, information search, choice processes, attitudes and persuasion, learning, and influence in consumer choice. Instructor: Bettman. 3 units. C-L: Psychology 315.

563. Marketing Models Seminar. The primary goals of this seminar are: (a) to review critically the most current research in marketing and (b) to gain a better understanding of and ability to build one's own model. After taking this course, students should be able to understand the assumptions and mathematical development of the current quantitative work in marketing and to use this understanding to develop meaningful extensions. Instructor: Staff. 3 units.

564. Experimental Design and Analysis Seminar. Examines issues in the design and analysis of experiments. Emphasis on analysis of variance (ANOVA), starting with the basic ANOVA model and examining multiple factor designs, blocking designs, nested models, within subject designs, repeated measure designs, and analysis of covariance. Instructor: Edell. 3 units.

571. Operations Strategy Seminar. Recent developments in the strategy of operations in both the manufacturing and service sectors. Topics include the focused factory concept, Japanese manufacturing philosophy, technological policy toward new process development and toward new product introduction, vertical integration, choice of capacity and location, industry analysis, and the impact of government regulation. Emphasis on the development of hypotheses about strategic topics and the empirical means by which they can be tested. Instructor: Staff. 3 units.

572. Seminar in Operational and Technological Tactics. Current issues in the day-to-day management of manufacturing and service delivery systems. Topics include material requirements planning, capacity requirements planning, quality of work life projects, productivity measurement and enhancement, implementation of new product introductions and production process modifications, quality assurance, production planning and scheduling, and logistics. Concentration on the substance of recent developments, the generation and test of hypotheses about tactical issues, and the applicability of various optimization techniques to the advance of operation tactics. Instructor: Staff. 3 units.

591. Selected Topics in Business. Allows the doctoral student the opportunity to study special topics in management on an occasional basis depending on the availability and interests of students and faculty. Instructor: Staff. Variable credit.

597. Dissertation Research. For students actively pursuing research on their dissertation. Credit to be arranged. Prerequisite: student must have passed the preliminary examination and have the consent of the director of the doctoral program and instructor. Instructor: Staff. Variable credit.

598. Independent Study. Allows the doctoral student the opportunity to engage in study or tutorial on special topics on an individual basis under the supervision of a faculty member. Credit to be arranged. Prerequisite: doctoral program standing and consent of the director of the doctoral program and instructor. Instructor: Staff. Variable credit.

599. Directed Research. Allows the doctoral student to engage in individual research projects under the supervision of a faculty member. Credit to be arranged. Prerequisite: doctoral program standing and consent of the director of the doctoral program and instructor. Instructor: Staff. Variable credit.

Canadian Studies Program (CANADIAN)

John Thompson, Ph.D., *Director*

The Canadian Studies Program offers a certificate of graduate study. The requirements for the certificate include completion of three Canadian studies courses,

including the core course, Interdisciplinary Studies Course 282, Canadian Issues. The other two courses may be from existing courses, or from independent studies with the center's faculty. In addition, the dissertation must be written on a Canadian or Canadian-comparative topic. The student must also demonstrate a knowledge of French or one of Canada's aboriginal languages.

The purpose of the Canadian Studies Program is to formalize and expand the interest of graduate students in Canada, to introduce the study of Canadian life and culture at the undergraduate level, and to encourage such study in primary and secondary schools.

The program awards a limited number of foreign language and area studies graduate fellowships and teaching assistantships for the study of Canada to American residents. Fellows must work on a Canadian or Canadian/comparative dissertation topic within their disciplines and must also study French. Grants of travel aid for field research in Canada are also offered.

The program sponsors lectures by Canadian specialists and supports seminars devoted to Canada. Opportunities for study in Canada are offered to honors undergraduates in Canadian studies, graduates, and faculty.

Inquiries should be addressed to the Director, Canadian Studies Center, Duke University, Box 90422, Durham, North Carolina 27708-0422.

282S. Canada. A research seminar for advanced students familiar with Canada. Topics vary each semester; recent perspectives have included nationalism, Canadian-American relations, regionalism in the Maritimes and the West, and cross-border environmental issues, among others. Instructor: Staff. 3 units. C-L: Cultural Anthropology 282S, History 282S, Political Science 282S, Sociology 282S.

The University Program in Cell and Molecular Biology (CMB)

Professor McClay, *Director* (zoology); Associate Professor Kreuzer, *Director of Graduate Studies*; 115 participating faculty

Research training in cell, developmental, and molecular biology is found in ten departments/programs at Duke University: Biochemistry, Biology, Cell Biology, Genetics, Immunology, Microbiology, Neurobiology, Pathology, and Pharmacology and Cancer Biology. To effectively utilize this broad spectrum of expertise for the training of promising scientists while still providing a coherent curriculum, the Duke University Program in Cell and Molecular Biology has been established, bringing together the research foci of approximately 120 faculty. The program offers a certificate of graduate studies, with the doctoral degree awarded by one of the ten degree-granting departments. Students admitted to CMB have up to one academic year to affiliate with a degree program. During the first semester of doctoral study a student will satisfy the program's core course requirements. This sequence presents a broad-based approach to key areas of contemporary cell and molecular biology, including macromolecular synthesis, structure of macromolecules, genetic analysis, cell biology, modern techniques in molecular biology, and physical chemistry for biologists. Particularly in the second and third semesters, each student will also choose elective courses in an area of specialization. Research training is stressed throughout the program and dissertation research usually begins by the third semester. Applicants must have demonstrated, in addition to overall academic excellence, a proficiency in the biological and physical sciences.

For additional information, please visit our web site at <http://cmb.duke.edu> or send email to: cmbtgp@biochem.duke.edu.

247. Macromolecular Synthesis. Fundamentals of DNA replication, transcription, and translation. Transcriptional and translational regulation mechanisms. Consent of

instructor required for undergraduates. First half of fall semester. Instructor: Kornbluth and Zhuang. 2 units. C-L: University Program in Genetics 247.

251. Molecular Cell Biology. Current research topics in cell biology presented in a lecture and discussion format based on recent research papers. Topics include: protein secretion and trafficking; mitochondria and organelles; the nucleus; cytoskeleton and cell motility; extracellular matrix and cell adhesion; growth factors and signalling; cell cycle. Instructors: Erickson and staff. 4 units. C-L: Cell Biology 251.

258. Structural Biochemistry I. 2 units. C-L: Biochemistry 258, Cell Biology 258, University Program in Genetics 258, Immunology 258, Microbiology 258, Molecular Biophysics 258.

264. Cell and Molecular Biology Colloquium. Required of all students. Third- and fourth-year students discuss their dissertation research. Instructor: Kreuzer. 1 unit.

278. Genetic Approaches to the Solution of Biological Problems. Use of genetic approaches to address research problems in cell and developmental biology. Genetic fundamentals build up to modern molecular genetic strategies including genetic screens, reverse genetics, genetic interactions, dominant negative mutants, and more. Several major genetic model organisms used to illustrate general principles. Consent of instructor required for undergraduates. Instructor: Staff. 4 units. C-L: University Program in Genetics 278.

297. Modern Techniques in Molecular Biology. Discussions of nucleic acid sequencing and manipulation, cloning strategies, vectors, expression, hybridization and blotting methods, PCR, etc. Consent of instructor required for undergraduates. First half of fall semester. Instructors: Casey and Fehon. 3 units.

298. Physical Chemistry for Biologists. Thermodynamics and kinetics using biological examples; spectroscopy (for example, NMR, UV, CD). Consent of instructor required for undergraduates. Second half of fall semester. Instructors: Hammes and Spicer. 2 units.

Cell Biology (CELLBIO)

Professor Sheetz, *Chair*; Professor V. Bennett, *Director of Graduate Studies*; Professors Blum, C. Bonaventura, J. Bonaventura, Caron, Gutknecht, Hatchell, Johnson, McIntosh, Nicklas, Padilla, Plonsey, Reedy, Somjen, Sommer, and Spach; Associate Professors Akwari, N. Anderson, P. Bennett, Cobb, Corless, Greenfield, Hannun, Kiehart, Mills, Nicchitta, Schachat, Schomberg, Stolp, Vigna, and Wright; Assistant Professors P. Anderson, Capel, Cohn, DeLozanne, Dittman, Drezner, Fehon, Freemark, Freudenrich, Garrett, Iglehart, Kindman, Klingensmith, Kraus, Lin, Mangel, Marchuck, Meyer, Obeid, OHalloran, Saling, Sladen, Stamler, Swenson, Titus, Webb, and Yarger; Professors Emeriti Blum, Counce, Jobsis, Johnson, McManus, and Moses; Associate Medical Research Professors Aitken and LeFurgey; Assistant Medical Research Professors Chang, Folz, Klitzman, Lee, Lightner, B. Lobaugh, McKay, O'Brien, Opara, Swenson, and Webb; Adjunct Professor Rodbell; Adjunct Associate Professors Horres and Schooler; Adjunct Assistant Professors Benjamin, L. Lobaugh, Murphy, and Shepherd; Associate Stolp

The Department of Cell Biology offers graduate training in modern cell biology and physiology leading to the Ph.D. degree. Specific research interests include: cytoskeleton and cell motility, including both actin and microtubule based motors, mechanisms of contraction, vesicle transport and chromosome movement; cardiac and skeletal muscle, including ultrastructure, physiology, developmental and molecular biology; cell adhesion and biophysics of membrane interactions; extracellular matrix; protein secretion and trafficking mechanisms; transmembrane receptors and molecular mechanisms of signal transduction; cell physiology, metabolism, and membrane transport in brain, kidney, muscle; vertebrate photoreceptors; high resolution electron

microscopy and computer image processing; and developmental biology using mouse and drosophila.

The department has excellent facilities for light and electron microscopy; X-ray diffraction; cell culture and micromanipulation; and modern biochemistry and molecular biology. The Department of Cell Biology also participates in several university-wide interdisciplinary training programs, including genetics, cell and molecular biology, neurobiology, pharmacology, biomedical engineering, and toxicology.

The Division of Physiology, which is centered in the Department of Cell Biology, brings together faculty and students with interests in cellular, organ, and systemic physiology. The program of graduate studies in physiology is organized through this division. The Division of Developmental Biology focuses research and teaching on mechanisms of development. Mouse and drosophila developmental systems are studied using modern approaches of genetics and molecular biology. For further information, contact the director of graduate studies.

200. Cell and Tissue Biology. This is the introductory medical school and graduate course in microscopic anatomy. Students participate in lectures and laboratories on the structure and function of cells and tissues of the body. The course provides practical experience in the use of the light microscope analyzing an extensive slide collection of mammalian tissues. 3 credits. McIntosh and staff. 3 units.

201. Microscopic Anatomy. Histology of all major organs of the body. Structure and cell biology at both the level of the light and electron microscope. 3 credits. McIntosh and staff. 3 units.

202. Medical Physiology. Medical and graduate level course on organ and cell physiology. Human and medical aspects are stressed. 4 credits. Anderson and staff. 4 units.

203. Introduction to Physiology. Modern organ physiology; cellular physiology, the heart and cardiovascular system, the kidney, the gastrointestinal, endocrine, and nervous systems. Minicourse. Prerequisite: elementary biology. Instructors: Vigna and Wright. 2 units.

204. Cell and Molecular Physiology. Selected aspects illustrating the use of cellular and molecular approaches to the understanding of physiological organ functions. Topics include: molecular basis of contraction and muscle diversity, cell-cell interactions through cell junctions, paracrine or hormonal signals, signal transduction, molecular basis of channel and carrier functions, physiology of transgenic mice. Prerequisite: Cell Biology 203 or cell biology. Instructor: Wright and staff. 3 units.

210. Independent Study. Research resulting in a substantive paper or written report containing significant analysis and interpretation of a previously approved topic. Descriptions of specific areas may be obtained from the director of graduate studies. Consent of director of graduate studies required. Instructor: Staff. 3 to 9 units each.

211. Cellular Mechanisms of Injury. Selected topics in mechanisms of injury at the cellular and molecular levels chosen for reading and discussion in a combined lecture/seminar format. Subject matter varies each semester; can be taken more than once. Consent of instructor required. Instructors: Fridovich, LeFurgey, Steenbergen, and guest faculty. 3 units.

212. Topics in Reproductive Biology. An in-depth, integrative study of male and female reproduction, including (i) hypothalamic, pituitary, and gonadal control mechanisms, (ii) gamete structure and development, (iii) fertilization, and (iv) pregnancy and parturition. Guest lectures will emphasize the interface between basic, veterinary, and medical sciences. Prerequisite: Cell Biology 269 or equivalent. Instructor: N. Anderson, Saling, Schomberg, or Tyrey. 3 units.

243. Environmental Biochemistry. Introduction to the (macro)molecules of life and fundamental metabolic pathways. Topics are presented in the context of environmental

perturbations. Fundamental aspects of energetics, proteins, enzymes, carbohydrates, lipids, and nucleic acids. Emphasis on mechanisms of adaptation, molecular controls, and responses to toxicants. (Given at Beaufort.) Prerequisite: organic chemistry. Instructor: C. Bonaventura. 3 units. C-L: Environment 243, Marine Sciences.

244L. Molecular and Cellular Processes in Marine Organisms. Joint research projects on the adverse effects of environmental pollutants on marine organisms at the cellular and molecular level. Research methodologies include: spectroscopy (UV/VIS, fluorescence, and atomic absorption); subcellular fractionation; protein purification and characterization using chromatography and electrophoresis; analysis of pollutant-induced damage to proteins, membranes, and DNA; measurement of activity of enzymatic defense systems. Lectures cover molecular mechanisms of damage and damage control, and concepts that underlie the methods to be used. (Given at Beaufort.) Prerequisite: organic chemistry. Instructors: C. Bonaventura and McClellan-Green. 4 units. C-L: Environment 244L, Marine Sciences.

251. Molecular Cell Biology. Current research topics in cell biology presented in a lecture and discussion format based on recent research papers. Topics include: protein secretion and trafficking; mitochondria and organelles; the nucleus; cytoskeleton and cell motility; extracellular matrix and cell adhesion; growth factors and signalling; cell cycle. Instructors: Erickson and staff. 4 units. Cell and Molecular Biology 251.

258. Structural Biochemistry I. 2 units. C-L: Biochemistry 258, Cell and Molecular Biology 258, University Program in Genetics 258, Immunology 258, Microbiology 258, Molecular Biophysics 258.

259. Structural Biochemistry II. 2 units. C-L: Biochemistry 259, University Program in Genetics 259, Immunology 259, Microbiology 259, Molecular Biophysics 259.

263. Molecular Genetics of Drosophila Development. Discussion of recent developments in the genetic and molecular analysis of Drosophila development. Topics include morphogenesis, neurogenesis, embryonic patterning, and cellular interactions. Student presentations are integral to the course. Consent of instructor required. Instructors: Fehon, Kiehart, and Wharton. 2 units. C-L: Biology 263, University Program in Genetics 263.

268. Nucleic Acids. 3 units. C-L: Biochemistry 268, University Program in Genetics 268, Immunology 268, Microbiology 268.

269. Advanced Cell Biology. 3 units. C-L: Biology 269, Immunology 269.

280. Student Seminar. Preparation and presentation of seminars to students and faculty on topics of broad interest to cell biology and physiology. Required of Department of Cell Biology students. Instructor: Staff. 1 unit.

293. Membrane Biophysics. Composition of biological membranes, structure/properties of membrane lipids and proteins (receptors, pores, channels, ion transport ATPases, membrane junctions), mechanical properties of membranes and bilayers, interaction of small molecules with membranes, ionic basis of membrane and action potentials, synaptic transmission. Instructor: McIntosh and staff. 3 units. C-L: Molecular Biophysics 293.

296. Developmental Biology Colloquium. Instructor: Staff. 3 units.

301. Introduction to Cell and Molecular Biology. Three weeks of intensive laboratory exercises utilizing modern techniques of gene cloning; PCR; protein expression and purification; light and electron microscopy. Laboratory work will be supplemented with lectures and discussion groups. Course begins two weeks prior to the opening of the semester. Instructors: Titus and staff. 1 unit.

312. Research. Specific areas of investigation include: membrane structure; extracellular matrix; cell adhesion; cell motility; cytoskeletal elements; chromosome structure and movement; genetics and molecular biology of contractile proteins; muscle

ultrastructure; gamete biology; molecular and structural biology of photoreceptors; hormone receptors; cell growth; developmental biology; membrane transport and electrophysiology; metabolism; cardiovascular physiology; microcirculation; hyperbaric physiology; and theoretical studies and computer modeling of physiological processes. Instructor: Staff. 1 to 4 units. Variable credit.

317. Neuronal Signaling: Ion Channels and Synapses. (Graduate Core Course.) Basic principles of neural electrical signaling. Areas of emphasis will include action potential generation, ion channel structure/function relationships, modulation of channel activity, neurotransmitter secretion, transmitter receptors, and mechanisms of synaptic plasticity. Consent of Instructors required. Fall. Instructor: Augustine, Kauer, Lo, and Reinhart. 3 units. C-L: Neurobiology 317.

320. Research Problems in Cell Biology. Coverage of selected topics important in current cell biology research. Format includes faculty lectures and directed readings of current research papers presented and discussed by students. Instructors: Sheetz and staff. 3 units.

417. Cellular Signaling. Mechanism of action of hormones at the cellular level including hormone-receptor interactions, secondary messenger systems for hormones, mechanisms of regulation of hormone responsiveness, regulation of growth, differentiation and proliferation, mechanisms of transport and ion channels, stimulus sensing and transduction. Some lectures stress the clinical correlation of the basic course concepts. Instructors: Caron, Casey, Means, and invited lecturers. 3 units. C-L: Biochemistry 417, Molecular Cancer Biology 417, Pharmacology 417.

COURSES CURRENTLY UNSCHEDULED

205. Design and Analysis of Biological Experiments

213. Oxygen and Physiological Function

215. Seminar in the Physiology of Disease

217. Selected Membrane Transport

219. Molecular and Cellular Bases of Differentiation

223. Cellular and Integrative Cardiovascular Physiology and Biophysics

232. Extracellular Matrix and Cell Adhesion

237. Analytical Imaging in Biomedical Research

305. Selected Topics in Cardiac Physiology

The University Program in Cellular and Biosurface Engineering

David F. Katz, Ph.D., *Director*; W.M. Reichert, Ph.D., *Director of Graduate Studies*

The University Program in Cellular and Biosurface Engineering is a multidisciplinary program which integrates activities in engineering, the life sciences, and medicine. Faculty from the graduate school departments of biochemistry, biomedical engineering, cell biology, chemistry, mechanical engineering and materials science, medicine, neurobiology, pathology, physics, and zoology as well as the departments of medicine, ophthalmology, obstetrics and gynecology, and surgery in the School of Medicine, are members of the center.

The program emphasizes research, education (both undergraduate and graduate) and interactions with industry. The focus of the program is upon biological cells and tissues, and the materials (both natural and synthetic) with which they interact in natural biological processes, and in medical diagnosis and therapy. It applies the principles and experimental methods of engineering to improve the understanding of these phenomena, and uses this knowledge to develop solutions to practical as well as fundamental problems. Thus, such work spans the most basic research to its

applications in health care. Students apply for graduate study to participating departments and are subject to the degree requirements of the university and these home departments. The University Program in Cellular and Biosurface Engineering offers a certificate of graduate study. The requirements for the certificate include completion of four core courses: Cellular and Surface Engineering (Mechanical Engineering 268); Laboratory in Cellular Engineering and Biosurface Science (Biomedical Engineering 228); and two advanced courses in cell biology and proteins, such as Advanced Cell Biology (Cell Biology 269) and Molecular Biology I: Proteins and Enzymes (Biochemistry 259). Participation in a seminar series (Biomedical Engineering 301,302) is also required. A limited number of fellowships are granted, providing stipend and tuition support.

For additional information contact The University Program in Cellular and Biosurface Engineering, B-213 Levine Science Research Center, Box 91010, Duke University, Durham, North Carolina 27708-1010; or visit the web site at: <http://bme-www.mc.duke.edu/Research/Cellsurf/>.

Chemistry (CHEM)

Professor Simon, *Chair* (101 Gross Chemical Laboratory); Professor Wells, *Director of Graduate Studies* (377 Gross Chemical Laboratory); Professors Baldwin, Bonk, Crumb-liss, Lochmüller, McGown, McPhail, Palmer, Pirrung, Shaw, and Yang; Associate Professors MacPhail and Toone; Assistant Professors Craig, Fitzgerald, Grinstaff, Liu, Oas, and Widenhoeffer; Professors Emeriti Arnett, Bradsher, Chesnut, Hobbs, Poirier, Quin, Smith, Strobel, and Wilder; Adjunct Professors Feldman, Kiserow, Porter and Sternbach; Adjunct Associate Professor Chao

The Department of Chemistry offers graduate work leading to the Ph.D. degree. While students are normally admitted only to the Ph.D. program, some students do ultimately pursue an M.S. degree. Entering graduate students should normally have taken an undergraduate degree in chemistry, along with related work in mathematics and physics. Graduate courses are offered in the fields of analytical, biological, inorganic, organic, physical, and theoretical chemistry, and there are active research programs in each of these areas. In addition, chemistry graduate students are also involved in a variety of interdisciplinary research programs, including biological chemistry, toxicology, pharmacology, and molecular biophysics.

Students will complete 22 units of graded course work by the end of the fall semester of the second year of residence. Normally, students will complete a minimum of 12 units during their first semester, along with the research orientation seminar (CHM 377). Courses from outside the department may be substituted for chemistry graduate courses, with permission of the director of graduate studies.

Further details concerning the general departmental program, admissions, departmental facilities, the faculty, ongoing research, and financial support may be obtained from the director of graduate studies (email: dgs@chem.duke.edu) or our web site (<http://www.chem.duke.edu>).

For Seniors and Graduates

275. Advanced Studies. (1) Analytical chemistry, (2) inorganic chemistry, (3) organic chemistry, and (4) physical chemistry. Open to especially well-prepared undergraduates by consent of director of undergraduate studies. Instructor: Staff. 3 units.

276. Advanced Studies. See Chemistry 275. Open to especially well-prepared undergraduates by consent of director of undergraduate studies. Instructor: Staff. 3 units.

301. Analytical Chemistry. Fundamental considerations of chemical measurements, optical spectroscopy, mass spectrometry, and separation methods. Instructors: Fitzgerald, Lochmüller, and McGown. 4 units.

302. Spectrochemical Analysis. Advanced topics in spectroscopic analysis, emphasizing absorption, emission, and luminescence techniques and applications to biomolecules. Prerequisite: Chemistry 301 or consent of instructor. Instructor: McGown. 2 units.

304. Separation Science. Fundamental separation chemistry, practical aspects of chromatographic methods, larger scale processes. Prerequisite: Chemistry 301 or consent of instructor. Instructor: Lochmüller. 2 units.

306. Biomolecular Mass Spectrometry. Advanced topics in the mass spectral characterization of biopolymers with an emphasis on protein and DNA analysis. Fundamental and practical aspects of the ionization processes and the instrumentation associated with MALDI- and ESI-Mass spectrometry discussed along with applications of these techniques to structural problems in chemistry and biochemistry. Prerequisite: Chemistry 301 or consent of instructor. Instructor: Fitzgerald. 2 units.

309. Special Topics in Analytical Chemistry. An advanced treatment of important areas in modern analysis. Topics may include: electrochemistry, small computer applications, magnetic resonance, and problem-solving approaches. 1 to 4 units. Instructor: Staff. Variable credit.

311. Biological Chemistry. Chemistry of the major classes of biological molecules, including nucleic acids, amino acids and proteins, carbohydrates and lipids. Topics include structure, reactivity and synthesis, and the interaction of biological molecules. Instructors: Pirrung, Shaw, and Toone. 4 units.

312. Chemistry and Biology of Nucleosides, Nucleotides, and Nucleic Acids. Synthesis, biosynthesis, and reactivity of nucleic acids and their polymers. Mechanisms of DNA and RNA coding, decoding, transmission, and in vitro evolution. Covalent and reversible interactions of nucleic acids with small molecules and macromolecules. Instructors: Grinstaff, Pirrung, Shaw, and Toone. 4 units.

314. Chemical Genomics. Information transfer, restructuring, and decoding in biological systems. Gene expression and evolution of function. Functional consequences of gene expression. Instructors: Pirrung, Shaw, and Toone. 2 units.

316. Techniques in Biochemistry. Purification and study of biological molecules including macromolecules. Chromatography, spectroscopy (IR, UV/vis, fluorescence, CD), electrophoretic methods, immunological methods, analytical ultracentrifugation, and their application to the study of biomolecules. Instructors: Fitzgerald, Shaw, and Toone. 2 units.

319. Special Topics in Biological Chemistry. Advanced topics and recent developments in biological chemistry. 1 to 4 units. Instructor: Staff. Variable credit.

320. Physical Methods in Inorganic Chemistry. Physical methods covered include paramagnetic NMR, EPR, magnetism, NQR, Mossbauer spectroscopy, photoelectron spectroscopy, and x-ray analysis. Instructors: McPhail and Palmer. 2 units.

321. Inorganic Chemistry. Bonding and spectroscopy, reactions, transition metal chemistry, main group chemistry, organometallics/catalysis, and solid state. Instructors: Crumbliss, Grinstaff, Palmer, and Wells. 4 units.

322. Chemical Applications of Group Theory Including Spectroscopy. Topics covered include symmetry, point groups, group theory, character tables, electronic absorption spectroscopy, infrared spectroscopy, Raman spectroscopy, and microwave spectroscopy. Instructors: Palmer and Simon. 2 units.

324. Bioinorganic Chemistry. Topics covered include metal activated enzymes in hydrolysis, oxygen carriers, nitrogen fixation, iron storage and transport, photosynthesis, protein electron transfer, and DNA mediated electron transfer. Instructors: Crumbliss and Grinstaff. 2 units.

326. Inorganic Reaction Mechanisms. A discussion of the mechanism of coordination reactions in solution. Examples include redox reactions and linear free energy relationships. Instructors: Crumbliss and Grinstaff. 2 units.

328. Synthesis and Synthetic Methods in Inorganic/Organometallic Chemistry. A discussion of inorganic synthetic methods including supramolecular chemistry and organometallic reactions. Instructors: Grinstaff, Wells, and Widenhoefer. 2 units.

329. Special Topics in Inorganic Chemistry. Lectures, oral reports, and discussions on advanced topics and recent advances in the field of inorganic chemistry. Topics may include: bioinorganic chemistry, fluxional molecules, homogeneous catalysis, synthesis and properties of selected groups of compounds, and new physical methods. 1 to 4 units. Instructor: Staff. Variable credit.

331. Organic Chemistry. Bonding and structure, stereochemistry, conformational analysis, substitution, addition, and elimination reactions, carbon reactive intermediates, concerted reactions, photochemistry, carbon alkylation, carbonyl addition nucleophilic substitution, electrophilic additions, reduction, cycloadditions, rearrangements, main group organometallics, oxidation. Instructors: Baldwin, Pirrung, Toone, and Widenhoefer. 4 units.

332. Organic Synthesis. Synthetic design, retrosynthetic analysis, synthetic methods, total syntheses. Instructors: Baldwin, Pirrung, and Widenhoefer. 4 units.

333. Nuclear Magnetic Resonance. Structural elucidation of organic and inorganic compounds by NMR. Fundamentals of data acquisition (pulse sequences, detection), multidimensional techniques, study of dynamic processes and their application to the determination of structure. Instructors: Baldwin and Widenhoefer. 2 units.

334. Physical Organic Chemistry. Reactive intermediates: carbocations, carbanions, carbenes radicals, photochemistry. Prerequisite: Chemistry 331. Instructors: Pirrung, Simon, and Toone. 4 units.

336. Biorganic Chemistry. Basic enzymology, mechanisms of enzymatic reactions, cofactors, oxidoreductases, C1 chemistry, carbon-carbon bond formation, carboxylation/decarboxylation, heme, pyridoxal enzymes, thiamine enzymes. Prerequisite: Chemistry 331 or equivalent. Instructors: Pirrung and Toone. 4 units.

338. Organometallic Chemistry. Bonding electron counting and structure. Ligand substitution, oxidative addition/reductive elimination, transmetallation, CO and olefin insertion, beta-hydride elimination, methathesis and attack on coordinated ligands. Cross-coupling, Heck coupling, catalytic hydrogenation, olefin polymerization, carbocyclization hydroformylation and related carbonylation chemistry Wacker, oxidation. Transition metal carbene complexes; transition metal oxo complexes. Instructors: Wells and Widenhoefer. 2 units.

339. Special Topics in Organic Chemistry. Advanced topics and recent developments in the field of organic chemistry. Representative topics include heterocyclic chemistry, natural products chemistry, carbohydrate chemistry, molecular mechanics, and two-dimensional NMR spectroscopy. Lectures and written and oral reports. 1 to 4 units. Instructor: Staff. Variable credit.

341. Quantum Chemistry. Foundations and approximate methods in quantum chemistry, with an emphasis on their applications to molecular structure and modeling. Instructors: Liu, MacPhail, McPhail, Simon, and Yang. 4 units.

342. Quantum Mechanics. Special emphasis on chemical applications. Topics include: linear algebra, the uncertainty relations, angular momentum, perturbation theory, time-dependent phenomena, molecules in electromagnetic fields, group theory, and electron correlation. Prerequisite: Chemistry 341 or consent of instructor. Instructors: Liu, MacPhail, Simon, and Yang. 4 units.

343. Statistical Thermodynamics. Introduction to statistical thermodynamics, with an emphasis on ideal systems and selected model approaches to more complex systems, for example, lattice models. Instructors: MacPhail and Yang. 2 units.

344. Statistical Mechanics. Fundamentals of quantum and classical statistical mechanics using the ensemble approach. Introduction of modern techniques and applications including the renormalization group treatment of phase transitions and linear response theory of time-dependent statistical mechanics. Prerequisite: Chemistry 343 or consent of instructor. Instructors: MacPhail and Yang. 4 units.

345. Kinetics. The phenomenology and theory of chemical dynamics and reaction rates. Instructors: Liu, MacPhail, and Simon. 2 units.

346. Biophysical Chemistry. The interrelationships between structure, function, and mechanisms of biological macromolecules. Principles of dynamics, including kinetics, reactivity and transport, and structure, including thermodynamics, NMR, fluorescence, and CD spectroscopy. Instructors: Oas, Shaw, and Simon. 4 units.

348. Solid-State and Materials Chemistry. Introduction to the structure, physical, and electronic properties of solid-state materials. Instructors: Liu and McPhail. 2 units.

349. Special Topics in Physical Chemistry. Presentation of one or more topics of staff interest such as advanced methods in crystallography, light scattering and small angle X-ray diffraction application of ESR spectroscopy to chemical problems, electronic spectroscopy of proteins group theory intermolecular forces, liquid crystals, methods of determining the rates of elementary steps in reaction kinetics, physical chemistry of aerosols, physical-chemical methods of polymer characterization, structure and bonding in metallo-enzymes, statistical mechanics of fluids, topics in structural chemistry, and triple excitons. 1 to 4 units. Instructor: Staff. Variable credit.

373. Seminar. One hour a week discussion. Credit/no credit grading only. Instructors: All members of the graduate staff. 1 unit.

374. Seminar. One hour a week discussion. Credit/no credit grading only. Instructors: All members of the graduate staff. 1 unit.

375. Research. Instruction in methods used in the investigation of original problems. Individual work and conferences. 1 to 6 units each. Instructors: All members of the graduate staff. Variable credit.

376. Research. Instruction in methods used in the investigation of original problems. Individual work and conferences. 1 to 6 units each. Instructors: All members of the graduate staff. Variable credit.

377. Research Orientation Seminar. A survey of departmental research. Required of all entering graduate students in chemistry. Consent of director of graduate studies required. Instructors: All members of the graduate staff. 1 unit.

Classical Studies (CLST)

Professor Davis, *Chair* (239-A Allen); Associate Professor Janan, *Director of Graduate Studies* (227 Allen); Professors Boatwright, Burian, Clay, Connor, Oates, Rigsby, Stanley, and Younger; Associate Professor Janan; Assistant Professor Woods; Professors Emeriti Newton, Richardson and Willis

The Department of Classical Studies offers graduate work leading to the A.M. and Ph.D. degrees in classical studies. Work in the department encompasses all aspects of the Greco-Roman world: students in the program are able, through course work, directed research, and their own teaching, to prepare for careers of teaching and research as broadly trained classical scholars. For regular admission, students should offer at least three years of college study in one of the classical languages and two in the other. Before developing a specialization within the program, students are expected to acquire facility in both Greek and Latin, a broad knowledge of the literatures and of

ancient history and archaeology, and command of research methods. Reading knowledge of French and German is required for the Ph.D. There are no specific course requirements for the Ph.D. in classical studies, but students normally complete their coursework by the end of the fifth semester. The resources of the department include important collections of Greek and Latin manuscripts and papyri, computer facilities in the ancient languages, and a valuable study collection of Greek and Roman art.

GREEK (GREEK)

For Seniors and Graduates

200. Intensive Readings in Greek Literature. Instructor: Staff. 3 units.

201. Readings in Greek Literature. Instructor: Staff. 3 units.

203. Homer. Problems of language, structure and interpretation in the *Iliad*; present state of Homeric scholarship and authorship. Instructor: Burian or Stanley. 3 units.

211. Greek Literature in the Roman Empire. Readings in the Second Sophistic, the novel, history, philosophy, and poetry. Instructor: Rigsby. 3 units.

220. The Presocratic Philosophers. Instructor: Clay. 3 units. C-L: Philosophy 220.

222. The Historians. Readings and studies in the major Greek historians Herodotus, Thucydides, and Xenophon. Instructor: Connor or Oates. 3 units.

301. Seminar in Greek Literature I. Selected authors and topics. Instructor: Burian, Clay, or Stanley. 3 units.

313. Seminar in Greek Epigraphy. Instructor: Rigsby. 3 units.

399. Directed Reading and Research. Credit to be arranged. Instructor: Staff. 1 to 4 units.

COURSES CURRENTLY UNSCHEDULED

205. Greek Lyric Poets

207. The Dramatists

209. Introduction to Hellenistic Literature

210. Alexandrian Poetry

221. Early Greek Prose

226. The Orators

321. Seminar in Literary Papyri

LATIN (LATIN)

For Seniors and Graduates

200. Intensive Readings in Latin Literature. Instructor: Staff. 3 units.

201. Readings in Latin Literature. Instructor: Staff. 3 units.

207S. Vergil's *Aeneid*. Intensive analysis of all of Vergil's *Aeneid*, focusing on text and historical context, complemented by research papers and reports. Instructor: Davis or Newton. 3 units.

211S. Latin Love Poetry II. Analysis of erotic themes in the works of Propertius, Tibullus, and Ovid, plus examples of "proto-elegy" by Catullus. Close attention to the stylistics of the poems, their place in the traditions of Latin love elegy, and their relation to other phenomena (historical, political, social) of the Augustan period. Instructor: Davis, Janan, or Richardson. 3 units.

217S. Latin Prose Syntax and Style. Latin prose composition combined with analysis of the style and syntax of select Latin prose authors. Instructor: Staff. 3 units.

221. Medieval Latin. Selected works of the Latin Middle Ages from Prudentius to the humanists. Genres studied include the hymn, sequence, drama, lyric, saints' lives,

chronicle, epic, and epistle. Instructor: Newton or Woods. 3 units. C-L: Medieval and Renaissance Studies 221C.

For Graduates

301. Seminar in Latin Literature I. Selected authors and topics. Instructor: Boatwright, Davis, Janan, or Newton. 3 units.

302. Seminar in Latin Literature II. Selected authors and topics. Instructor: Boatwright, Davis, Janan, or Newton. 3 units.

312. Seminar in Latin Palaeography. Instructor: Newton or Woods. 3 units.

399. Directed Reading and Research. Credit to be arranged. Instructor: Staff. 1 to 4 units. Variable credit.

COURSES CURRENTLY UNSCHEDULED

204. Epic of the Silver Age

205. The Roman Novel

206S. Cicero

214S. The Historians

314. Seminar in Latin Epigraphy

315. Seminar in Roman Law

CLASSICAL STUDIES

For Seniors and Graduates

203. Ancient Political Philosophy. 3 units. C-L: Political Science 223.

211S. Plato. Selected dialogues. Instructor: Ferejohn. 3 units. C-L: Philosophy 211S.

217S. Aristotle. Selected topics. Instructor: Ferejohn. 3 units. C-L: Philosophy 217S.

222. Fifth- and Fourth-Century Greece. From the Persian Wars to the dominance of Philip of Macedon. Instructor: Oates or Rigsby. 3 units. C-L: History 260.

223. The Hellenistic World. The Hellenistic kingdoms in the Eastern Mediterranean and the rise of Roman power. Instructor: Oates or Rigsby. 3 units. C-L: History 261.

224. The Roman Republic. The rise of Rome, to its mastery of the Mediterranean; the political, social, and cultural consequences. Instructor: Boatwright or Rigsby. 3 units. C-L: History 263.

225. The Roman Empire. The foundation, consolidation, and transformation of Roman rule from Augustus to Diocletian. Instructor: Boatwright. 3 units. C-L: History 264.

226. Late Antiquity. The institutional, intellectual, religious, and social transformation of the late Roman Empire. Instructor: Rigsby. 3 units. C-L: History 266.

227S. Topics in Roman Art. 3 units. C-L: Art History 202S.

231S. Greek Sculpture. Free standing, relief, and architectural sculpture from the Archaic period to the Hellenistic age, representing changing aesthetic, social, and political aims. Instructor: Younger. 3 units. C-L: Art History 238S.

232S. Greek Painting. 3 units. C-L: Art History 237S.

233S. Greek Architecture. Development of form and function in the various religious, civic, and domestic building types, from the Bronze Age through the Hellenistic period. Instructor: Richardson or Younger. 3 units. C-L: Art History 205S.

236S. Roman Painting. Techniques, iconography, and use in decoration. Instructor: Richardson. 3 units. C-L: Art History 227S.

240. The Literary Culture of the Latin Middle Ages. Readings in translation of medieval Latin literature and its vernacular offshoots. Instructor: Woods. 3 units.

260. The Byzantine Empire. History, politics, religion, and art and architecture of the Byzantine empire from the late Roman empire to the Turkish conquest. Instructor: Rigsby. 3 units. C-L: Medieval and Renaissance Studies 260A.

301. Proseminar: Introduction to Classical Studies. Instructor: Rigsby. 3 units.

311. Archaeology Seminar I. Selected topics. Instructor: Staff. 3 units.

312. Archaeology Seminar II. Selected topics. Instructor: Staff. 3 units.

321. Seminar in Ancient History I. Selected topics. Instructor: Boatwright, Oates, or Rigsby. 3 units.

322. Seminar in Ancient History II. Selected topics. Instructor: Boatwright, Oates, or Rigsby. 3 units.

399. Directed Reading and Research. Credit to be arranged. Instructor: Staff. 1 to 4 units. Variable credit.

COURSES CURRENTLY UNSCHEDULED

220S. Topics in Greek Art

221. Archaic Greece

230S. Topics in Early Christian and Byzantine Art

234S. Roman Sculpture

235S. Roman Architecture

258. The Hellenistic and Roman East

Computer Science (COMPSCI)

Professor Vitter, *Chair* (D315 Levine Science Research Center); Associate Professor of the Practice Lucic, *Associate Chair* (D310 Levine Science Research Center); Associate Professor Wagner, Director of Graduate Studies (D336 Levine Science Research Center); Professors Agarwal, Behringer, Biermann, Edelsbrunner, Ellis, Loveland, Marinós, Palmer, Reif, Rose, Trivedi, and Utku; Associate Professors Board, Greenside, and Kedem; Assistant Professors Arge, Chase, Lebeck, Prisant, Sun and Vahdat; Associate Professor of the Practice Astrachan, Ramm and Rodger; Professors Emeritus Gallie and Patrick; Adjunct Professor Coughran; Adjunct Associate Professor Chatterjee; Adjunct Assistant Professors Marcus, Narten, Pitsianis, and Yousif; Lecturer Duval

The Department of Computer Science offers programs leading to the M.S. and Ph.D. degrees in areas of concentration including systems, algorithms, scientific computing, and artificial intelligence. The first two years of the Ph.D. program are typically spent completing coursework, breadth, and research requirements. The breadth requirement is satisfied by passing a qualifying exam or receiving a **Iquals passmk** in four of the six subject areas covered by courses designated below with an asterisk (*). In addition, Ph.D. students complete at least four other computer science courses and two courses in a related, noncomputer science field. To satisfy the research requirement, students complete a two-semester project under faculty supervision which demonstrates ability to dissect problems, propose solutions, and analyze critically. All first-year Ph.D. students participate in a special seminar course (CPS 300) during the first semester to assist them in planning their research projects. The master's degree requires successful completion of ten courses and a thesis or project.

A student entering graduate work in computer science should have had three semesters of calculus and one semester of linear algebra, and should have a knowledge of data structures, and of assembler as well as higher-level computer programming languages. Research interests of present faculty include mathematical foundations of computer science, artificial intelligence, analysis of algorithms, programming methodology, real-time computing, operating data base systems, computer systems

design and analysis, parallel processing systems, scientific computation (including numerical analysis), and VLSI design.

Students should consult the document Graduate Degree Requirements of the Computer Science Department for degree requirements not listed in this bulletin.

For Seniors and Graduates

206. Programming Languages. Information binding, data structures and storage, control structures, recursion, execution environments, input/output; syntax and semantics of languages; study of PL/1, Fortran, Algol, APL, LISP, SNOBOL, and SIMULA; exercises in programming. Prerequisite: Computer Science 100. Instructor: Wagner. 3 units.

208. Programming Methodology. Practical and theoretical topics including structured programming, specification and documentation of programs, debugging and testing strategies, choice and effective use of programming languages and systems, psychology of computer programming, proof of correctness of programs, analysis of algorithms, and properties of program schemata. Prerequisite: Computer Science 100. Instructor: Staff. 3 units.

210. Operating Systems. Fundamental principles of operating system design applied to state-of-the-art computing environments (multiprocessors and distributed systems) including process management (coscheduling and load balancing), shared memory management (data migration and consistency), and distributed file systems. Instructor: Chase or Ellis. 3 units.

212. Distributed Information Systems. Principles and techniques for sharing information reliably and efficiently in computer networks, ranging from high-speed clusters to global-scale networks (for example, the Internet). Topics include advanced distributed file systems, distributed programming environments, replication, caching and consistency, transactional concurrency control, reliable update and recovery, and issues of scale and security for Internet information services. Prerequisite: Computer Science 210, or Computer Science 110 and 214, or consent of instructor. Instructor: Chase. 3 units.

214. Computer Networks and Distributed Systems. Basic systems support for process-to-process communications across a computer network. The TCP/IP protocol suite and the Berkeley sockets application programs interface. Development of network application programs based on the client-server model. Remote procedure call and implementation of remote procedure call. Prerequisite: knowledge of the C programming language. Instructor: Staff. 3 units.

216. Data Base Methodology. Basic concepts and principles. Relational, hierarchical, and network approaches to data organization; data entry and query language support for data base systems; theories of data organization; security and privacy issues. Not open to students who have taken Computer Science 241. Prerequisite: Computer Science 104 and either 109 or equivalent. Instructor: Staff. 3 units.

218. Compiler Construction. Models and techniques used in the design and implementation of assemblers, interpreters, and compilers. Lexical analysis, compilation of arithmetic expressions and simple statements, specifications of syntax, algorithms for syntactic analysis, code generation and optimization techniques. Instructor: Wagner. 3 units.

220. Advanced Computer Architecture I. Fundamental aspects of advanced computer architecture design and analysis, with consideration of interaction with compilers, operating systems, and application programs. Topics include processor design, pipelining, caches (memory hierarchies), virtual memory, and advanced storage systems, and simulation techniques. Advanced topics include a survey of parallel architectures and future directions in computer architecture. Prerequisite: Computer Science 104 or equivalent. Instructor: Kedem, Lebeck, or Wagner. 3 units.

221. Advanced Computer Architecture II. Fundamental aspects of parallel computer architecture design and analysis, including hardware/software tradeoffs, interactions with compilers, operating systems, run-time libraries, and parallel applications. Topics include parallel programming, message passing, shared memory, cache coherence, cache consistency, bus-based shared memory, distributed shared memory, interconnection networks, synchronization, on-chip parallelism. Prerequisite: Computer Science 220 or equivalent. Instructor: Lebeck. 3 units.

225. Fault-Tolerant and Testable Computer Systems. 3 units. C-L: Electrical Engineering 254.

226. Mathematical Methods for Systems Analysis I. Basic concepts and techniques used in the stochastic modeling of systems. Elements of probability, statistics, queuing theory, and simulation. Prerequisite: four semesters of college mathematics. Instructor: Trivedi. 3 units. C-L: Electrical Engineering 255.

230. Design and Analysis of Algorithms. Design and analysis of efficient algorithms. Algorithmic paradigms. Applications include sorting, searching, dynamic structures, graph algorithms, randomized algorithms. Computationally hard problems. NP completeness. Prerequisite: Computer Science 100 or equivalent. Instructor: Agarwal, Arge, or Reif. 3 units.

232. Mathematical Analysis of Algorithms. Techniques for efficient implementation and precise analysis of computer algorithms. Combinatorial mathematics and elementary probability. Emphasis on obtaining exact closed-form expressions describing the worst-case or average-case time and space requirements for particular computer algorithms, whenever possible. Asymptotic methods of analysis for obtaining approximate expressions in situations where exact expressions are too difficult to obtain or to interpret. Prerequisite: Mathematics 103 and 104 or equivalents. Instructor: Vitter. 3 units.

234. Computational Geometry. Models of computation and lower-bound techniques; storing and manipulating orthogonal objects; orthogonal and simplex range searching, convex hulls, planar point location, proximity problems, arrangements, linear programming and parametric search technique, probabilistic and incremental algorithms. Prerequisite: Computer Science 230 or equivalent. Instructor: Agarwal or Reif. 3 units.

235. Topics in Data Compression. Emphasis on the redundancies found in textual, still-frame images, video, and voice data, and how they can be effectively removed to achieve compression. The compression effects in information processing. Additional topics may include information theory, the vulnerability of compressed data to transmission errors, and the loss of information with respect to the human visual system (for image data). Available compression technologies and the existing compression standards. Prerequisite: Computer Science 130 and 208 or Computer Science 254 or Electrical Engineering 282. Instructor: Markas or staff. 3 units.

236. Parallel Algorithms. Models of parallel computation including parallel random access machines, circuits, and networks; NC algorithms and P-completeness; graph algorithms, sorting algorithms, network routing, tree contraction, string matching, parsing algorithms; randomization and derandomization techniques. Prerequisite: Computer Science 230 or equivalent. Instructor: Reif. 3 units.

237. Randomized Algorithms. Models of computation, Las Vegas and Monte Carlo algorithms, linearity of expectation, Markov and Chebyshev inequalities and their applications, Chernoff bound and its applications, probabilistic methods, expanders, Markov chains and random walk, electric networks and random walks, rapidly mixing Markov chains, randomized data structures, randomized algorithms for graph problems, randomized geometric algorithms, number theoretic algorithms, RSA cryptosystem, derandomization. Prerequisite: Computer Science 230. Instructor: Agarwal and staff. 3 units.

240. Computational Complexity. Turing machines, undecidability, recursive function theory, complexity measures, reduction and completeness, NP, NP-Completeness, co-NP, beyond NP, relativized complexity, circuit complexity, alternation, polynomial time hierarchy, parallel and randomized computation, algebraic methods in complexity theory, communication complexity. Prerequisite: Computer Science 140 or equivalent. Instructor: Agarwal. 3 units.

250. Numerical Analysis. Error analysis, interpolation and spline approximation, numerical differentiation and integration, solutions of linear systems, nonlinear equations, and ordinary differential equations. Prerequisite: knowledge of an algorithmic programming language, intermediate calculus including some differential equations, and Mathematics 104. Instructor: Rose or Sun. 3 units. C-L: Mathematics 221, Statistics and Decision Sciences 273.

254. Numerical Linear Algebra. Solution of large, sparse linear systems of equations. Storage schemes, graph theory for sparse matrices, different orderings to minimize fill, block factorizations, iterative methods, analysis of different splittings, conjugate gradient methods. Eigen value problems, QR factorization, Lanczos method, power method and inverse iteration, Rayleigh quotient. Prerequisite: Computer Science 250 or equivalent. Instructor: Rose or Sun. 3 units. C-L: Mathematics 223.

260. Introduction to Computational Science. Introduction for students and faculty to computing resources that facilitate research involving scientific computing: contemporary computers, programming languages, numerical software packages, visualization tools, and some basic issues and methods for high performance algorithm design. Prerequisite: programming experience in Fortran or C, calculus, numerical-linear algebra or equivalent. Instructor: Greenside, Rose, or Sun. 3 units.

264. Nonlinear Dynamics. 3 units. C-L: Physics 213.

270. Artificial Intelligence. Heuristic versus algorithmic methods; programming of games such as chess; theorem proving and its relation to correctness of programs; readings in simulation of cognitive processes, problem solving, semantic memory, analogy, adaptive learning. Prerequisite: Computer Science 100 or consent of instructor. Instructor: Biermann or Loveland. 3 units.

271. Numeric Artificial Intelligence. Introduction to the core areas of artificial intelligence from a quantitative perspective. Topics include planning in deterministic and stochastic domains; reasoning under uncertainty, optimal decision making; computer speech, computer vision, and robotics; machine learning, supervised and reinforcement learning; natural language processing; agents. Minimal overlap with Computer Science 270. Prerequisite: Computer Science 100 or consent of instructor. Instructor: Littman. 3 units.

274S. Computational Linguistics Seminar. Readings and research seminar on topics related to the processing of English or other natural languages: syntax, semantics, pragmatics, discourse, and others. Prerequisite: Computer Science 270 or consent of instructor. Instructor: Biermann. 3 units.

296. Advanced Topics in Computer Science. Instructor: Staff. 3 units.

For Graduates

300. Computer Science Research Seminar. The course is designed to orient first-year graduate students and to provide an in-depth look at the research projects going on in the department. The course also emphasizes the necessary skills for research investigation and presentation in computer science. In particular, instruction is given in how to formulate research problems or projects, identify goals, and present results. (Concentration on the problem-solving aspect of research is the focus of the research project or thesis during the following semester.) Students will make and critique technical presentations, both oral and written. Not open to students who have taken Computer Science 303. Instructor: Vitter. 3 units.

310. Topics in Operating Systems. Not open to students who have taken Computer Science 332. Instructor: Staff. 3 units.

315. Computer Systems Seminar. Topics in computer systems. 1 to 3 units. Instructor: Staff. 3 units.

320. Advanced Topics in Digital Systems. A selection of advanced topics from the areas of digital computer architectures and fault-tolerant computer design. Prerequisite: Electrical Engineering 252 or equivalent. Instructor: Staff. 3 units. C-L:

322. Advanced VLSI Design. Theory of advanced VLSI design. Specifications development, methodology, issues, circuit-level trade-offs. Full custom design, standard cell design, gate array design, silicon compilation. Semiconductor technologies and logic families for semi-custom design. Clocking schemes and distribution, race conditions. Design of a variety of circuits (adders, I/O drivers, RAM, FIFO, etc.) Testing of all phases in the life cycle of an integrated circuit. Top-down design and bottom-up implementation. Student projects. Not open to students who have taken Computer Science 310 before Fall 1994. Prerequisite: Electrical Engineering 261 or equivalent. Instructor: Kedem. 3 units. C-L: Electrical Engineering 361.

327. Seminar in Computer Systems Analysis. Topics in computer systems analysis, especially for fault-tolerant systems, including reliability, availability and performance analysis, comparative analysis of architectures, performability, analytic and numerical solution techniques, stochastic Petri nets, simulation. Not open to students who have taken Computer Science 381. Instructor: Trivedi. 1 to 3 units.

331. Operating Systems Theory. Advanced study of theoretical aspects of operating systems emphasizing models and control of concurrent processes, processor scheduling, and memory management. Prerequisite: Computer Science 226 and 231. Instructor: Ellis or Wagner. 3 units.

340. Theory of Computation. Not open to students who have taken Computer Science 325. Instructor: Staff. 3 units.

350. Topics in Numerical Mathematics. Advanced topics in numerical mathematics to be selected from areas of current research. Not open to students who have taken Computer Science 321. Prerequisite: Computer Science 250 and 252. Instructor: Green-side, Rose, or Sun. 3 units.

355. Principles of Research Management. A survey of topics in modern research management techniques that will cover proven successful principles and their application in the areas of research lab organization, resource management, organization of technical projects, team leadership, financial accountability, and professional ethics. Instructor: Staff. 1 unit.

364. Advanced Topics in Nonlinear and Complex Systems. Survey of current research topics that may include: advanced signal analysis (wavelets, Karhunen-Loeve decomposition, multifractals), bifurcation theory (amplitude and phase equations, symmetry breaking), spatio-temporal chaos, granular flows, broken ergodicity, complexity theory of dynamical systems, and adaptive systems (genetic algorithms, neural networks, artificial life). Emphasis on quantitative comparisons between theory, simulations, and experiments. Not open to students who have taken Computer Science 313. Prerequisite: Computer Science 264 or Physics 213; recommended: Physics 230, 231, and 303 or equivalents. Instructor: Behringer, Greenside, or Palmer. 3 units. C-L: Physics 313.

370. Seminar in Artificial Intelligence. Topics in artificial intelligence, such as natural language understanding, learning, theorem proving and problem solving, search methodologies. Topics will vary from semester to semester. Includes research literature reading with student presentation. Not open to students who have taken Computer Science 382. Instructor: Staff. 1 to 3 units.

376. Advanced Topics in Artificial Intelligence. Course content will vary from year to year and will include a detailed study of one or more of the following: mechanical theorem proving, natural language processing, automatic program synthesis, machine learning and inference, representations of knowledge, languages for artificial intelligence research, artificial sensorimotor systems, and others. Not open to students who have taken Computer Science 315. Prerequisite: Computer Science 270. Instructor: Biermann or Loveland. 3 units.

391. Internship. Student gains practical computer science experience by taking a job in industry, and writes a report about this experience. Requires prior consent from the student's advisor and from the director of graduate studies. May be repeated with consent of the advisor and the director of graduate studies. Credit/no credit grading only. Instructor: Staff. 1 unit.

395. Research. Instruction in methods used in the investigation of original problems. Individual work and conferences. 1 to 6 units. Instructor: All members of the graduate staff. 1 to 6 units. Variable credit.

399. Special Readings. Staff. 1 to 4 units. Variable credit.

COURSES CURRENTLY UNSCHEDULED

222. Introduction to VLSI Systems

223. Application Specific VLSI Design

242. Logic for Computer Science

252. Numerical Methods for Partial Differential Equations

256. Functional Analysis for Scientific Computing

266. Communication, Computation, and Memory in Biological Systems

291. Reading and Research in Systems

292. Reading and Research in Algorithms and Complexity

293. Reading and Research in Scientific Computing

294. Reading and Research in Artificial Intelligence

326. Systems Modeling

337. VLSI Algorithmics

Computational Science and Engineering (CSE)

Professor Board, *Director of Graduate Studies*

The objective of the graduate certificate program in computational science and engineering (CSE) is to facilitate interdisciplinary training in the use of modern computational techniques in the conduct of research. This broad charter encompasses algorithmic, numerical, and implementation issues. The expectation is not that a student will be expert in all these areas after limited course-time available via a certificate program, but rather that a student will have an awareness that all of these areas are important. The program is designed for Ph.D. students who have been admitted to one of the participating departments, though applications from terminal M.S. students who are pursuing a thesis option will be accepted. Students will be expected to take credit for three CSE courses. Additionally, some component of a student's dissertation or thesis research is expected to involve significant computation, and at least one member of the CSE-affiliated faculty will serve on the student's dissertation or thesis committee. Participation in CSE seminars will be encouraged and expected, and internships or other off-site work experiences at industrial or government labs will be encouraged and facilitated. For more information, contact the director of graduate studies at Computational Science and Engineering, Box 90291, Durham, North Carolina 27708; email: jab@ee.duke.edu; web site: <http://www.ee.duke.edu/~jab/CSE>.

Cultural Anthropology (CULANTH)

Professor O'Barr, *Chair*; Associate Professor Piot, *Director of Graduate Studies*; Professors Apte, Andrews (Slavic languages), Butters (English), Dirlík (history), Mignolo (Romance studies), Quinn, and Reddy (history); Associate Professors Allison, Baker, Ewing, Silverblatt, Starn, and Tetel (English); Assistant Professors Daniels, Litzinger, and Meintjes (music); Adjunct Professors Conley and Peacock; Professor Emeritus Friedl

The department offers graduate work leading to the Ph.D. degree in cultural anthropology. It also participates in a program with the law school leading to a joint J.D./M.A. degree. Students are expected to take an active role in development of their own research goals and design of their own plan of study, as well as their pursuit of relevant cross-disciplinary background, within and outside the department. Requirements include courses in anthropological theory and research methodology, as well as spoken and/or written competence in at least one foreign language, at the level appropriate to the planned research program. The core courses include two year-long sequences: Theories in Cultural Anthropology (330S, 331S), required of first-year graduate students, and Research Seminar in Cultural Anthropology (332S, 333S), required in the fourth and fifth semesters. Students must also take an approved methods course. Field research is required in the summer following the second year of classes. The *Guidelines for Graduate Students in the Doctoral Program in Cultural Anthropology* and the *Guidelines for Graduate Students in the J.D./M.A. Program* fully describe these and additional requirements and the detailed steps in the student's graduate career.

Applications for admission are accepted in alternate years. Applications to the J.D./M.A. program are accepted every year. Please contact the departmental web site at <http://ca-www.aas.duke.edu> or send email to duca@socsci.duke.edu for further information.

For Seniors and Graduates

201S. Marxism and Anthropology. The interaction of Marxist and anthropological theory over the last half century; particular attention to evolution, historical transformation, mode of production, labor processes, culture, ideology, and consciousness. Instructor: Staff. 3 units.

202. Semiotics of Culture. 3 units. C-L: English 206, Russian 202.

207S. Anthropology and History. Recent scholarship that combines anthropology and history, including culture history, ethnohistory, the study of mentalité, structural history, and cultural biography. The value of the concept of culture to history and the concepts of duration and event for anthropology. Prerequisite: major in history, one of the social sciences, or comparative area studies; or graduate standing. Instructor: Reddy. 3 units. C-L: History 210S.

208S. Postcolonial Anthropology. Interdisciplinary approach to the review and critique of postcolonial ethnography and historiography. How postcolonial scholarship questions historical modes of cultural ordering and representation and envisions new modes of reading and writing in relation to global structures of domination. Instructor: Ewing, Litzinger, Silverblatt, or Starn. 3 units.

216S. Gender, Race, and Class. Gender, race, and class as theoretical constructs and lived experiences. Analytical frameworks include social history, discourse analysis, critical theory, cultural studies, and feminist theories. Consent of instructor required. Instructor: Staff. 3 units. African and African American Studies 216S, Women's Studies.

232S. Historical and Anthropological Approaches to Emotion. 3 units. C-L: History 232AS.

234S. Political Economy of Development: Theories of Change in the Third World. 3 units. C-L: Political Science 234S, Sociology 234S.

249S. Anthropology and Psychology. The necessity of psychology to any adequate theory of cultural processes, and the application of psychological theory from cognitive studies, social psychology, psychoanalysis, and other fields to anthropological questions including culture acquisition, cultural universals, culturally expressed psychic conflicts, gender, sexuality, and variability and stability in culturally shared thoughts, emotions, and motivations. Prerequisite: Cultural Anthropology 151 or consent of instructor. Instructor: Quinn. 3 units. C-L: Psychology 249S.

250S. The Cultural Analysis of Discourse. Theoretical approach to culture and methods for the investigation of culture through analysis of discourse, especially interview texts. Application of this approach and these methods to the study of a domain of American culture. Instructor: Apte or Quinn. 3 units.

251. Cognitive Anthropology. A cognitively-based theory of culture, its history, justification, substantiation through discourse analysis, application to everyday understanding, feeling and motivation, and implications for the acquisition of culture, cross-cultural variation, and cultural universals in human thought. Readings; individually designed research project involving the cultural analysis of discourse. Not open to students who have taken Cultural Anthropology 151. Instructor: Quinn. 3 units.

253S. Person-Centered Interviewing. Strategies for effective interviewing, including how to establish rapport, ask productive questions, recognize nonverbal communications, and interpret data using various theoretical models. Students are required to conduct several interviews during the semester. Consent of instructor required. Instructor: Ewing. 3 units.

254. East Asian Cultural Studies. 3 units. C-L: Asian and African Languages and Literature Studies 253.

255. Anthropology as Public Discourse. The historic role of science in general and anthropology in particular in shaping United States public discourse on culture, immigration, race, and ethnicity. Anthropological texts within their historical and political contexts; how policy experts, pundits, legislators, and others appropriate anthropological ideas for specific agendas. Particular attention given to arguments about race and culture, and how science, as an epistemology, has been used in political and policy debates. Instructor: Baker. 3 units. C-L: African and African American Studies 255.

260. Modern Japanese Literature and Culture. An examination of modern Japanese culture through a variety of media including literary texts, cultural representations, and films. Different material each year; may be repeated for credit. (Same as Asian and African Languages and Literature 162 but requires extra assignments.) Instructor: Ching or Yoda. 3 units. Asian and African Languages and Literature Studies 262.

265S. Anthropological Approaches to Life History. Form and function of life history and its linkages to sociocultural systems; methodology for collecting life history in ethnographic fieldwork; textual, social-structural, and interpretive analyses of life history. Instructor: Apte. 3 units.

279S. Race, Racism, and Democracy. The paradox of racial inequality in societies that articulate principles of equality, democratic freedom, and justice for all. Instructor: Baker. 3 units. C-L: African and African American Studies 279S.

280S. Seminar in Selected Topics. Special topics in methodology, theory, or area. Consent of instructor required. Instructor: Staff. 3 units.

281S. Seminar in Selected Topics. Special topics in methodology, theory, or area. Consent of instructor required. Instructor: Staff. 3 units.

282S. Canada. 3 units. C-L: Canadian Studies 282S, History 282S, Political Science 282S, Sociology 282S.

284S. Transnationalism and Public Culture. Critical examination of issues in transnational studies in anthropology and beyond. Tracking the theories of contemporary scholars of the global, and examining new multisited strategies of method, we explore the emerging ethnographic landscape of the global and the role transnational studies is playing in a revitalized anthropology of the twenty-first century. Consent of instructor required. Instructor: Staff. 3 units.

288S. Seminar in Asian and African Cultural Studies. Concentration on a theoretical problem or set of issues germane to the study of Asian and African cultures. Instructor: Staff. 3 units. C-L: African and African American Studies 200S, Asian and African Languages and Literature Studies 200S, Literature 200S.

290. Research Methods in Japanese. Introduction to various research approaches to literary, sociological, and historical studies of Japan. Emphasis on bibliographical sources that best serve needs in chosen area of specialization. Consent of instructor required. Instructor: Staff. 3 units. C-L: History 292, Japanese 291, Political Science 291, Sociology 291.

For Graduates

300S. Popular Culture, Theories and Practices. Theories and writings about popular culture questioning what it is, its relation to mass and dominant culture(s), what politics and pleasures it carries, and how it varies over time and across space. Project-based with emphasis on conducting studies of popular culture. Focus on methodology analyzing specific forms of popular culture. Issues include transnationalism, capitalism, postmodernism, production, consumption, ethnography, fantasy, and identity. Instructor: Allison. 3 units.

330S. Theories in Cultural Anthropology. A two-semester seminar in which the historical development of the field and its modern currents and debates are examined and discussed. Particular topics to be chosen by the instructors. Instructor: Staff. 3 units.

331S. Theories in Cultural Anthropology. A two-semester seminar in which the historical development of the field and its modern currents and debates are examined and discussed. Particular topics to be chosen by the instructors. Instructor: Staff. 3 units.

332S. Research Seminar in Cultural Anthropology. Yearlong individual projects, from research design and proposal writing through summer field research, to data analysis, theory development, and write-up as publishable papers. Approaches, methods, and lessons appropriate to these projects. Instructor: Staff. 3 units.

333S. Research Seminar in Cultural Anthropology. Yearlong individual projects, from research design and proposal writing through summer field research, to data analysis, theory development, and write-up as publishable papers. Approaches, methods, and lessons appropriate to these projects. Instructor: Staff. 3 units.

380S. Advanced Selected Topics. Special topics in methodology, theory, or area. Consent of instructor required. Instructor: Staff. 3 units.

382S. Music; Studies in Ethnomusicology. A theoretical and methodological exploration of ethnomusicological approaches to the study of music and related expressive forms. Topics vary. Instructor: Meintjes. 3 units. C-L: Music 382S.

393. Individual Research in Cultural Anthropology. Supervision and guidance of A. M. thesis preparation, Ph. D. dissertation preparation, or other intensive research on a selected problem. Instructor: Staff. 3 units.

399. Special Readings. Supervision and guidance of selected readings at an advanced level. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

206S. Anthropological Controversies

210S. Ideology and the Image in Ethnographic Film

- 211S. Ethnography of Communication
- 215S. The Anthropology of Gender: Theoretical Issues
- 217. Culture Versus Nature? History and Ecology in Anthropology
- 219. Language and Social Theory
- 220S. Theoretical Bases of Social Interpretation
- 261. Religion: Tradition and Cultural Innovation
- 263. The Bestseller: Cultural Populism in the 1990s' China
- 270S. Non-Western Indigenous Anthropology
- 272S. Marxism and Feminism

Program for the Study of Democracy, Institutions, and Political Economy

John Aldrich, Ph.D. and Robert O. Keohane, Ph.D., *Directors*

The Program for the Study of Democracy, Institutions, and Political Economy seeks to encourage intellectual interchange within the Department of Political Science, with other political scientists, and with members of cognate disciplines such as economics, history, and sociology. It does so by emphasizing four themes: democratization and democracy; institutions and organization; international politics and security; and values, culture, and behavior. The program seeks to encourage work both on these themes, which cross conventional subfields in political science and extend to other disciplines, and work that bridges them.

The Graduate School offers a certificate in political economy. The certificate is awarded to graduate students in the departments of economics and political science who successfully complete a series of courses designed to provide interdisciplinary training. Completion of the certificate should enable a student to teach and conduct research in the field of political economy. Work in this field should also be sufficiently compatible with the student's departmental training to enable students to present themselves on the market with the disciplinary credentials to secure an academic appointment.

To earn the certificate in political economy, a student must successfully complete a minimum of five courses, three of which are to be drawn from the core courses and two from a specialized area. One of the three core courses and two of the five courses overall must be in economics, taken in the Department of Economics, the Fuqua School of Business, or the Sanford Institute of Public Policy. All of these courses must be at the graduate level, unless an exception is approved by the program director.

All students seeking the certificate are also required to complete successfully at least two courses within the following fields of specialization: individual and social choice; normative political theory and the history of economic thought; and governments and markets.

For additional information about a certificate, contact Professor John Aldrich or Professor Michael Munger, Duke University, Department of Political Science, 214 Perkins Library, Box 90204, Durham NC 27708-90204, 919/660-4300.

Earth and Ocean Sciences (EOS)

Professor Karson, *Chair* (206B Old Chemistry); Associate Professor Boudreau, *Director of Graduate Studies* (305 Old Chemistry); Professors Baker, Barber, Corliss, Haff, Kay, Livingstone, and Schlesinger; Associate Professors Clark, Klein, Lozier, Malin, Murray; and Rojstaczer; Adjunct Associate Professor Spivack; Assistant Professors Klein, Murray, and Pratson; Adjunct Faculty Feingloss, Gillette, and Molnia; Professors Emeriti Heron, Perkins, and Pilkey

The Division of Earth and Ocean Sciences of the Nicholas School of the Environment (formerly the Department of Geology, School of Arts and Sciences) offers graduate work leading to the M.S. and Ph.D. degrees in earth and ocean sciences. Active research areas of the staff include: aquatic geochemistry, biogeochemistry, carbonate diagenesis, clastic and carbonate facies analysis, continental margin and deep-sea sedimentation, coastal and near-shore processes, desert studies, economic geology, hydrogeology, igneous petrology and geochemistry, isotope geochemistry, limnology, marine micropaleontology, paleoecology, paleoceanography, paleoclimatology, sediment dynamics, seismology, structure and development of transform faults, rift basins, spreading centers and passive margins, and tectonics. Research projects have involved fieldwork throughout North and South America, across Africa, as well as the world's oceans. In addition, the division is home of the Duke University Program for the Study of Developed Shorelines, which focuses on man's impact on the world's coastal areas; the Center for Hydrologic Science, which provides a cohesive program in research and graduate education in hydrology; and the journal *Southeastern Geology*.

Laboratory facilities available in the department are described in this bulletin under the chapter "Resources for Study."

Degree Requirements

Students entering the graduate program normally have an undergraduate degree in geology or one of the other natural sciences. It is expected that the incoming student will have taken one year of college chemistry, one year of college physics, and mathematics through calculus. Both M.S. and Ph.D. graduate students take 30 credit hours of courses and research. Typically, the total time for a Ph.D. degree is five years past the B.S. or three years past the M.S. Because the division encourages participation in fieldwork and other research opportunities outside the university, there are no firm time limits for degrees, except as required by the university.

Up-to-date information about the division and the faculty can be found on our web site, at <http://www.eos.duke.edu/>. For further information on the graduate program, send email inquiries to dgs@eos.duke.edu.

For Seniors and Graduates

200. Beach and Coastal Processes. The study of sedimentary processes and geomorphology of nearshore environments with emphasis on both developed and undeveloped barrier island systems. Instructor: Staff. 3 units.

201L. Physical Processes in Coastal Environments. 3 units. C-L: Environment 222L, Marine Sciences.

202. Beach and Island Geological Processes. Field seminar in the evolution of beaches and barrier islands with emphasis on the interaction of nearshore processes with the trappings of man. Consent of instructor required. (Given at coast on two week-ends.) Instructor: Staff. 3 units.

203. Physical Oceanography. Introduction to the dynamic principles of ocean circulation with an emphasis on large temporal and spatial scales of motion. Topics include wind-driven and density-driven flow, western boundary intensification, mid-ocean, shelf, and tropical circulations. Prerequisite: Mathematics 31 and 32 or consent of instructor. Instructor: Lozier. 3 units. C-L: Environment 290.

205. Geological Oceanography. 3 units. C-L: Environment 291, Marine Sciences.

206S. Principles of Geological Oceanography. Geological aspects of the ocean basins including coastal to deep water sediment types and sedimentation processes, sea floor physiography, and environmental problems. Not open to students who have taken Earth and Ocean Sciences 205. Consent of instructor required. Instructor: Baker. 3 units.

207S. Analysis of Coastal Engineering Models. A critical evaluation of the assumptions and principles underlying coastal engineering mathematical models used to predict the behavior of beaches. Involves classroom discussion of both the geology and engineering modeling literature. Consent of instructor required. Instructor: Staff. 3 units.

209S. Climate Dynamics and the Paleoclimatic Record. Introductory readings and reviews of modern physical climatology followed by extensive readings covering the record of past climatic change, concentrating on latest Quaternary and Holocene time. Topics include the global energy balance, the hydrologic cycle, general circulation of the atmosphere and oceans, climate modeling, future climate change, and the known record of paleoclimate (from marine and lake sediments, corals, soils, ice cores, etc.). Some background in physical sciences recommended. Instructor: Baker. 3 units.

213. Modern and Ancient Oceanic Environments. Description of oceanic environments and geological processes that create or modify them through time. Reconstruction of paleoenvironmental/paleoceanographic conditions in the world's oceans using sediments and fossils with emphasis on global climate change over a range of time scales. Inductive interpretations of geological data to construct paleoenvironmental models. Includes field trip. Research paper required. Instructors: Corliss, Klein, and staff. 3 units.

215. Introduction to Physical Coastal Processes. Nearshore physical processes responsible for the evolution of beaches and barrier islands. Various problems and possible solutions arising from human development of retreating shorelines. Involves a field trip and research paper. Consent of instructor required. Instructor: Murray. 3 units.

221. Hydrogeology. Theory of groundwater flow and solute transport with application to geologic processes, water resources, and water quality. Prerequisite: Chemistry 12L, Mathematics 103, and Physics 42L or consent of instructor. Instructor: Rojstaczer. 3 units.

233S. Oceanic Crust and Ophiolites. Structure, tectonics, petrology, and geochemistry of oceanic spreading environments and ophiolite complexes. Prerequisite: Earth and Ocean Sciences 106L and 130L or consent of instructor. Instructor: Karson. 3 units.

236S. Lithosphere Plate Boundaries. Plate tectonics and the geological and geophysical expression of orogenic belts, spreading centers, transform faults, subduction zones. Prerequisite: Earth and Ocean Sciences 130L or consent of instructor. Instructor: Karson. 3 units.

239S. Advanced Topics in Structural Geology and Tectonics. Selected topics related to deformation of rocks ranging from microstructure to plate tectonics. Prerequisite: Earth and Ocean Sciences 130L or consent of instructor. Instructor: Karson. 3 units.

240. Introduction to Modeling in the Earth Sciences. Elementary methods for quantitatively modeling problems in the earth sciences. Formulation and solution of classic equations that express fundamental behaviors of fluids, sediments, and rocks. Examples from different fields of geology. Simple modeling exercises, including a final project. Consent of instructor required. Instructors: Haff, Murray, and Pratson. 3 units.

241S. Coastal Processes and Geomorphology. Selected readings in near shore processes and pattern formation, ranging from beach scales (for example, bars and channels) to shoreline scales (for example, barrier islands, and capes), and ranging from coastal plain to rocky and arctic coasts. Optional field trip to study ocean island geomorphology in Hawaii after the semester. Consent of instructor required. Instructor: Murray. 3 units.

242S. New Perspectives and Methods in Surface Process Studies. Nonlinear dynamics and related approaches to understanding, modeling, and analyzing physical systems, with emphasis on applications in the geomorphology. Consent of instructor required. Instructor: Murray. 3 units.

243S. Advanced Geomorphology. How landscape changes with time. The dynamics and mechanisms underlying earth surface processes. Discussion of quantitative models. Hillslope, fluvial, marine, glacial, periglacial, volcanic, tectonic, and aeolian processes. Consent of instructor required. Instructor: Haff or Murray. 3 units.

244. Sedimentary Basins. Relationship between fundamental patterns of basin infilling, regional sedimentary processes and how they interact with global sea level change and tectonics. Introduction to sequence stratigraphy. Key concepts illustrated using computer and laboratory models. Field trip to the Guadalupe Mountains in West Texas. Hands-on exercises using seismic reflection data, well logs, and industry interpretation software. Consent of instructor required. Instructor: Pratson. 3 units.

245S. Desert Landforms and Processes. Geomorphic processes and landforms in arid regions. Consent of instructor required. Instructor: Haff. 3 units.

246S. Nearshore Hydrodynamics and Sediment Transport. Phenomena resulting from waves, wave momentum (radiation stress), and wave interactions. Includes oscillatory flow, long period (infragravity) motions, and mean currents. Nearshore sediment transport and possible origins of beach and nearshore topographic features. Consent of instructor required. Instructor: Murray. 3 units.

247S. Natural History of the Great Basin. Integrated study of the geomorphology, hydrology, climate, biology, and anthropology of the internally drained areas of Nevada, California, Utah, and Oregon. Comparison of Ice Age and modern features including lakes, soils, vegetation, animals, and humans. Consent of instructor required. Instructor: Haff. 3 units.

250. Applied Mathematics for the Environmental and Earth Sciences. Mathematical methods used in modeling and data analysis of environmental and geologic problems. Data sets or quantitative problems from the students used as original problems, to be completed as a final quantitative research product at the end of the semester. Different mathematical modeling approaches compared and evaluated. Focus depends on the research areas of class members. Instructor: Staff. 3 units.

252. Geophysics and Crustal Dynamics. A critical and mathematical evaluation of the earth's seismology, gravity, magnetism, heat flow, and internal dynamics. Derivation and evaluation of the basic equations of geophysics and geodynamics. The physics and computer methods of the locations and mechanics of earthquakes, seismotectonics and crustal dynamics, the earth's internal layers, the gravitational attraction of mountains, the magnetic properties of rocks, the cooling of the earth, and the basics of continental drift. Original research project required. Prerequisite: upper division or first-year graduate standing in science or engineering. Instructor: Malin. 3 units.

258S. Practical Experience in Modern Seismic Profiling II: Data Processing. Second of a three-course sequence in the application of seismic profiling in geological investigations for research, resource, and environmental purposes; signal processing step necessary to process portions of the 3D seismic reflection profiling from central Texas into interpretable images of the geology. Background topics include basic methods and theory of seismic data processing; focus on applying these methods to the field data. Prerequisite: Earth and Ocean Sciences 257S. Instructor: Malin. 3 units.

269. Thermodynamics of Geological Systems. Introductory thermodynamics applied to geologic problems through understanding of phase equilibrium. Prerequisite: Earth and Ocean Sciences 105L (may be concurrent) and Mathematics 32. Instructor: Boudreau. 3 units.

270. Sedimentary Geochemistry. Chemistry of aqueous solutions and authigenic minerals in sedimentary systems. Prerequisite: Chemistry 12L and Mathematics 32. Instructor: Baker. 3 units.

271. Stable and Radioactive Isotopes in Environmental Sciences. Theory and applications of stable and radioactive isotope distributions in nature (including oceano-

graphic, geologic, hydrologic, and biological processes). Prerequisite: Chemistry 12L and Mathematics 32. Instructor: Baker. 3 units.

272. Biogeochemistry. Processes controlling the circulation of carbon and biochemical elements in natural ecosystems and at the global level, with emphasis on soil and surficial processes. Topics include human impact on and social consequences of greenhouse gases, ozone, and heavy metals in the environment. Prerequisite: Chemistry 12L or equivalent. Instructor: Schlesinger. 3 units. C-L: Biology 272.

273S. Analytic Techniques. An introduction to advanced analytic procedures used in the earth sciences: such as electron microbeam techniques (scanning electron microscopy, electron microprobe analysis) and plasma emission/absorption spectroscopy. Consent of instructor required. Instructors: Boudreau and Klein. 3 units.

275. Near-Surface Field Geophysics. Field oriented class in near-surface geophysical profiling for scientific and engineering uses. Covers the use of basic seismic and potential field methods for determining shallow geological structure and stratigraphy. Required data collection, analysis, and interpretation project. Consent of instructor required. Prerequisite: upper division or first-year graduate standing in science or engineering. Instructors: Boadu and Malin. 3 units.

285S. Layered Intrusions. Survey of layered igneous intrusions and current theories on crystallization and other processes occurring in mafic magmas. Quantitative methods related to magma crystallization including crystal size distribution theory, quantitative analysis of rock texture and its interpretation, crystal aging and numerical models of compaction, infiltration and reaction processes occurring in magma chambers. Offered alternate years. Research paper and presentation required. Prerequisite: Earth and Ocean Sciences 105L and 106L or consent of instructor. Instructor: Boudreau. 3 units.

291. Independent Study. Consent of instructor required. Instructor: Staff. 3 units.

293S. Frontiers of Geology I. Survey of the history, status, and trajectory of "hard-rock" petrology, structural geology, tectonics, and geophysics. Instructors: Karson and staff. 3 units.

294S. Frontiers of Geology II. Survey of the history, status, and trajectory of "soft-rock" petrology, stratigraphy, sedimentation, geochemistry, hydrology, and paleontology. Instructors: Karson and staff. 3 units.

295S. Advanced Topics in Geology. Topics, instructors, and credits to be arranged each semester. Instructor: Staff. 1 to 4 units. Variable credit.

For Graduates

321L. Methods in Hydrogeology. Field and laboratory methods for investigation of applied hydrogeology problems. Must be taken concurrently with Earth and Ocean Sciences 221. Open to graduate students only. Instructor: Rojstaczer. 1 unit.

371. Advanced Topics in Geology. To meet the individual needs of graduate students for independent study. Instructor: Staff. 1 to 4 units. Variable credit.

372. Advanced Topics in Geology. To meet the individual needs of graduate students for independent study. Instructor: Staff. 1 to 4 units. Variable credit.

COURSES CURRENTLY UNSCHEDULED

208S. Paleooceanography

222L. Statistics and Data Analysis in Earth and Ocean Science

223. Computational Methods in the Hydrologic Sciences

230S. Advanced Structural Geology

237S. Structure and Evolution of the Appalachian Orogen

259S. Practical Experience in Modern Seismic Profiling III: Geological Interpretation

East Asian Studies

Professor Lin, *Director of Graduate Studies*; Professors Corless, Dirlik, Horowitz, Lewin and Zeng; Associate Professors Allison, Li, Mazuka, McKean, Niou, Wang, Wigen, and Zhou; Assistant Professors Abe, Ching, Gao, Litzinger, Mazumdar, Nickerson, Partner, Shi, Weisenfeld, Yang, and Yoda; Assistant Professors of the Practice Endo, Kim, and Lee; Adjunct Assistant Professor Troost; Instructor Uno and Soo-Hoo

The master's degree in East Asian studies requires ten courses (including an integrated core course), of which at least eight must be in East Asian studies, drawn from two or more departments or programs, with no more than four courses in any one department. Two language courses may be counted as part of the ten courses needed for the degree. Courses should be chosen in consultation with an advisor. In lieu of a thesis, each student, after consulting with his/her advisor, will submit a research paper, produced in a capstone course taken during the program, to the graduate committee. At least one other faculty member in a related field will read, evaluate, and accept this paper as an adequate research document, meeting professional requirements. The degree is dependent on the acceptance of the research paper by the graduate committee and successful completion of an oral examination on this paper by an M.A. advisory committee of at least three people. At the conclusion of the program, students must have attained advanced proficiency in one East Asian language, equivalent to three years of college-level study. It is strongly recommended that applicants complete at least one year of such language study before beginning the program. Students whose native tongue is an East Asian language are encouraged to take one year (two semesters) of another East Asian language.

The focus of the program is on the nineteenth and twentieth centuries, with particular emphasis on institutional transformations, nationalism, political economy, race and ethnicity, popular culture, and women's studies. Areas of specialization for China and Japan include: art history, cultural anthropology, economics, history, modern literature, political science, religion, sociology, and (for Japan only) psychology. Limited instruction in Korean is also available.

In addition to the A.M. degree, the Asian/Pacific Studies Institute offers graduate students at Duke the opportunity to demonstrate their training and competence in East Asian studies by pursuing a course of study leading to the certificate in East Asian studies. The certificate demonstrates that a student has completed significant cross-disciplinary coursework relating to this region and has attained some proficiency in at least one East Asian language. Students enrolled in the Graduate School or in one of the professional schools are eligible to receive the certificate provided that they meet the following academic requirements: students must complete at least four courses from an approved list of courses in East Asian studies, from at least two different departments or programs, together with minimum language proficiency (two years) in an East Asian language. Students will be assigned an advisor who will monitor the completion of requirements; the advisor will be a member of the core faculty of the Asian/Pacific Studies Institute.

More information regarding both programs can be obtained by contacting the Asian/Pacific Studies Institute, Duke University, Box 90411, Durham, NC 27708-0411; through email to mmayer@acpub.duke.edu, or at our web site: <http://www.duke.edu/APSI/main.html>.

See also the listing in this bulletin under Asian/Pacific Studies Institute.

COURSES ON EAST ASIAN STUDIES OFFERED BY DEPARTMENTS AND PROFESSIONAL SCHOOLS

Asian and African Languages and Literatures

200S. Seminar in Asian and African Cultural Studies. CL: Lit 200S, AAS 200S, CA 288S. *Ching*

205/206. Asian and African Language and Literature. *Wang, Yoda, or staff*
250S. Chinese Modernism in Post-Mao Era. *Wang*
252. Special Topics in Asian and African Literature. *Staff*
253. East Asian Cultural Studies. *Ching or Yoda*
262. Modern Japanese Literature and Culture. CL: CA 262. *Ching*
280S. Intellectuals/Culture/History: Modern China in Transition. *Staff*
288S. Seminar on Modern Chinese Cinema. *Wang*

Art and Art History

272S. Topics in Chinese Art. CL: Lit 292S. *Abe*
274S. Topics in Japanese Art. *Weisenfeld*
379. Fascism East and West: The Visual Culture of Japan, Germany, and Italy. *Weisenfeld*
387. Art History and Representation. *Abe*

Business Administration

330. International Business Management. *Li*
400 Business After Communism. *Li*
436. Management and Organization Design of Global Corporations. *Lewin or staff*
439. Cultural Setting of Business. *Staff*
465. International Marketing. *Staff*
491. Special Topics in Management. *Li*
492. Global Academic Travel Experience. *Lewin or Li*

Cultural Anthropology

280S. Seminar in Selected Topics. *Allison*
300S Popular Culture, Theories, and Practices. *Allison*

Economics

242S. The Chinese Economy in Transition. CL: PPS 242S. *Yang or Staff*
358. Seminar in Labor Market and Related Analysis. *Yang*

History

204S. Technology, Economic Development and Social Change, 1750 to the Present. *Partner*
207B, S. Geographic Perspectives in History II: Asian and Pacific Worlds. *Wigen*
208A/B, S. Decentering the Cultural Map. *Wigen or Lewis*
210S. Anthropology and History. CL: CA 207S. *Reddy*
245/246. Social and Intellectual History of China. *Dirlik*
252A. Construction of China in European and American Literature. *Dirlik*
276A. Asian-American Experience: Immigration, Labor, and the American Experience. *Mazumdar*
299. Lectures in Special Topics. *Dirlik*
343A. Before Modern Japan. *Wigen*
343B. Modernity in the Japanese Archipelago. *Partner or Wigen*
351/352. Colloquia. *Hsu or Wigen*

Japanese

205S/206S. Seminar in Japanese. *Yoda*
291. Research Methods in Japanese Studies. CL: CA290, Hst 292, PS 291, Soc 291. *Troost*

Law

211H*. Comparative Criminal Law.
218H*. The World Trade Organization: The Adjudication of International Trade Disputes.
LAW 235H*. Comparative Securities Law: China and Japan.
242H*. Healthcare Regulation: Asian and Western Perspectives.
250H*. South East Asian Law: Impact on the Economic Crisis
275. Public International Law. *Byers*
352. International Business Transactions. *Wallenstein*
356. International Civil Litigation. *Carrington*
361. International Economic Law. *Byers*
500 (SEM). International Politics and International Law. *Byers*
508. Chinese Law and Society. *Ocko/Gao*
512. Comp. Public Law and Policy.
555 (SEM). International Environmental Law. *Admay*

* Course is taught at Summer Institute, Hong Kong

Political Science

200S. Senior Seminars. *Staff*
271S.01. International Environmental Regimes. *McKean*
206S. Political Participation Comparative Perspectives. *Shi*
234S. Political Economy of Develop. Theories of Change in the Third World. *Staff*
262. Transitions from Classic Communism. *Hough*
270S. Fundamentals of Political Economy. *Aldrich or Niou*
272. China and the World. *Shi*
284S. Public Policy Process in Developing Countries. *Asher*
351. Comparative Law and Politics: Ethnic Group Relations. *Horowitz*
399.75. Special Readings: Environment in China. *Shi*

Public Policy Studies

264/264S Advanced Topics in Public Policy: International Trade Policy. *Staff*

Sociology

222S. Proseminars in Comparative and Historical Sociology. *Gereffi*
225S. Proseminars in Organizations, Markets, and Work. *Zhou*
228S. Proseminars in Stratification, Mobility, and Labor Force Behavior. *Lin*

Courses currently uncheduled:

AALL 259. The Best-Seller: Cultural Populism in the 1990's China
BA 200A/B. Elementary Japanese for Business Professionals
BA 200C/D. Intermediate Japanese for Business Professionals
History 224S. The World Wars
History 245/246. Social and Intellectual History of China
History 275S. Asian and Asian-American Women in Comparative Perspective
History 288S. Germany and Japan in World War II
Sociology 234S. Political Economy of Development: Theories of Change in the Third

University Program in Ecology (UPE)

Professor Schlesinger (biology), *Chair*; Professor Clark (biology), *Director of Graduate Studies*; Professors Christensen (environment), Crowder (environment), Glander (biological anthropology and anatomy), Livingstone (biology), Rausher (biology), Reynolds (biology), Richardson (environment), Terborgh (environment), van Schaik (biological anthropology and anatomy); Associate Professors Katul (environment), Morris (biology), Nowicki (biology), Oren (environment), Richter (environment) and Rittschoff (environment); Assistant Professors Alberts (biology), Ellsworth (environment), Halpin (environment), Hartshorn (environment), Jackson (biology); Read (environment), Stow (environment), Wilson (biology), and Urban (environment)

The University Program in Ecology was created in 1999 to provide interdisciplinary, graduate training in all aspects of ecology. The program brings together the broad range of expertise in the environmental sciences found in various departments and schools on the Duke campus. Faculty participating in the program represent an array of research interests spanning basic and applied ecological science. Students can receive training in behavioral, community, physiological, and population ecology, paleoecology, ecosystem analysis, and global change biology. The program provides the organizational structure necessary for graduate students and scientific researchers to integrate across scales of biological organization and apply their research to pressing ecological and environmental problems.

Course offerings include graduate-level core courses in (1) population, community and behavioral ecology, and (2) physiological ecology and global change. Students in this program participate in a weekly seminar series and are encouraged to arrange laboratory rotations during their first year of study.

301. Population, Community, and Behavioral Ecology. An overview of how organisms interact within populations and among species. Focus on current concepts of population growth and its limits, stability of population numbers, interactions among

species including competition, predation, and behavioral adaptations to these processes, determinants and maintenance of species diversity, community structure, distribution, and disturbance. Instructor: Staff. 4 units.

302. Physiological Ecology and Ecosystem Analysis. A comprehensive course on the processes and factors that determine the capture and flow of energy and materials through individual organisms, populations, and entire ecosystems, both natural and disturbed. Interactions between ecosystem processes and the determinants of species number, and home range link this course to material covered in University Program in Ecology 301. Focus on human impacts that affect the movements of energy and materials in ecosystems. Studies of paleoecology provide a historical context for current patterns of global change. Instructor: Staff. 4 units.

303. Ecology Seminar. Presentation of current research by faculty and students in the University Graduate Program in Ecology. Instructor: Staff. 1 unit.

Economics (ECON)

Professor McElroy, *Chair* (215A Social Sciences); Professor Graham, *Director of Graduate Studies* (238 Social Sciences); Professors Bollerslev, Clotfelter, Cook, De Marchi, Goodwin, Grabowski, Kelley, Kimbrough, Kramer, Ladd, Sloan, Tauchen, Tower, Vernon, and Weintraub; Associate Professors Bansal, Conrad, Mendoza, Nechyba and Zhou; Assistant Professors An, Arcidiacono, Connolly, Coppejans, Crawford, Hamilton, Mansfield, Peretto, Quadrini, Ramachandran, Sieg, Vettas, and Yang; Professors Emeriti Blackburn, Davies, Kreps, Trembl, Wallace, and Yohe; Research Professor Burmeister; Adjunct Professor Gallant; Visiting Professor Toniolo

The Department of Economics offers graduate work leading to the A.M. and Ph.D. degrees. Among the undergraduate courses of distinct advantage to the graduate student in economics are statistics, economic theory, and basic courses in mathematics and social sciences other than economics. Advanced work in mathematics or statistics is very useful.

Requirements for the Ph.D. degree in economics include courses in economic theory and econometrics in the first year. In order to continue in the program, students must pass both the macro and micro examinations no later than September at the beginning of their second year. In addition, a student must obtain certification in three fields, one of which may be in an outside minor. The student may select from advanced economic theory, health economics, history of political economy, economic development, economic history, international economics, money and banking, labor economics, public finance, industrial organization, econometrics, Soviet economics, and certain fields outside the economics department (e.g., finance, resource and environmental economics, statistics, or demography). Course work for the Ph.D. degree should be completed in five or six semesters of residence.

For additional information, please visit our web site at <http://www.econ.duke.edu/Grad/grad.page.html>

For Seniors and Graduates

205S. Advanced Monetary Theory and Policy. The theory of monetary policy from Keynesian, neoclassical and classical perspectives. Public choice and political economy approaches to monetary policy. The term structure interest rates. Portfolio theory. The theory of the financial services firm. Theories of financial regulatory policy. Prerequisite: Economics 153 and Statistics 103. Instructor: Staff. 3 units.

206S. Regulation and Industrial Economics. Analysis of industrial competition and performance in industries such as automobiles, telephones, cable TV, airlines, pharmaceuticals, tobacco, and health care services. Analysis of the efficiency of regulation and other public policy programs. Research project required. Prerequisite: Economics 149 and statistics. Instructor: Grabowski. 3 units.

207. Models of Conflict and Cooperation. Cooperative and noncooperative game theory with applications to trading, imperfect competition, cost allocation, and voting. Prerequisite: Economics 149 and Mathematics 26L or 31 or 31L. Instructor: Zhou. 3 units.

207S. Models of Conflict and Cooperation. Seminar version of 207. Prerequisite: Economics 149 and Mathematics 26L or 31 or 31L. Instructor: Zhou. 3 units.

208S. Economics of the Family. Economic functions of families including home production gains from marriage, the demand for children, marriage and divorce, child support and alimony, labor supplies of women and men, the distribution of resources within families ('rotten kid theorems' and cooperative and noncooperative games). Applications to marriage and divorce law, day care, United States welfare policy, mortality, and farm efficiency in developing nations. Research project required. Prerequisite: Economics 149 and Statistics 103. Instructor: McElroy. 3 units.

216S. Economics of Education. Topics include investment in human capital, return to and demand for education, the production function for schooling, public expenditures on schools, effectiveness of private and public schools, the distribution of public educational expenditures, public financing of higher education, inflation in college costs, and labor markets for teachers and professors. Emphasis on students' research projects. Prerequisite: Economics 149 or Public Policy Studies 110. Instructor: Clotfelter. 3 units. C-L: Public Policy Studies 216S.

218. Macroeconomic Policy. 3 units. C-L: Public Policy Studies 218.

219S. Economic Problems of Underdeveloped Areas. Assessment of the economic determinants of development with consideration given to demographic, political, and public policy impacts. Emphasis on student-directed research that employs modern statistical methods to expose development issues, across countries and over time. Prerequisite: Economics 139, 149, and 154. Instructor: Kelley or Wallace. 3 units.

220S. Computer Modeling for Policy Analysis. Introduction to the use of computer techniques in economic policy evaluation; policy applications to international economics, public finance and development economics; computer analysis of linearized and nonlinear models. Students required to complete a major modeling project. Prerequisite: Economics 149 and Economics 154. Instructor: Tower. 3 units.

236. The International Economy Since 1800. Same as Economics 136, but requires an additional paper; not open to students who have taken Economics 136. Prerequisite: Economics 1D or 51D; recommended: Economics 154. Instructor: Toniolo. 3 units.

239. Introduction to Econometrics. Data collection, estimation, and hypothesis testing. Use of econometric models for analysis and policy. (Same as Economics 139 but requires additional term paper; not open to students who have taken Economics 139.) Prerequisite: Economics 2 or 52 and Mathematics 32 or equivalent and Statistics 103. Instructor: Sieg, Tauchen, or Wallace. 3 units.

240. Comparative Economic Systems. Analysis and comparison of basic economic systems; market versus centrally planned economies; decision making, information, property rights (income and control), and incentives. Western industrialized market economies compared with Soviet-type command economies. Analysis of change, reforms, and of economic problems of systems transformation. Not open to students who have taken Economics 140. Prerequisite: Economics 1 or 51, and 2 or 52. Instructor: Trembl. 3 units.

242S. Chinese Economy in Transition. Evolution of the Chinese economy since 1949. Exposition of alternative economic systems, the commune, incentive problems and state enterprises. Analysis of recent reforms and their effects on economic efficiency: agricultural growth, changes in ownership structures, financial markets, reforms and inflation, privatization, gradualism and shock treatment. Through a research project students develop expertise in one aspect of the Chinese economy. (Same as Economics 142S but requires additional paper; not open to students who have

taken Economics 142 or 142S.) Prerequisite: Economics 1 or 51, and 2 or 52. Instructor: Yang. 3 units. C-L: Public Policy Studies 242S.

246. Adam Smith and the System of Natural Liberty. Same as Economics 146, but requires an additional paper; not open to students who have taken Economics 146 or 151. Instructor: De Marchi. 3 units.

248. History of Economic Thought. Approaches to economic problems from Aristotle to Keynes, emphasizing certain models and doctrines—their origins, relevance, and evolution. Readings from Mun, Quesnay, Adam Smith, Malthus, Ricardo, Marx, Walras, Veblen, and Keynes. (Similar to Economics 148, but requires an additional assignment. Not open to students who have taken Economics 148.) Prerequisites: Economics 1 or 51 and 2 or 52. Instructor: De Marchi or Goodwin. 3 units.

249. Microeconomics. Cost and supply considerations in price theory; the demand for factors of production. The allocation of resources in the context of competitive and monopolistic market structures. (Similar to Economics 149 but at a more advanced level; not open to students who have taken Economics 149.) Instructor: Graham, Trembl, Vernon, or Zhou. 3 units.

252. Mercantile Culture and Art in the Netherlands. Same as Economics 152, but requires additional assignments; not open to students who have taken Economics 152 or Art History 155. Instructor: De Marchi and Van Miegroet. 3 units.

254. Macroeconomics. Concepts and measurement of national income and expenditures, employment, interest rates, and price levels; the theoretical determination of these aggregates; applications of macroeconomic theory to business cycles and economic growth. (Similar to Economics 154 but at a more advanced level; not open to students who have taken Economics 154.) Instructor: Connolly, Kimbrough, Mendoza, or Yohe. 3 units.

257. Financial Markets and Investments. Same as Economics 157, but requires an additional paper. Not open to students who have had Economics 158/258 before Fall 1998. Prerequisite: Economics 149, Economics 154, Statistics 103 or equivalent. Instructor: Bollerslev or Tauchen. 3 units.

258. Applied Financial Economics. Same as Economics 158, but requires additional work. Not open to students who have had Economics 158/258. Prerequisite: Economics 149, Economics 154, Statistics 103 or equivalent. Instructor: Burmeister. 3 units.

259S. State and Local Public Finance. 3 units. C-L: Public Policy Studies 259S.

261. Evaluation of Public Expenditures. 3 units. C-L: Public Policy Studies 261, Environment 272.

262S. Seminar in Applied Project Evaluation. 3 units. C-L: Public Policy Studies 262S.

263. Environmental Economics: Quantitative Methods and Applications. Uses envirometrics (mathematical programming, multivariate statistics, and simulation techniques) to address environmental problems; properties of economic instruments for externality problems developed with programming models; regression and maximum likelihood techniques used in nonmarket valuation; and simulation in applied benefit and cost analysis. Prerequisite: Economics 149. Instructor: Staff. 3 units. Environment 263.

264. Formulating Macroeconomic Concerns, 1936-86. Same as Economics 164, but requires an additional paper; not open to students who have taken Economics 164. Prerequisite: (or corequisite) Economics 154/254. Instructor: De Marchi. 3 units.

265S. International Trade. International trade, investment and migration, commercial policy, and the political economy of trade. Prerequisite: Economics 149, 154. Instructor: Tower. 3 units.

266S. International Monetary Economics. Financial aspects of growth and income determination, and macroeconomic policy in open economies. Applications to

exchange rate determination, capital markets, fluctuations in the trade balance and current account, monetary and fiscal policies in open economies, currency crises, and monetary reform. Significant research component required. Prerequisite: Economics 149, 154. Instructor: Kimbrough. 3 units.

268S. Current Issues in International and Development Economics. Issues of income distribution within and between countries, vehicles for growth, regional development, the role of politics in economic policy, multinational institutions. Cross-country and cross-time comparisons. Emphasis on individual research projects. Prerequisite: Economics 149, 154. Instructor: Tower. 3 units.

269. Microeconomic Analysis. The basic tools for using microeconomic analysis to address practical economic problems. Topics include consumption, production, externalities, partial equilibrium, and general equilibrium. Applications drawn from labor markets, public goods, cost/benefit analysis, and optimal taxation. The level of the course is between intermediate microeconomics (Economics 149/249) and the core Ph.D. microeconomics sequence (Economics 301/302). Instructor: Yang. 3 units.

270. Resource and Environmental Economics. 3 units. C-L: Environment 270, Public Policy Studies 272.

272. Economic Analysis of Resource and Environmental Policies. 3 units. Environment 271.

275. Economics of Modern Latin America. The remarkable shift that has taken place in various countries of Latin America from a statist, import substitution model of development towards a more free-market economy. Emphasis on case studies of individual countries and specific policies including opening markets to foreign trade and investment, privatization, deregulation, creation of private pension systems, and building greater transparency in financial markets. The end of Latin American debt crises and prospects for hemispheric integration. (Same as Economics 175, but requires an additional paper; not open to students who have taken Economics 175.) Prerequisite: Economics 1 or 51 and 2 or 52; or consent of instructor. Instructor: Staff. 3 units.

282S. Canada. 3 units. C-L: Canadian Studies 282S, Cultural Anthropology 282S, History 282S, Political Science 282S, Sociology 282S.

284S. Financial Development and History. Development of financial institutions and markets across civilizations and time. The political, economic, and institutional factors which influenced that evolution and the theoretical implications for contemporary emerging markets. Prerequisite: Economics 181 or consent of instructor. Instructor: Staff. 3 units.

287. Public Finance. Economic aspects of the allocative and distributive role of government in the economy, the incidence and efficiency of taxation, the effects of taxation on behavior, and analysis of major government spending programs. Not open to students who have had Economics 187. (Taught concurrently with Economics 187 but requires additional graduate-level work.) Prerequisite: Economics 149. Instructor: Sieg. 3 units.

291. Issues in European Economic History. Covers period since the late eighteenth century. Topics include: modern economic growth in historical perspective, the industrial revolution, the standard-of-living debate, patterns of European growth (with case studies of France, Germany, Italy, and Russia), the classical gold standard, the economic consequences of World War II, the great depression, postwar reconstruction, and the European "miracle" of the 1950s and 1960s. Instructor: Toniolo. 3 units.

293S. Russian Economic History. From 1917 through the present. Foundations of the command economy and promises of socialism—rejection of markets, establishment of central planning, industrialization, collectivization of agriculture; economic reforms. Gorbachev's perestroika, collapse of the Soviet system, and emerging market economy in Russia. Instructor: Trembl. 3 units.

295. Selected Topics in Economics. Instructor: Staff. 3 units.

296. Selected Topics in Economics. Instructor: Staff. 3 units.

For Graduates

301. Microeconomic Analysis I. Review of contemporary theory relating to consumer choice, production, the firm, and income distribution in competitive and imperfectly competitive markets. Restricted to Ph. D. students in economics except with consent of instructor and director of graduate studies. Instructor: Moulin. 3 units.

302. Microeconomic Analysis II. A continuation of Economics 301 with emphasis on analyses of consumer behavior, general equilibrium, welfare economics, and capital theory. Prerequisite: Economics 301. Instructor: Graham or Zhou. 3 units.

303. Microeconomic Analysis III. A discussion of the formal models of economic justice with the tools of cooperative games and social choice. Topics include cost-sharing formulas, fair division, natural monopolies, public goods, collective preferences and utilities, and implementation theory. Prerequisite: Economics 301 and 302. Instructor: Moulin or Zhou. 3 units.

304. Advanced Macroeconomics. Advanced topics in macroeconomics with some emphasis on computation and econometric analysis. Topics include real business cycle theory, endogenous growth theory, monetary theory, optimal monetary and fiscal policy and time consistency. Instructor: Connolly. 3 units.

305. Monetary Theory and Policy. Same topics as Economics 205S but with additional graduate level work. Prerequisite: Economics 304. Instructor: Staff. 3 units.

306. Microeconomics: Policy Applications. Cost benefit analysis of public programs. Public utility regulation, pollution regulation, hospital rate setting, regulation of product safety. Quantitative methods and microeconomic theory for analysis of both normative and positive aspects of economic policy. Graduate status only. Prerequisites: Economics 149 or Public Policy Studies 110 or 217 and familiarity with regression analysis or concurrent enrollment in Public Policy Studies 231. Instructor: Conrad, Ladd, or Moore. 3 units. C-L: Public Policy Studies 311.

309. Trade and Development Theory. Theory of international trade and trade policy as it affects the structure and growth of individual economies, with emphasis on developing countries. Comparative advantage, factor proportions explanation of trade, infant industry and other arguments for protection, interactions of exchange rate and trade policy, and special issues relating to primary commodities are examined. Instructor: Staff. 3 units.

311. History of Political Economy. A detailed review of the development of economic theory, the tools of economic analysis, and economics as a science, together with an analysis of the circumstances affecting this development. Instructor: De Marchi, Goodwin, or Weintraub. 3 units.

312. History of Political Economy. A detailed review of the development of economic theory, the tools of economic analysis, and economics as a science, together with an analysis of the circumstances affecting this development. Instructor: De Marchi, Goodwin, or Weintraub. 3 units.

313. Seminar in Economic Theory. Prerequisite: Economics 301 or equivalent. Instructor: Graham or Weintraub. 3 units.

314. Seminar in Economic Theory. Prerequisite: Economics 301 or equivalent. Instructor: Graham or Weintraub. 3 units.

315. Noncooperative Game Theory. A self-contained presentation of the main non-cooperative concepts: dominant strategies, Nash equilibrium, subgame perfect equilibrium. Introduction to mixed and correlated strategies and the Bayesian equilibrium for games of incomplete information. Examples include oligopolistic competition,

auctions, bargaining, and voting. Instructor: Moulin. 3 units. C-L: Political Science 315. Statistics and Decision Sciences 386.

316. Seminar in Economics of Soviet-Type Socialism. Selected topics in analysis of theoretical and institutional framework of Soviet economic system, such as markets versus plan, optimizing techniques in planning, price determination, balanced economic development, and ideology and economic policy. Instructor: Trembl. 3 units.

317. Development Economics I. Historical, empirical, and theoretical topics in development economics. Instructor: Kelley. 3 units.

318. Quantitative Development Economics. Selected topics in development economics with emphasis on empirical techniques. Topics include economic growth, income distribution, labor markets, human capital fertility, health, and their relationship with structural adjustment. Instructor: Staff. 3 units.

319. Seminar in the Theory and the Problems of Economic Growth and Change (Development Economics II). Links between aid, financial markets, and real investment in an open economy stressing tariff protection and capital controls (internal and external). Economic policy-making using market solutions and/or planning models (input-output, linear programming, and computable general equilibrium). Instructor: Staff. 3 units.

320. Macroeconomic Analysis I. Intertemporal models of consumption and labor supply; implications of these models for the behavior of macroeconomic aggregates, fiscal policy, and monetary policy; money demand and inflation; economic growth. Restricted to Ph. D. students in economics except with consent of instructor and director of graduate studies. Instructor: Kimbrough or staff. 3 units.

322. Macroeconomic Analysis II. Further analysis of topics treated in Economics 320. Optimal economic growth; business cycles. Issues in economic policy. Prerequisite: Economics 320. Instructor: Kimbrough or Peretto. 3 units.

326. Stochastic Macroeconomics. Final course in the graduate macroeconomics sequence, dealing with advanced topics and frontier research. Development of a framework for the analysis of the positive and normative implications of dynamic, stochastic general equilibrium models. Objectives are to clarify the central role that optimal intertemporal decision making under uncertainty plays in modern macroeconomics, and to familiarize students with the methods and problems discussed in recent literature. Focus on models of open economies, recognizing the high degree of international integration of goods and services markets, and the importance of international financial flows. Instructor: Mendoza. 3 units.

329. Theory of Public Economics. Topics include taxation, public goods, externalities, risk and uncertainty, social choice, and cost benefit analysis. Instructor: Staff. 3 units.

330. Empirical Public Economics. Topics include the incentive effects of the tax and welfare system, social security, Tiebout competition, the demand for local public goods, education, and school competition. Instructor: Sieg. 3 units.

341. Econometrics I. Matrix algebra, probability theory, and statistics used to develop methods for multiple regression analysis. Covers material up to generalized least squares estimation. Restricted to Ph. D. students in economics, except with consent of instructor. Instructor: Crawford, Sieg, or Tauchen. 3 units.

342. Econometrics II. Advanced multivariate regression analysis. Topics include panel data models, systems, limited dependent variables, discrete choice, and nonlinear estimation. Prerequisite: Economics 341. Instructor: Crawford or Sieg. 3 units.

343. Econometrics III. Asymptotic theory for finite dimensional parametric models. Topics include nonlinear maximum likelihood, nonlinear regression, extremum estimators, aspects of computation, hypothesis testing, and models with limited depen-

dent variables. Prerequisite: Economics 342. Instructor: An, Copejans, or Tauchen. 3 units.

348. Advanced Topics in Microeconometrics. Nonparametric and semiparametric methods for limited dependent variables. Duration analysis and simulation-based estimation in a microeconomics context. Prerequisite: Economics 343. Instructor: An. 3 units.

349. Empirical Methods in Finance/Financial Econometrics. Selected current empirical research topics in finance and related econometric methods. Focus on testing theories of asset price determination, exploring the interplay between economic theory, statistical assumptions about returns, and the relevant econometric techniques. Prerequisite: Economics 304 and 347, or equivalent course work with consent of instructor. Instructor: Bollerslev or Tauchen. 3 units.

350. Econometrics of Macroeconomic Time Series. Statistical analysis of economic time series. The temporal dependence in such data and the formulation of dynamic economic models combine to present some unique problems and consequently require the application of specialized methods. Focus on applications rather than on proving theorems. Different econometric methodologies applicable to specific problems in macroeconomics, monetary economics, and finance. Prerequisite: Economics 302, 322; corequisite: Economics 345. Instructor: Bollerslev. 3 units.

355. Seminar in Labor Economics. Instructor: McElroy. 3 units.

356. Graduate Health Economics I. Survey course designed for students considering Ph. D. research in health economics. Topics will include demand for health insurance, moral hazard, health as an investment, technological change, the principal-agent problem, occupational entry, and the supply of physician services. Prerequisite: Economics 243 and 301. Instructor: Sloan. 3 units.

357. Seminar in Health Economics. Conceptual and empirical analysis of demand for health, medical services, and insurance; decisions by physicians and hospitals about price, quantity, and quality of services; technological change; and structure and performance of the pharmaceutical industry. Prerequisite: Economics 243 and 301. Instructor: Sloan. 3 units.

358. Seminar in Labor Market and Related Analysis. A survey of several topics in modern labor economics including human capital, signaling, static and dynamic labor supply, household production, labor contracts, search, the theory of equalizing differences, and discrimination. Instructor: Yang. 3 units.

359. Economic Analysis of Legal Issues. An exploration of diverse topics in law and economics such as property rights and externalities, tort law and optimal accident prevention, bargaining and game theory, the economics of contracts, and theories of economic justice. Instructor: Culp. 3 units.

363. Economics of Natural Resource Damage Assessment. Topics vary each semester offered. Instructor: Staff. 3 units. C-L: Environment 363.

365. Seminar in International Trade Theory and Policy. Instructor: Kimbrough or Tower. 3 units.

366. Seminar in International Monetary Theory. Instructor: Mendoza. 3 units.

372. Advanced Theory of Environmental and Natural Resource Economics. The application of economic concepts to private- and public-sector decision making concerning natural and environmental resources. Topics include modeling externalities and public goods, design of policy instruments, management of renewable and nonrenewable resources, welfare theory and valuation methods, and environmental risk. Prerequisite: Economics 301 and 302 or consent of instructor. Instructor: Mansfield. 3 units. Environment 372.

373. Topics in Environmental and Natural Resource Economics. Examination of current research in environmental and natural resource economics, building on the the-

ory of environmental and natural resource economics developed in Economics/Environment 372. Includes selected topics from Economics/Environment 372 and other quantitative and theoretical issues pertinent to prevailing research in environmental economics. Prerequisite: Economics/Environment 372 or consent of instructor. Instructor: Mansfield. 3 units. C-L: Environment 373.

380. Graduate Economics Workshops. May be taken for multiple credit. Sections: 01 Industrial Organization and Regulation; 02 International Economics; 03 Labor Economics; 04 Macroeconomics; 05 Public Finance; 06 Economic Thought; 07 Corporate Economics; 08 Econometrics; 09 Microeconomics; 10 Economic History. 3 units each. Instructor: Staff. 3 units.

388. Industrial Organization. Analysis of models of markets, especially oligopoly. Game theoretic models of entry deterrence and predation. Product selection and advertising and other selected topics. Instructor: Crawford, Grabowski, Vernon, or Vettas. 3 units.

389. Seminar in Industrial and Governmental Problems. Criteria for evaluating industrial performance. Antitrust, policy toward innovation, natural monopoly regulation, and regulation of selected industries. Instructor: Crawford. 3 units.

390. Economics of Auctions, Procurements, and Bargaining. Study of allocation mechanisms where offers are considered simultaneously and sequentially. Special emphasis on the distinction between allocation mechanisms from the viewpoint of sellers and buyers. Instructor: Staff. 3 units.

391. Issues in European Economic History. (Same as Economics 291, but requires an additional paper.) Not open to students who have taken Economics 291. Instructor: Toniolo. 3 units.

395. Special Topics in Economics. Instructor: Staff. 3 units.

397. Directed Research. Instructor: Staff. 3 units.

398. Directed Research. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

224S. Economics of the Law

225S. Games and Information

231S. Economic Development in Latin America

235. The Economics of Crime

241. Applied Econometrics

244. Education, Development, and Growth

251S. Regulation of Vice and Substance Abuse

253. Econometric Methods

255S. Labor Economics: Analysis and Measurement

273. Economics of Organization and Management

281. Corporate Finance

283. Agency and Accounting

286S. Economic Policy-Making in Developing Countries

294S. Soviet Economy in Transition

299. Distributive Justice and the Social Sciences

307. Quantitative Analysis I

308. Quantitative Analysis II

321. Theory of Quantitative Economic Policy

323. Income Distribution Theory

324. Economics of the Law

325. Economics of the Law

401. Seminar on the British Commonwealth

402. Interdisciplinary Seminar in the History of the Social Sciences

Engineering (EGR)

Kristina M. Johnson, Ph.D., *Dean* (305 Teer Engineering Library Building); Phillip L. Jones, Ph.D., *Associate Dean for Academic Affairs* (305 Teer Engineering Library Building); Robert W. Carr, Jr., B.S.E., *Associate Dean, Director of Development* (305 Teer Engineering Library Building)

The Pratt School of Engineering offers programs of study and research leading to the M.S. and Ph.D. degrees with a major in biomedical, civil and environmental, electrical and computer, and mechanical engineering and materials science. These programs are designed to provide: (1) development of depth and breadth in mathematics, computer science, the basic physical sciences, the life sciences where appropriate, and the engineering sciences; (2) mastery of an advanced body of knowledge in the candidate's chosen field of specialization or research; (3) experience in the art of engineering, including strong elements of intuition, imagination, and judgment; and (4) performance of original research which, in the case of the M.S. degree, demonstrates the ability to advance knowledge in the area of professional study and, in the case of the Ph.D. degree, makes a significant contribution to the research literature through publication in a leading professional journal in the field. Engineering graduate students are expected to participate in seminars appropriate to their fields of study. A minimum of 30 units of earned graduate credit beyond the bachelor's degree is required for the M.S. degree: 12 in the major, 6 in related minor work (usually mathematics or natural science), 6 in either the major or minor subject or in other areas approved by the major department, and 6 for a research-based thesis. A nonthesis option requiring 30 units of course credit is available. Each of the departments imposes additional requirements in the exercise of this option. There is no language requirement for this degree. For the Ph.D. degree in civil and environmental engineering, 12 units of course work beyond the master's degree are required to be in the major field, 6 in a related minor field, and 6 in either the major or minor field; in electrical engineering, 24 units are required in the major field and 12 units in a related minor field (often mathematics or natural science), 12 in either the major or minor subject or other areas approved by the major department, and 12 for a research-based dissertation. In biomedical and mechanical engineering and materials science there are no specific course requirements; each program is planned to meet individual needs. Doctoral students are required to pass qualifying and preliminary examinations which may be either written, oral, or a combination of written and oral components, at the discretion of the committee and the department. In addition, the Pratt School of Engineering and the Fuqua School of Business offer an MBA/MS Joint-Degree Program.

Additional information may be obtained by visiting our web site at <http://www.egr.duke.edu>. Send email to kristina.johnson@duke.edu or judge.carr@duke.edu.

221. Computational Linear Algebra. Linear vector spaces of real and complex n -tuples, norms, metrics, inner-products, basis vectors, rank and dimensionality; matrices as linear maps, rank and nullity; particular and general solutions of $Ax=b$; factorization of matrices by successive transformations; solution of $Ax=b$ by direct and iterative methods; special and general eigen value problems; diagonalization and tridiagonalization by similarity transformations; power methods; and computational complexities, storage requirements, convergence characteristics, error propagation, and the mathematical basis of the studied algorithms. Prerequisite: Mathematics 111 or equivalent, and knowledge of any algorithmic programming language. Instructor: S. Utku. 3 units.

300. Teaching Engineering. Designed for engineering graduate students contemplating careers in academia. Topics include teaching skills, philosophy of higher education, academic integrity, research ethics, operation of a modern university, student development and learning, evaluation of performance, conducting teaching laboratories, advising, and other topics. Instructor: Staff. 0 units.

COURSES CURRENTLY UNSCHEDULED

222. Computer Solutions of Ordinary and Partial Differential Equations

Biomedical Engineering (BME)

Professor Barr, *Chair*; Associate Professor Trahey, *Director of Graduate Studies* (275 Engineering Annex); Professors Floyd, Hammond, Jaszczak, Johnson, Katz, Nolte, Plonsey, Reichert, S. Smith, and von Ramm; Associate Professors Burdick, Dobbins, Glower, Henriquez, Krassowska, MacFall, Massoud, Myers, Needham, and Truskey; Assistant Professors Chilkoti, Collins, Guilak, Hsu, Niklason, Setton, Wolf, and Yuan; Professors Emeriti Clark, McElhaney, and Plonsey; Assistant Research Professors Baydush, Bohs, Lo, Lobach, K. Nightingale and R. Nightingale

Biomedical engineering is the discipline in which the physical, mathematical, and engineering sciences and associated technology are applied to biology and medicine. Contributions range from modeling and simulation of physiological systems through experimental research to solutions of practical clinical problems. The goal of the graduate program in biomedical engineering is to combine training in advanced engineering, biomedical engineering, and the life sciences so that graduates of the program can contribute at the most advanced professional level. The doctoral dissertation should demonstrate significant and original contributions to an interdisciplinary topic, accomplished as an independent investigator. The major, current research areas of the department are: biochemical engineering, biofluid mechanics, biomechanics, biomedical materials, biomedical modeling, biosensors, biotechnology, data acquisition and processing, medical imaging, and electrophysiology. Every biomedical engineering graduate student is required to serve as a teaching assistant as part of the graduate training.

201L. Electrophysiology. The electrophysiology of excitable cells from a quantitative perspective. Topics include the ionic basis of action potentials, the Hodgkin-Huxley model, impulse propagation, source-field relationships, and an introduction to functional electrical stimulation. Students choose a relevant topic area for detailed study and report. Not open to students who have taken Biomedical Engineering 101L or equivalent. Instructor: Barr or Henriquez. 3 units; 4 units with laboratory.

204. Measurement and Control of Cardiac Electrical Events. Design of biomedical devices for cardiac application based on a review of theoretical and experimental results from cardiac electrophysiology. Evaluation of the underlying cardiac events using computer simulations. Examination of electrodes, amplifiers, pacemakers, and related computer apparatus. Construction of selected examples. Prerequisite: Biomedical Engineering 101L and 163L or equivalents. Instructor: Wolf. 3 units.

205L. Microprocessors and Digital Instruments. Design of microcomputer-based devices including both hardware and software considerations of system design. Primary emphasis on hardware aspects, including a progression through initial design, prototype construction in the laboratory, testing of prototypes to locate and correct faults, and final design evaluation. Evaluation includes examination of complexity, reliability, and cost. Design and construction oriented toward biomedical devices or instruments that include dedicated microcomputers, usually operating in real time. Prerequisite: Biomedical Engineering 163L, 164L and Engineering 53L or equivalents. Instructor: Hammond. 4 units.

207. Transport Phenomena in Biological Systems. An introduction to the modeling of complex biological systems using principles of transport phenomena and biochemical kinetics. Topics include the conservation of mass and momentum using differential and integral balances; rheology of Newtonian and non-Newtonian fluids; steady and transient diffusion in reacting systems; dimensional analysis; homogeneous versus heterogeneous reaction systems. Biomedical and biotechnological applications are discussed. Instructor: Katz, Truskey, or Yuan. 3 units. C-L: Civil Engineering 207, Mechanical Engineering 207.

208. Theoretical and Applied Polymer Science. 3 units. C-L: Mechanical Engineering 211.

211. Theoretical Electrophysiology. Advanced topics on the electrophysiological behavior of nerve and striated muscle. Source-field models for single-fiber and fiber bundles lying in a volume conductor. Forward and inverse models for EMG and ENG. Bidomain model. Model and simulation for stimulation of single-fiber and fiber bundle. Laboratory exercises based on computer simulation, with emphasis on quantitative behavior and design. Readings from original literature. Prerequisite: Biomedical Engineering 101L or 201L or equivalent. Instructor: Barr or Krassowska. 4 units.

212. Theoretical Electrocardiography. Electrophysiological behavior of cardiac muscle. Emphasis on quantitative study of cardiac tissue with respect to propagation and the evaluation of sources. Effect of junctions, inhomogeneities, anisotropy, and presence of unbounded extracellular space. Bidomain models. Study of models of arrhythmia, fibrillation, and defibrillation. Electrocardiographic models and forward simulations. Laboratory exercises based on computer simulation, with emphasis on quantitative behavior and design. Readings from original literature. Prerequisite: Biomedical Engineering 101L or 201L or equivalent. Instructor: Barr. 4 units.

213L. Nonlinear Dynamics in Electrophysiology. Electrophysiological behavior of excitable membranes and nerve fibers examined with methods of nonlinear dynamics. Phase-plane analysis of excitable membranes. Limit cycles and the oscillatory behavior of membranes. Phase resetting by external stimuli. Critical point theory and its applications to the induction of rotors in the heart. Theory of control of chaotic systems and stabilizing irregular cardiac rhythms. Initiation of propagation of waves and theory of traveling waves in a nerve fiber. Laboratory exercises based on computer simulations, with emphasis on quantitative behavior and design. Readings from original literature. Prerequisite: Biomedical Engineering 101L or 201L or equivalent. Instructor: Krassowska. 4 units.

215. Biomedical Materials and Artificial Organs. Chemical structures, processing methods, evaluation procedures, and regulations for materials used in biomedical applications. Applications include implant materials, components of ex vivo circuits, and cosmetic prostheses. Primary emphasis on polymer-based materials and on optimization of parameters of materials which determine their utility in applications such as artificial kidney membranes and artificial arteries. Prerequisite: Biomedical Engineering 83L, Chemistry 151L or Engineering 83L or consent of instructor. Instructor: Reichert. 3 units. C-L: Mechanical Engineering 215.

216. Transport Phenomena in Cells and Organs. Applications of the principles of mass and momentum transport to the analysis of selected processes of biomedical and biotechnological interest. Emphasis on the development and critical analysis of models of the particular transport process. Topics include: reaction-diffusion processes, transport in natural and artificial membranes, dynamics of blood flow, pharmacokinetics, receptor-mediated processes and macromolecular transport, normal and neoplastic tissue. Prerequisite: Biomedical Engineering 207 or equivalent. Instructor: Truskey. 3 units.

220L. Introduction to Biomolecular Engineering. Structure of biological macromolecules, recombinant DNA techniques, principles of and techniques to study protein structure-function. Discussion of biomolecular design and engineering from the research literature. Linked laboratory assignments to alter protein structure at the genetic level. Expression, purification, and ligand-binding studies of protein function. Consent of instructor required. Instructor: Chilkoti. 3 units.

222. Principles of Ultrasound Imaging. Propagation, reflection, refraction, and diffraction of acoustic waves in biologic media. Topics include geometric optics, physical optics, attenuation, and image quality parameters such as signal-to-noise ratio, dynamic range, and resolution. Emphasis is placed on the design and analysis of medical ultrasound imaging systems. Prerequisite: Mathematics 111 and Physics 52L. Instructor: von Ramm. 3 units.

228. Laboratory in Cellular and Biosurface Engineering. Introduction to common experimental and theoretical methodologies in cellular and biosurface engineering. Experiments may include determination of protein and peptide diffusion coefficients in alginate beads, hybridoma cell culture and antibody production, determination of the strength of cell adhesion, characterization of cell adhesion or protein adsorption by total internal reflection fluorescence, and Newtonian and non-Newtonian rheology. Laboratory exercises are supplemented by lectures on experiment design, data analysis, and interpretation. Instructor: Truskey. 3 units.

229. Tissue Mechanics. Introduction to conservation laws and thermodynamic principles of continuum mechanics with application to tissues of the musculoskeletal and cardiovascular systems. Constitutive equations for hyperelastic solids and multiphase viscoelastic materials using mixture theory formulation. Emphasis on the application of these constitutive formulations to determination of stress and strain fields in equilibrium and transient deformations of calcified tissues (for example, cortical and trabecular bone), soft tissues (for example, ligament, cartilage, cornea, intervertebral disc, left ventricle, aorta), and biological fluids (for example, mucus, synovial fluid, polymer solutions). Tensor fields and indicial notation. Prerequisite: Biomedical Engineering 110L or Engineering 75L or equivalent, and Mathematics 111 or equivalent. Instructor: Setton. 3 units.

231. Intermediate Biomechanics. Biomechanics of hard and soft tissues: nonlinear viscoelastic behavior of tendon and ligament; poroelastic behavior of cartilage and meniscus; continuum modeling of bone. Emphasis will be placed on experimental techniques used to evaluate these tissues. Student seminars on topics in applied biomechanics will be included. Prerequisite: Biomedical Engineering 110L or Engineering 75L or equivalent, and Biomedical Engineering 83L or Engineering 83L or equivalent. Instructor: Myers. 3 units.

232L. Biomedical Instrumentation. A study of the basic principles of biomedical electronics and measurements with emphasis on the operational performance and selection of transducers, instruments, and systems for biomedical data acquisition and processing. Selected laboratory work emphasizes the measurement of specific physiologic events. Students will design and build a working medical instrument. Consent of instructor required. Not open to students who have taken Biomedical Engineering 164L. Instructor: Wolf. 4 units.

233. Modern Diagnostic Imaging Systems. The underlying concepts and instrumentation of several modern medical imaging modalities. Review of applicable linear systems theory and relevant principles of physics. Modalities studied include X-ray radiography (conventional film-screen imaging and modern electronic imaging), computerized tomography (including the theory of reconstruction), and nuclear magnetic resonance imaging. Prerequisite: junior or senior standing. Instructor: Trahey. 3 units.

235. Acoustics and Hearing. The generation and propagation of acoustic (vibrational) waves and their reception and interpretation by the auditory system. Topics

under the heading of generation and propagation include free and forced vibrations of discrete and continuous systems, resonance and damping, and the wave equation and solutions. So that students may understand the reception and interpretation of sound, the anatomy and physiology of the mammalian auditory system are presented; and the mechanics of the middle and inner ears are studied. Prerequisite: Mathematics 111 and Physics 52L or equivalents. Instructor: Collins or Trahey. 3 units. C-L:

237. Biosensors. Biosensors are defined as the use of biospecific recognition mechanisms in the detection of analyte concentration. The basic principles of protein binding with specific reference to enzyme-substrate, lectin-sugar, antibody-antigen, and receptor-transmitting binding. Simple surface diffusion and absorption physics at surfaces with particular attention paid to surface binding phenomena. Optical, electrochemical, gravimetric, and thermal transduction mechanisms which form the basis of the sensor design. Prerequisite: Biomedical Engineering 215 and consent of instructor. Instructor: Reichert. 3 units.

239. Cell Transport Mechanisms. Analysis of the migration of cells through aqueous media. Focus on hydrodynamic analysis of the directed self-propulsion of individual cells, use of random walk concepts to model the nondirected propulsion of individual cells, and development of kinetic theories of the migrations of populations of cells. Physical and chemical characteristics of the cells' environments that influence their motion, including rheologic properties and the presence of chemotactic, stimulatory, or inhibitory factors. Cell systems include mammalian sperm migration through the female reproductive tract, protozoa, and bacteria. Emphasis on mathematical theory. Experimental designs and results. Consent of instructor required. Instructor: Katz. 3 units.

241. Artificial Intelligence in Medicine. Basic concepts of artificial intelligence (AI) and in-depth examination of medical applications of AI. Knowledge of heuristic programming; brief examination of classic AI programming languages (LISP and PROLOG) and AI programming; rule-based systems and cognitive models. Instructor: Hales or Hammond. 3 units.

243. Introduction to Medical Informatics. An introduction to medical informatics: an in-depth study of the use of computers in biomedical applications. Hardware, software, and applications programming. Data collection, analysis, and presentation studied within application areas such as patient monitoring, computer-based medical records, computer-aided decision making, computer-aided instruction, quality assurance laboratory systems, wave form analysis, hospital information systems, and medical information systems. Instructor: Hales or Hammond. 3 units.

246. Computational Methods in Biomedical Engineering. Introduction to practical computational methods for data analysis and simulation with a major emphasis on implementation. Methods include numerical integration and differentiation, extrapolation, interpolation, splining FFTs, convolution, ODEs, and simple one- and two-dimensional PDEs using finite differencing. Introduction to concepts for optimizing codes on a CRAY-YMP. Examples from biomechanics, electrophysiology, and imaging. Project work included and students must have good working knowledge of Unix, Fortran, or C. Intended for graduate students and seniors who plan on attending graduate school. Prerequisite: Engineering 53L or equivalent, Mathematics 111 or equivalent, or consent of instructor. Instructor: Henriquez. 3 units.

260. Devices for the Disabled. Design of custom devices to aid disabled individuals. Students will be paired with health care professionals at local hospitals who will supervise the development of projects for specific clients. Formal engineering design principles will be emphasized; overview of associative technologies, patent issues, engineering ethics. Oral and written reports will be required. Selected projects may be continued as independent study. Prerequisite: Biomedical Engineering 164L or equivalent or consent of instructor. Instructor: Bohs. 3 units.

264L. Medical Instrument Design. General principles of signal acquisition, amplification processing, recording, and display in medical instruments. System design, construction, and evaluation techniques will be emphasized. Methods of real-time signal processing will be reviewed and implemented in the laboratory. Each student will design, construct, and demonstrate a functional medical instrument and collect and analyze data with that instrument. Formal write-ups and presentations of each project will be required. Prerequisite: Biomedical Engineering 164L or equivalent or senior standing. Instructor: S. Smith, Trahey, or Wolf. 4 units.

265. Advanced Topics in Biomedical Engineering. Advanced subjects related to programs within biomedical engineering tailored to fit the requirements of a small group. Consent of instructor required. Instructor: Staff. 1 to 4 units. Variable credit.

301. Cellular and Biosurface Engineering Seminar. Current topics in cellular and biosurface engineering. Theory and practice. Weekly seminar series. Instructor: Reichert or Truskey. 1 unit.

302. Cellular and Biosurface Engineering Seminar. Current topics in cellular and biosurface engineering. Theory and practice. Weekly seminar series. Instructor: Reichert or Truskey. 1 unit.

320. Medical Ultrasound Transducers. A study of the design, fabrication, and evaluation of medical ultrasound transducers. Topics include wave propagation in piezoelectric crystals, Mason and KLM circuit models, linear arrays and two-dimensional arrays, piezoelectric ceramic/epoxy composite materials, piezoelectric polymers, and photo-acoustic materials. Consent of instructor required. Instructor: S. Smith. 3 units.

330. Finite Element Method for Biomedical Engineers. The finite element method with an emphasis on applications to biomedical engineering. Several detailed examples illustrate the finite element analysis process, which includes setting up a mathematical description of the problem, putting it into a form suitable for finite element solution, solving the discretized problem, and using advanced computer codes to check the correctness of the numerical results. Consent of instructor required. Instructor: Staff. 3 units.

331. Viscoelasticity. Viscoelasticity of hard and soft tissue solids and composite structures. Linear and nonlinear one-dimensional viscoelastic behavior, internal damping, and three-dimensional viscoelasticity. Approximation techniques for determination of viscoelastic constitutive equations from experimental data. Mathematical formulations for the characterization of the dynamic behavior of biologic structures. Consent of instructor required. Instructor: Myers. 3 units.

333. Biomedical Imaging. A study of the fundamentals of information detection, processing, and presentation associated with imaging in biology and medicine. Analysis of coherent and incoherent radiation and various image generation techniques. Design and analysis of modern array imaging systems as well as systems. Instructor: von Ramm. 3 units.

340. Mechanics of Multiphase Biological Tissues. Introduction to constitutive modeling of multiphase mixtures with application to biological tissues (for example, skin, cornea, ligament, cartilage, intervertebral disc). Fundamental conservation laws and thermodynamic principles of the theory of mixtures will be reviewed. Development of constitutive equations for mixtures containing in viscid and viscous fluids, as well as hyperelastic, viscoelastic, and charged solids. Emphasis on solution methods required to determine the stress, strain, and flow fields in boundary value problems of simplified geometries, including problems for contact of two bodies. A knowledge of tensor fields, indicial notation, and partial differential equations is required. Prerequisite: Mathematics 114 or equivalent, and Biomedical Engineering 229 or consent of instructor. Instructor: Setton. 3 units.

350. Principles of Research Management. A survey of topics in modern research management techniques that will cover proven successful principles and their application in the areas of research lab organization, resource management, organization of technical projects, team leadership, financial accountability, and professional ethics. Instructor: Staff. 1 unit.

399. Special Readings in Biomedical Engineering. Individual readings in advanced study and research areas of biomedical engineering. Approval of director of graduate studies required. 1 to 3 units each. Instructor: Staff. 1 to 3 units. Variable credit.

COURSES CURRENTLY UNSCHEDULED

202. Biomedical Transfer Processes

206L. Microprocessors and Digital Instruments

209. Kinetics and Reactor Design

223. Cellular and Integrative Cardiovascular Physiology and Biophysics

230. Biomechanics

244. Mathematical Models of Physiological Systems

250. Cardiovascular Mechanics

Civil and Environmental Engineering (CE)

Professor Medina, *Chair* (121 Engineering); Associate Professor Laursen, *Director of Graduate Studies* (127 Engineering); Professors Haff, Malin, Medina, Petroski, Reckhow, Strohhahn, and Utku; Associate Professors Hueckel, Kabala, Peirce, Rojstaczer, Virgin and Katul; Assistant Professors Boadu, Dolbow, Gavin, Kasibhatla, Linden, Nadeau, Schuler, and Vasudevan; Professors Emeriti Brown and Wilson; Adjunct Associate Professor Piver

Civil and environmental engineering extends across mathematics, the natural sciences including physics, biology, and chemistry, and the social and management sciences. Civil and environmental engineers develop expertise in these disciplines to research, plan, design, construct, and analyze solutions to technical problems faced throughout society. These solutions vary widely in nature, size, and scope: space satellites and launching facilities, environmental systems and controls to protect public health, nuclear and conventional power plant structures, bridges, dams, buildings, tunnels, highways, and mass transportation systems.

Several specialty areas at Duke enjoy national and international reputations for quality:

- engineering and computational mechanics: the study of the behavior and control of solid and fluid systems under a broad range of design and extreme loading conditions; the development of new computational paradigms for complex mechanical systems;
- environmental engineering: the study of the disposal of hazardous waste, solid waste processing, pollutant fate and transport in water, soil, and air, and wastewater treatment to protect public health and the environment;
- geomechanics and applied geophysics: the study of the response of soils and rocks to mechanical, hydraulic, and environmental loadings and its mathematical modeling;
- structural engineering: the study of behavior of structures and materials, the safe and economical design of engineered structures, fundamentals of adaptive structures, use of adaptive structures technology in precision and vibration control of space structures, and vibration inhibition in buildings subjected to seismic and wind excitations;
- water resources engineering: the analysis of use, preservation, and efficient management of surface and groundwater supplies.

Environmental mechanics is an interdisciplinary area of interest to many civil and environmental engineering faculty. The emphasis is on the mechanics of chemically and/or biologically interacting solids and liquids, including transport phenomena in porous media, environmental geomechanics and geophysics, degradation and aging of structures and materials due to chemically aggressive environments, and natural and engineered environmental processes including sedimentation, coagulation, mixing, sludge processing, water and wastewater treatment, and barriers to prevent pollutant transport.

Laboratory facilities in the department are competitive with those found in major research universities worldwide.

Computers are used for data collection and analysis, and a wide range of physical, chemical, and biological testing equipment is used in the laboratory for teaching and research activities. Advanced-graphics computer systems are also available. Project-specific measurement equipment is designed, constructed, and applied in many of the specialty areas mentioned above.

201. Advanced Mechanics of Solids. Tensor fields and index notation. Analysis of states of stress and strain. Conservation laws and field equations. Constitutive equations for elastic, viscoelastic, and elastic-plastic solids. Formulation and solution of simple problems in elasticity, viscoelasticity, and plasticity. Instructor: Hueckel, Laursen, Nadeau, or Petroski. 3 units.

203. Plasticity. Inelastic behavior of soils and engineering materials. Yield criteria. Flow rules. Concepts of perfect plasticity and plastic hardening. Methods of rigid-plasticity. Limit analysis. Isotropic and kinematic hardening. Plastic softening. Diffused damage. Thermo-plasticity. Visco-plasticity. Prerequisite: Civil Engineering 201 or consent of instructor. Instructor: Hueckel. 3 units.

204. Plates and Shells. Differential equation and extremum formulations of linear equilibrium problems of Kirchhoffian and non-Kirchhoffian plates of isotropic and anisotropic material. Solution methods. Differential equation formulation of thin anisotropic shell problems in curvilinear coordinates; membrane and bending theories; specialization for shallow shells, shells of revolution, and plates. Extremum formulation of shell problems. Solution methods. Prerequisite: Engineering 75L or 135 and Mathematics 111. Instructor: Utku. 3 units.

207. Transport Phenomena in Biological Systems. 3 units. C-L: Biomedical Engineering 207, Mechanical Engineering 207.

210. Intermediate Dynamics. 3 units. C-L: Mechanical Engineering 210.

211. Energy Flow and Wave Propagation in Elastic Solids. Derivation of equations for wave motion in simple structural shapes: strings, longitudinal rods, beams and membranes, plates and shells. Solution techniques, analysis of systems behavior. Topics covered include: nondispersive and dispersive waves, multiple wave types (dilatational, distortional), group velocity, impedance concepts including driving point impedances and moment impedances. Power and energy for different cases of wave propagation. Prerequisites: Engineering 123L and Mathematics 111 or consent of instructor. Instructor: Franzoni. 3 units. C-L: Mechanical Engineering 234.

217. Transportation Systems Analysis. The transportation systems planning process. Quantitative analysis; mathematical modeling and computer simulation techniques for short- and long-range planning and evaluation of transportation systems. Prerequisite: (or corequisite) Civil Engineering 116 or consent of instructor. Instructor: Staff. 3 units.

220. Water Resources Systems Planning and Management. Focus on the development and application of mathematical modeling techniques to water resources systems problems. Deterministic and stochastic river basin modeling, irrigation planning and modeling, water quality prediction and management, wetlands management, the opti-

mal expansion of existing water resources systems and reservoir operations. Emphasis on development and application of optimization models for the planning and management of complex water resources systems involving the interaction of groundwater and surface water resources. Mathematical techniques include linear and dynamic programming, Monte Carlo simulation, simulated annealing, nonlinear optimization and stochastic optimization. Prerequisite: Civil Engineering 123L and Engineering 115 or equivalent. Instructor: Staff. 3 units.

221. Engineering Systems Reliability, Safety, and Risk Assessment. Introduction to the concepts of design reliability and safety. Topics include: concepts of probability in engineering planning and design, decision analysis and assessment of reliability, modeling and analysis of uncertainty, reliability-based design, multiple failure mode analysis, redundant and nonredundant systems, and fault tree analysis. Emphasis on determining the probability of failure for numerous engineering systems including structural systems, infrastructure systems, water treatment systems, environmental systems, and transportation networks. Prerequisite: Mathematics 111 or consent of instructor. Instructor: Staff. 3 units.

225. Dynamic Engineering Hydrology. Dynamics of the occurrence, circulation, and distribution of water; climate, hydrometeorology, geophysical fluid motions. Precipitation, surface runoff and stream flow, infiltration, water losses. Hydrograph analysis, catchment characteristics, hydrologic instrumentation, and computer simulation models. Prerequisite: Civil Engineering 122L or consent of instructor. Instructor: Medina. 3 units.

227. Groundwater Hydrology and Contaminant Transport. Review of surface hydrology and its interaction with groundwater. The nature of porous media, hydraulic conductivity, and permeability. General hydrodynamic equations of flow in isotropic and an isotropic media. Water quality standards and contaminant transport processes: advective-dispersive equation for solute transport in saturated porous media. Analytical and numerical methods, selected computer applications. Deterministic versus stochastic models. Applications: leachate from sanitary landfills, industrial lagoons and ponds, subsurface wastewater injection, monitoring of groundwater contamination. Conjunctive surface-subsurface models. Prerequisite: Civil Engineering 123L or consent of instructor. Instructor: Medina. 3 units.

228L. Sludge Management and Disposal. Production and characterization of residues from wastewater treatment. Theory of solid/water interfaces and vicinal water. Gravitational thickening and dewatering. Anaerobic stabilization, incineration, composting, and other treatment processes. Ultimate disposal. Prerequisite: Civil Engineering 124L or equivalent and consent of instructor. Instructor: Vesilind. 3 units.

231. Theory of Adaptive Structures. Behavior of structures composed of one-dimensional members, under inserted internal deformations. Linear excitation response relations. Energy and power requirements of insertion. Conditions of insertion without structural resistance. Computation of internal deformations yielding a partially prescribed response. Static shape control and slow moving mechanical manipulators. Vibration control by internal deformation insertion in autonomous and nonautonomous systems. Prerequisite: senior or graduate standing. Instructor: Utku. 3 units.

233. Prestressed Concrete Design. A critical review of research and recent developments in prestressed concrete design. Prestressed tanks, beams, and columns; partial prestressing and composite design. Prerequisite: Civil Engineering 133L or consent of instructor. Instructor: Staff. 3 units.

237. Advanced Soil Mechanics. Characterization of behavior of geomaterials. Stress-strain incremental laws. Nonlinear elasticity, hypo-elasticity, plasticity and visco-plasticity of geomaterials; approximated laws of soil mechanics; fluid-saturated soil behavior; cyclic behavior of soils; liquefaction and cyclic mobility; elements of soil

dynamics; thermal effects on soils. Prerequisite: Civil Engineering 139L or equivalent. Instructor: Hueckel. 3 units.

240. Chemical Fate of Organic Compounds. Equilibrium, kinetic, and analytical approaches applied to quantitative description of processes affecting the distribution and fate of anthropogenic and natural organic compounds in surface and groundwaters, including chemical transfers between air, water, soils/sediments, and biota; and thermochemical and photochemical transformations. The relationships between organic compound structure and environmental behavior will be emphasized. Sampling, detection, identification, and quantification of organic compounds in the environment. Prerequisite: university-level general chemistry and organic chemistry within last four years. Instructor: Dubay and Vasudevan. 3 units. C-L: Environment 240.

242. Environmental Aquatic Chemistry. Principles of chemical kinetics and equilibria applied to quantitative description of the chemistry of lakes, rivers, oceans, groundwaters, and selected treatment processes. Equilibrium and steady state models applied to processes such as acid-base chemistry, the carbonate system, coordination chemistry, precipitation and dissolution, oxidation-reduction, adsorption. Prerequisite: university-level general chemistry within last four years. Instructor: Staff. 3 units. C-L: Environment 242.

243. Physicochemical Unit Operations in Water Treatment. Fundamental bases for design of water and waste treatment systems, including transport, mixing, sedimentation and filtration, gas transfer, coagulation, and absorption processes. Emphasis on physical and chemical treatment combinations for drinking water supply. Prerequisite: Civil Engineering 124L. Instructor: Kabala. 3 units.

244. Applied Microbial Processes. Existing and novel microbial processes as they pertain to biotechnological products, specialty bioconversions, and to treat or exploit wastes. Concepts of microbiology, chemical engineering, the stoichiometry and kinetics of complex microbial metabolism, and process analysis. Specific processes such as carbon oxidation, vinegar and alcohol production, nitrification, methane production, biological electricity generation, recombinant protein secretion, and wastewater treatment in long-term space travel are discussed. Consent of instructor required. Instructor: Staff. 3 units.

245. Pollutant Transport Systems. Distribution of pollutants in natural waters and the atmosphere; diffusive and advective transport phenomena within the natural environment and through artificial conduits and storage/treatment systems. Analytical and numerical prediction methods. Prerequisite: Civil Engineering 122L and Mathematics 111 or equivalents. Instructor: Medina. 3 units.

246. Water Supply Engineering Design. The study of water resources and municipal water requirements including reservoirs, transmission, treatment and distribution systems; methods of collection, treatment, and disposal of municipal and industrial wastewaters. The course includes the preparation of a comprehensive engineering report encompassing all aspects of municipal water and wastewater systems. Field trips to be arranged. Prerequisite: Civil Engineering 124L or consent of instructor. Instructor: Vesilind. 3 units.

247. Air Pollution Control Engineering. The problems of air pollution with reference to public health and environmental effects. Measurement and meteorology. Air pollution control engineering: mechanical, chemical, and biological processes and technologies. Instructor: Peirce. 3 units.

248. Solid Waste Engineering. Engineering design of material and energy recovery systems including traditional and advanced technologies. Sanitary landfills and incineration of solid wastes. Application of systems analysis to collection of municipal refuse. Major design project in solid waste management. Prerequisite: Civil Engineering 124L or consent of instructor. Instructor: Vesilind. 3 units. Environment 248.

249. Control of Hazardous and Toxic Waste. Engineering solutions to industrial and municipal hazardous waste problems. Handling, transportation, storage, and disposal technologies. Biological, chemical, and physical processes. Upgrading abandoned disposal sites. Economic and regulatory aspects. Case studies. Consent of instructor required. Instructor: Peirce. 3 units.

251. Systematic Engineering Analysis. Mathematical formulation and numerical analysis of engineering systems with emphasis on applied mechanics. Equilibrium and eigenvalue problems of discrete and distributed systems; properties of these problems and discretization of distributed systems in continua by the trial functions with undetermined parameters. The use of weighted residual methods, finite elements, and finite differences. Prerequisite: senior or graduate standing. Instructor: Laursen or Utku. 3 units.

252. Buckling of Engineering Structures. An introduction to the underlying concepts of elastic stability and buckling, development of differential equation and energy approaches, buckling of common engineering components including link models, struts, frames, plates, and shells. Consideration will also be given to inelastic behavior, postbuckling, and design implications. Prerequisite: Civil Engineering 131L or consent of instructor. Instructor: Virgin. 3 units. C-L:

254. Introduction to the Finite Element Method. Investigation of the finite element method as a numerical technique for solving linear ordinary and partial differential equations, using rod and beam theory, heat conduction, elastostatics and dynamics, and advective/diffusive transport as sample systems. Emphasis placed on formulation and programming of finite element models, along with critical evaluation of results. Topics include: Galerkin and weighted residual approaches, virtual work principles, discretization, element design and evaluation, mixed formulations, and transient analysis. Prerequisite: a working knowledge of ordinary and partial differential equations, numerical methods, and programming in FORTRAN. Instructor: Laursen. 3 units.

255. Nonlinear Finite Element Analysis. Formulation and solution of nonlinear initial/boundary value problems using the finite element method. Systems include nonlinear heat conduction/diffusion, geometrically nonlinear solid and structural mechanics applications, and materially nonlinear systems (for example, elastoplasticity). Emphasis on development of variational principles for nonlinear problems, finite element discretization, and equation-solving strategies for discrete nonlinear equation systems. Topics include: Newton-Raphson techniques, quasi-Newton iteration schemes, solution of nonlinear transient problems, and treatment of constraints in a nonlinear framework. An independent project, proposed by the student, is required. Prerequisite: Civil Engineering 254 or consent of instructor. Instructor: Laursen. 3 units.

260. Vadose Zone Hydrology. Transport of fluids, heat, and contaminants through unsaturated porous media. Understanding the physical laws and mathematical modeling of relevant processes. Field and laboratory measurements of moisture content and matric potential. Prerequisite: Civil Engineering 122L and Mathematics 111, or consent of instructor. Instructor: Kabala. 3 units.

261. Stochastic Subsurface Hydrology. Stochastic partial differential equations of subsurface hydrology and their solutions for the first few concentration moments and for the full concentration probability density function. Local and nonlocal models. Formulation in terms of integral properties of porous media which account for heterogeneities that influence solute transport. Prerequisite: Civil Engineering 122L and Mathematics 111, or consent of instructor. Instructor: Kabala. 3 units.

262. Analytical Models of Subsurface Hydrology. Reviews the method of separation of variables, surveys integral transforms, and illustrates their application to solving initial boundary value problems. Three parts include: mathematical and hydrologic fundamentals, integral transforms and their philosophy, and detailed derivation via

integral transforms of some of the most commonly used models in subsurface hydrology and environmental engineering. Discussion and use of parameter estimation techniques associated with the considered models. Prerequisites: Mathematics 111 and either Civil Engineering 122L or 123L, or consent of instructor. Instructor: Kabala. 3 units.

263. Multivariable Control. Synthesis and analysis of multivariable linear dynamic feedback compensators. Standard problem formulation. Performance norms. Full state feedback and linear quadratic Gaussian synthesis. Lyapunov and Riccati equations. Passivity, positivity, and self-dual realizations. Nominal performance and robust stability. Applications to vibration control, noise suppression, tracking, and guidance. Prerequisite: a course in linear systems and classical control, or consent of instructor. Instructor: Bushnell, Clark, Gavin, or H. Wang. 3 units. C-L: Electrical Engineering 263, Mechanical Engineering 263.

264. Physico-Bio-Chemical Transformations. Surveys of a selection of topics related to the interaction between fluid flow (through channels or the porous media) and physical, chemical, and biochemical transformations encountered in environmental engineering. Numerous diverse phenomena, including solute transport in the vicinity of chemically reacting surfaces, reverse osmosis, sedimentation, centrifugation, ultrafiltration, rheology, microorganism population dynamics, and others will be presented in a unifying mathematical framework. Prerequisite: Civil Engineering 122L and Mathematics 111, or consent of instructor. Instructor: Kabala. 3 units.

265. Advanced Topics in Civil and Environmental Engineering. Opportunity for study of advanced subjects relating to programs within the civil and environmental engineering department tailored to fit the requirements of individuals or small groups. Instructor: Staff. 1 to 4 units. Variable credit.

270. Environmental and Engineering Geophysics. Use of geophysical methods for solving engineering and environmental problems. Theoretical frameworks, techniques, and relevant case histories as applied to engineering and environmental problems (including groundwater evaluation and protection, siting of landfills, chemical waste disposals, roads assessments, foundations investigations for structures, liquefaction and earthquake risk assessment). Introduction to theory of elasticity and wave propagation in elastic and poroelastic media, electrical and electromagnetic methods, and ground penetrating radar technology. Prerequisite: Mathematics 111 or Physics 52L or consent of instructor. Instructor: Boadu. 3 units.

271. Inverse Problems in Geosciences and Engineering. Basic concepts, theory, methods of solution, and application of inverse problems in engineering, groundwater modeling, and applied geophysics. Deterministic and statistical frameworks for solving inverse problems. Strategies for solving linear and nonlinear inverse problems. Bayesian approach to nonlinear inverse problems. Emphasis on the ill-posed problem of inverse solutions. Data collection strategies in relation to solution of inverse problems. Model structure identification and parameter estimation procedures. Prerequisite: Mathematics 111 or consent of instructor. Instructor: Boadu. 3 units.

272. Wave Propagation in Elastic and Poroelastic Media. Basic theory, methods of solution, and applications involving wave propagation in elastic and poroelastic media. Analytical and numerical solution of corresponding equations of motion. Linear elasticity and viscoelasticity as applied to porous media. Effective medium, soil/rock materials as composite materials. Gassmann's equations and Biot's theory for poroelastic media. Stiffness and damping characteristics of poroelastic materials. Review of engineering applications that include NDT, geotechnical and geophysical case histories. Prerequisite: Mathematics 111 or consent of instructor. Instructor: Boadu. 3 units.

281. Experimental Systems. Formulation of experiments; Pi theorem and principles of similitude; data acquisition systems; static and dynamic measurement of displace-

ment, force, and strain; interfacing experiments with digital computers for data storage, analysis, and plotting. Students select, design, perform, and interpret laboratory-scale experiments involving structures and basic material behavior. Prerequisite: senior or graduate standing in engineering or the physical sciences. Instructor: Gavin. 3 units.

283. Structural Dynamics. Formulation of dynamic models for discrete and continuous structures; normal mode analysis, deterministic and stochastic responses to shocks and environmental loading (earthquakes, winds, and waves); introduction to nonlinear dynamic systems, analysis and stability of structural components (beams and cables and large systems such as offshore towers, moored ships, and floating platforms). Instructor: Gavin. 3 units.

For Graduates

301. Graduate Colloquium. Current topics in civil and environmental engineering theory and practice. Weekly seminar series. Instructor: Wilson. 0 units.

302. Graduate Colloquium. Current topics in civil and environmental engineering theory and practice. Weekly seminar series. Instructor: Wilson. 0 units.

399. Special Readings in Civil and Environmental Engineering. Special individual readings in a specific area of study in civil and environmental engineering. Approval of director of graduate studies required. 1 to 3 units. Instructor: Graduate faculty. 1 to 3 units. Variable credit.

COURSES CURRENTLY UNSCHEDULED

202. Advanced Mechanics of Solids II

205. Elasticity

209. Kinetics and Reactor Design

212. Mechanical Behavior and Fracture of Materials

215. Engineering Systems Analysis

218. Engineering Management and Project Evaluation

222. Open Channel Flow

223. Flow Through Porous Media

226. Operational Hydrology

232. Reinforced Concrete Design

234. Advanced Structural Design in Metals

235. Foundation Engineering

236. Earth Structures

238. Rock Mechanics

239. Physical Properties of Soils

257. Structural Optimization

258. Analysis of Dynamic and Nonlinear Behavior of Structures

337. Elements of Soil Dynamics

350. Advanced Engineering Analysis

Electrical and Computer Engineering (EE)

Professor Nolte, *Chair*; Associate Professor Board, *Associate Chair*; Professor Massoud, *Director of Graduate Studies* (163 Hudson Hall); Professors Casey, Fair, Joines, Marinos, Trivedi, and P. Wang; Associate Professors Carin, Kedem, Krolik, Liu, Samulski, Schmajuk, and Teitsworth; Assistant Professors Chakrabarty, Collins, Cummer, George, Lebeck, and H. Wang; Professors Emeriti Owen and Wilson; Associate Research Professor Daniels-Race; Assistant Research Professor Ybarra; Adjunct Asso-

ciate Professor Derby; Adjunct Assistant Professors Bushnell and Morizio; Visiting Professors Kaiser and McCumber

A student may specialize in any one of the following fields in working toward either the M.S. or the Ph.D. degree with a major in electrical engineering: computer engineering, computer architecture, fault-tolerant computer systems, scientific computing, parallel processing, VLSI CAD tools, signal processing, digital speech processing, signal processing for auditory prostheses; signal detection and estimation, ocean acoustic signal processing, image processing, intelligent systems and control, nonlinear dynamics and control, hybrid control, diagnosis of dynamical systems, solid-state electronics, integrated circuit processing and process simulation, molecular-beam epitaxy, III-V compound semiconductor materials and devices, machine intelligence, applications of electromagnetic fields and waves. Recommended prerequisites for the graduate courses in electrical engineering include a knowledge of basic mathematics and physics, electrical networks, electromagnetic and system theory. Students in doubt about their background for enrollment in specific courses should discuss the matter with the director of graduate studies. The M.S. degree program includes either a thesis or a project and an oral examination. A qualifying examination is required for the Ph.D. degree program. This examination is intended to test both the breadth and depth of the student's understanding of basic electrical engineering concepts. There is no foreign language requirement.

211. Quantum Mechanics. Discussion of wave mechanics including elementary applications, free particle dynamics, Schrödinger equation including treatment of systems with exact solutions, and approximate methods for time-dependent quantum mechanical systems with emphasis on quantum phenomena underlying solid-state electronics and physics. Prerequisite: Mathematics 111 or equivalent. Instructor: Staff. 3 units.

214. Introduction to Solid-State Physics. Discussion of solid-state phenomena including crystalline structures, X-ray and particle diffraction in crystals, lattice dynamics, free electron theory of metals, energy bands, and superconductivity, with emphasis on understanding electrical and optical properties of solids. Prerequisite: quantum physics at the level of Physics 143L or Electrical Engineering 211. Instructor: Daniels-Race or Teitsworth. 3 units.

215. Semiconductor Physics. A quantitative treatment of the physical processes that underlie semiconductor device operation. Topics include band theory and conduction phenomena; equilibrium and nonequilibrium charge carrier distributions; charge generation, injection, and recombination; drift and diffusion processes. Prerequisite: Electrical Engineering 211 or consent of instructor. Instructor: Staff. 3 units.

216. Devices for Integrated Circuits. Derivation of basic semiconductor properties such as the effective mass, effective density of states, SHR recombination, avalanche breakdown and energy-band diagrams. Application of the continuity equation, Gauss' law, and Poisson's equation to obtain the I-V and C-V behavior of Si and GaAs Schottky barriers, GaAs MESFETs; Si JFETs, bipolar transistors and MOSFETs. Relation of device physics to SPICE parameters. Four laboratory exercises. Instructor: Casey. 3 units.

217. Analog Integrated Circuits. Analysis and design of bipolar and CMOS analog integrated circuits. SPICE device models and circuit macromodels. Classical operational amplifier structures, current feedback amplifiers, and building blocks for analog signal processing, including operational transconductance amplifiers and current conveyors. Biasing issues, gain and bandwidth, compensation, and noise. Influence of technology and device structure on circuit performance. Extensive use of industry-standard CAD tools, such as Analog Workbench. Prerequisite: Electrical Engineering 216. Instructor: Staff. 3 units.

218. Integrated Circuit Engineering. Basic processing techniques and layout technology for integrated circuits. Photolithography, diffusion, oxidation, ion implantation,

and metallization. Design, fabrication, and testing of integrated circuits. Prerequisite: Electrical Engineering 216. Instructor: Fair. 3 units.

219. Digital Integrated Circuits. Analysis and design of digital integrated circuits. IC technology. Switching characteristics and power consumption in MOS devices, bipolar devices, and interconnects. Analysis of digital circuits implemented in NMOS, CMOS, TTL, ECL, and BiCMOS. Propagation delay modeling. Analysis of logic (inverters, gates) and memory (SRAM, DRAM) circuits. Influence of technology and device structure on performance and reliability of digital ICs. SPICE modeling. Prerequisite: Electrical Engineering 151L and 216. Instructor: Massoud. 3 units.

241. Linear System Theory and Optimal Control. Consideration of system theory fundamentals: observability, controllability, and realizability; stability analysis; linear feedback, linear quadratic regulators, Riccati equation, and trajectory tracking. Prerequisite: Electrical Engineering 141. Instructor: Bushnell, H. Wang, or P. Wang. 3 units.

243. Pattern Classification and Recognition. Parameter estimation and supervised learning, nonparametric techniques, linear discriminant functions, clustering, language theory related to pattern recognition, examples from areas such as character and severe weather recognition, classification of community health data, recognition of geometrical configurations, algorithms for recognizing low resolution touch-sensor array signatures and 3-D objects. Consent of instructor required. Instructor: P. Wang. 3 units.

245. Digital Control Systems. Review of traditional techniques used for the design of discrete-time control systems; introduction of "nonclassical" control problems of intelligent machines such as robots. Limitations of the assumptions required by traditional design and analysis tools used in automatic control. Consent of instructor required. Instructor: Staff. 3 units.

246. Optimal Control. Review of basic linear control theory and linear/nonlinear programming. Dynamic programming and the Hamilton-Jacobi-Bellman Equation. Calculus of variations. Hamiltonian and costate equations. Pontryagin's Minimum Principle. Solution to common constrained optimization problems. This course is designed to satisfy the need of several engineering disciplines. Prerequisite: Electrical Engineering 141 or equivalent. Instructor: Bushnell. 3 units. C-L: Mechanical Engineering 232.

251. Advanced Digital System Design. Theory and hands-on experience in advanced digital system design. High-speed design, high complexity design (more than 10,000 gates), implementation technology selection, system modeling, power and clock distribution, line termination, and cooling. Case studies and demonstrations. Extensive use of CAD tools for logic minimization, logic synthesis, and system simulation. Rapid system prototyping with off-the-shelf and custom components. Laboratory exercises and a semester project. Prerequisite: Electrical Engineering 151L and 163L (or Biomedical Engineering 163L with consent of instructor). Instructor: Marinos. 3 units.

252. Advanced Digital Computer Architecture. A second course on computer architecture. Definition of high-performance computing. Performance measurement. Memory organization, cache hierarchies, and virtual memory. Instruction set design, instruction pipelining, superscalar processing. Vector processing. High-performance input/output. Multiprocessor interconnection networks, communications, and synchronization. Survey of current architectures. Prerequisite: Computer Science 104 or Electrical Engineering 152L. Instructor: Board. 3 units.

253. Parallel System Performance. Intrinsic limitations to computer performance. Amdahl's Law and its extensions. Components of computer architecture and operating systems, and their impact on the performance available to applications. Intrinsic properties of application programs and their relation to performance. Task graph models of parallel programs. Estimation of best possible execution times. Task assignment and related heuristics. Load balancing. Specific examples from computationally intensive,

I/O intensive, and mixed parallel and distributed computations. Global distributed system performance. Prerequisite: Computer Science 110; Electrical Engineering 151L and 152L. Instructor: Staff. 3 units.

254. Fault-Tolerant and Testable Computer Systems. Faults and failure mechanisms, test generation techniques and diagnostic program development for detection and location of faults in digital networks; design for testability, redundancy techniques, self-checking and fail-safe networks, fault-tolerant computer architectures. Prerequisite: Electrical Engineering 151L or equivalent. Instructor: Marinos. 3 units. Computer Science 225.

255. Mathematical Methods for Systems Analysis I. Basic concepts and techniques used in the stochastic modeling of systems. Elements of probability, statistics, queuing theory, and simulation. Prerequisite: four semesters of college mathematics. Instructor: Trivedi. 3 units. Computer Science 226.

257. Performance and Reliability of Computer Networks. Methods for performance and reliability analysis of local area networks as well as wide area networks. Probabilistic analysis using Markov models, stochastic Petri nets, queuing networks, and hierarchical models. Statistical analysis of measured data and optimization of network structures. Prerequisite: Electrical Engineering 156 and 255. Instructor: Trivedi. 3 units.

258. Artificial Neural Networks. Elementary biophysical background for signal propagation in natural neural systems. Artificial neural networks (ANN) and the history of computing; early work of McCulloch and Pitts, of Kleene, of von Neumann and others. The McCulloch and Pitts model. The connectionist model. The random neural network model. ANN as universal computing machines. Associative memory; learning; algorithmic aspects of learning. Complexity limitations. Applications to pattern recognition, image processing and combinatorial optimization. Prerequisite: Electrical Engineering 151L. Instructor: Staff. 3 units.

261. Full Custom VLSI Design. A first course in VLSI design with CMOS technologies. A study of devices, circuits, fabrication technology, logic design techniques, subsystem design and system architecture. Modeling of circuits and subsystems. Testing of gates, subsystems and chips, and design for testability. The fundamentals of full-custom design, and some semi-custom design. Prerequisite: Electrical Engineering 151L or equivalent; Electrical Engineering 163L (or Biomedical Engineering 163L with consent of instructor) or equivalent. Instructor: Chakrabarty. 3 units.

262. Analog Composite Microsystems. Advanced very large scale integrated (VLSI) circuits. Emphasis on analog electrical circuit analysis and design; introduction to composite circuit analysis and design. Composite circuits involve coupled-energy domains such as microelectromechanical and microelectrofluidic. Brief review of electrostatics and derivation of transistor large signal and small signal models. Basic analog circuits including current sources, amplifiers, voltage sources, and buffers. Strength of material and mechanics with design applications to microstructure sensing and actuating. Mixed-signal (electrical and mechanical), coupled-energy component modeling, and simulation using a behavioral hardware description language and SPICE. Prerequisite: Electrical Engineering 261. Instructor: Dewey. 3 units.

263. Multivariable Control. Synthesis and analysis of multivariable linear dynamic feedback compensators. Standard problem formulation. Performance norms. Full state feedback and linear quadratic Gaussian synthesis. Lyapunov and Riccati equations. Passivity, positivity, and self-dual realizations. Nominal performance and robust stability. Applications to vibration control, noise suppression, tracking, and guidance. Prerequisite: a course in linear systems and classical control, or consent of instructor. Instructor: Bushnell, Clark, Gavin, or H. Wang. 3 units. C-L: Civil Engineering 263, Mechanical Engineering 263.

271. Electromagnetic Theory. The classical theory of Maxwell's equations; electrostatics, magnetostatics, boundary value problems including numerical solutions, currents and their interactions, and force and energy relations. Three class sessions. Consent of instructor required. Instructor: Carin or Joines. 3 units.

272. Electromagnetic Communication Systems. Review of fundamental laws of Maxwell, Gauss, Ampere, and Faraday. Elements of waveguide propagation and antenna radiation. Analysis of antenna arrays by images. Determination of gain, loss, and noise temperature parameters for terrestrial and satellite electromagnetic communication systems. Prerequisite: Electrical Engineering 170L or 271. Instructor: Joines. 3 units.

273. Optical Communication Systems. Mathematical methods, physical ideas, and device concepts of optoelectronics. Maxwell's equations, and definitions of energy density and power flow. Transmission and reflection of plane waves at interfaces. Optical resonators, wave guides, fibers, and detectors are also presented. Prerequisite: Electrical Engineering 170L or equivalent. Instructor: Joines. 3 units.

274. Modern Optics I. Optical processes including the propagation of light, coherence, interference, and diffraction. Consideration of the optical properties of solids with applications of these concepts to lasers and modern optical devices. Lecture and laboratory projects. Instructor: Guenther. 3 units.

275. Microwave Electronic Circuits. Microwave circuit analysis and design techniques. Properties of planar transmission lines for integrated circuits. Matrix and computer-aided methods for analysis and design of circuit components. Analysis and design of input, output, and interstage networks for microwave transistor amplifiers and oscillators. Topics on stability, noise, and signal distortion. Prerequisite: Electrical Engineering 170L or equivalent. Instructor: Joines. 3 units.

281. Random Signals and Noise. Introduction to mathematical methods of describing and analyzing random signals and noise. Review of basic probability theory; joint, conditional, and marginal distributions; random processes. Time and ensemble averages, correlation, and power spectra. Optimum linear smoothing and predicting filters. Introduction to optimum signal detection, parameter estimation, and statistical signal processing. Prerequisite: Mathematics 135 or Statistics 113. Instructor: Collins or Hansen. 3 units.

282. Digital Signal Processing. Introduction to the fundamentals of processing signals by digital techniques with applications to practical problems. Discrete time signals and systems, elements of the Z-transform, discrete Fourier transforms, digital filter design techniques, fast Fourier transforms, and discrete random signals. Instructor: Nolte. 3 units.

283. Digital Communication Systems. Digital modulation techniques. Coding theory. Transmission over band width constrained channels. Signal fading and multipath effects. Spread spectrum. Optical transmission techniques. Prerequisite: Electrical Engineering 281 or consent of instructor. Instructor: Staff. 3 units.

284. Acoustics and Hearing. 3 units. C-L: Biomedical Engineering 235.

285. Signal Detection and Extraction Theory. Introduction to signal detection and information extraction theory from a statistical decision theory viewpoint. Subject areas covered within the context of a digital environment are decision theory, detection and estimation of known and random signals in noise, estimation of parameters and adaptive recursive digital filtering, and decision processes with finite memory. Applications to problems in communication theory. Prerequisite: Electrical Engineering 281 or consent of instructor. Instructor: Nolte. 3 units.

286. Digital Processing of Speech Signals. Detailed treatment of the theory and application of digital speech processing. Modeling of the speech production system and speech signals; speech processing methods; digital techniques applied in speech trans-

mission, speech synthesis, speech recognition, and speaker verification. Acoustic-phonetics, digital speech modeling techniques, LPC analysis methods, speech coding techniques. Application case studies: synthesis, vocoders, DTW (dynamic time warping)/HMM (hidden Markov modeling) recognition methods, speaker verification/identification. Prerequisite: Electrical Engineering 182 or equivalent or consent of instructor. Instructor: Hansen. 3 units.

287. Underwater Communications. Elements of communication theory and digital signal processing are combined with basic physics and oceanography to offer an overview of underwater communications, with an emphasis on the radar/sonar problem. Beam forming with transducer arrays. Signal design and target resolution; the ambiguity function. The ocean as a communication channel: sound propagation and ambient noise characteristics. Performance analysis of selected communication scenarios and case studies of operational sonar systems. Prerequisite: Electrical Engineering 181 or consent of instructor. Instructor: Staff. 3 units.

288. Image and Array Signal Processing. Multidimensional digital signal processing with applications to practical problems in image and sensor array processing. Two-dimensional discrete signals and systems, discrete random fields, 2-D sampling theory, 2-D transforms, image enhancement, image filtering and restoration, space-time signals, beam forming, and inverse problems. Prerequisite: Electrical Engineering 282 or consent of instructor. Instructor: Krolik. 3 units.

289. Adaptive Filters. Adaptive digital signal processing with emphasis on the theory and design of finite-impulse response adaptive filters. Stationary discrete-time stochastic processes, Wiener filter theory, the method of steepest descent, adaptive transverse filters using gradient-vector estimation, analysis of the LMS algorithm, least-squares methods, recursive least squares and least squares lattice adaptive filters. Application examples in noise cancelling, channel equalization, and array processing. Prerequisite: Electrical Engineering 281 and 282 or consent of instructor. Instructor: Krolik. 3 units.

299. Advanced Topics in Electrical Engineering. Opportunity for study of advanced subjects related to programs within the electrical engineering department tailored to fit the requirements of a small group. Consent of director of undergraduate studies and of supervising instructor required. Instructor: Staff. 1 to 4 units. Variable credit.

For Graduates

312. Electronic Properties of Submicron Solid-State Devices. Review of quantum mechanics, scattering and transport, Boltzmann transport equation, quantum effects in devices with emphasis on one- and two-dimensional transport, electron-polar phonon interactions, quantum transport. Prerequisite: quantum mechanics. Instructor: Stroschio. 3 units.

316. Advanced Physics of Semiconductor Devices. Semiconductor materials: band structure and carrier statistics. Advanced treatments of metal-semiconductor contacts, Schottky barriers, p-n junctions, bipolar transistors (charge-control and Gummel-Poon models), and field-effect transistors (short channel effects, scaling theory, subthreshold conduction, nonuniformly doped substrates, surface and buried-channel devices, hot-electron effects). Device modeling in two dimensions using PISCES. Prerequisite: Electrical Engineering 216. Instructor: Massoud. 3 units.

318. Integrated Circuit Fabrication Laboratory. Introduction to IC fabrication processes. Device layout. Mask design and technology. Wafer cleaning, etching, thermal oxidation, thermal diffusion, lithography, and metallization. Laboratory fabrication and characterization of basic IC elements (p-n junctions, resistors, MOS capacitors, gated diodes, and MOSFETs). Use of four-point probe, ellipsometer, spreading resis-

tance probe, scanning electron microscope, and evaporation system. Testing of basic inverters and gates. Prerequisite: Electrical Engineering 218 and consent of instructor. Instructor: Massoud. 3 units.

352. Advanced Topics in Digital Systems. A selection of advanced topics from the areas of digital computer architectures and fault-tolerant computer design. Prerequisite: Electrical Engineering 252 or equivalent. Instructor: Staff. 3 units. Computer Science 320.

361. Advanced VLSI Design. Theory of advanced VLSI design. Specifications development, methodology, issues, circuit-level trade-offs. Full custom design, standard cell design, gate array design, silicon compilation. Semiconductor technologies and logic families for semi-custom design. Clocking schemes and distribution, race conditions. Design of a variety of circuits (adders, I/O drivers, RAM, FIFO, etc.) Testing of all phases in the life cycle of an integrated circuit. Top-down design and bottom-up implementation. Student projects. Not open to students who have taken Computer Science 310 before Fall 1994. Prerequisite: Electrical Engineering 261 or equivalent. Instructor: Kedem. 3 units. Computer Science 322.

373. Selected Topics in Field Theory. Instructor: Staff. 3 units.

391. Internship. Student gains practical electrical and computer engineering experience by taking a job in industry, and writing a report about this experience. Requires prior consent from the student's advisor and from the director of graduate studies. May be repeated with consent of the advisor and the director of graduate studies. Credit/no credit grading only. Instructor: Staff. 1 unit.

399. Special Readings in Electrical Engineering. Special individual readings in a specified area of study in electrical engineering. Approval of director of graduate studies required. 1 to 4 units. Instructor: Graduate staff. 1 to 4 units. Variable credit.

COURSES CURRENTLY UNSCHEDULED

276. Laser Physics

311. Quantum Electronics

334. Nonlinear Oscillations in Physical Systems

342. Optimal Control Theory

371. Advanced Electromagnetic Theory

382. Advanced Topics in Signal Processing

383. Applied Information Theory and Statistical Estimation

Mechanical Engineering and Materials Science (ME)

Professor Cocks, *Chair* (142A Engineering); Professor Harman, *Director of Graduate Studies* (145 Engineering); Professors Behringer, Bejan, Clark, Dowell, Garg, Hochmuth, Needham, Pearsall, Shaughnessy, and Tan; Associate Professors Bliss, Hall, Howle, Jones, Knight, Lozier, Virgin, and Wright; Assistant Professor Zhelev; Research Associate Professor Zhong; Research Assistant Professor Ping-Beall; Adjunct Professors Kuhn, Lee, and Wu; Adjunct Associate Professor Crowson

The department offers programs of study and research leading to the M.S. and Ph.D. degrees in both mechanical engineering and materials science. Within mechanical engineering, the broad areas of concentration include thermal and fluids systems, mechanics and biomechanics, and dynamics, including nonlinear dynamics and control. Within materials science, the areas of concentration include electronic materials, biomaterials, thin films, and the determination of material characteristics. The department emphasizes a highly research-oriented Ph.D. degree program. Students in the Ph.D. degree program who do not already have a master's degree are urged to meet the course and other general requirements for this degree and to obtain

it during completion of their program. Programs of study are highly flexible to meet individual needs. Current research areas available include: cell, membrane, and surface engineering; biorheology; convection; diffusion and heat transfer in heterogeneous media; aeroelasticity; computational fluid dynamics; chaotic systems; vibrations and acoustics of dynamic systems; sound propagation and absorbing materials; unsteady aerodynamics; thermal design by entropy generation minimization; feedback and feed forward control systems; robotics; expert systems; bearing design and lubrication; nano-tribology; magnetic bearings; mechanical properties of kidney stones; positron annihilation spectroscopy; diffusion and kinetics in Si, GaAs, and other electronic materials; semiconductor wafer bonding; novel thin film processing, magnetic materials, oxide heterostructures and computational materials science.

For additional information, visit the departmental web site at <http://www.egr.duke.edu/mems/index.html>.

202. Engineering Thermodynamics. Axiomatic formulations of the first and second laws. General thermodynamic relationships and properties of real substances. Energy, availability, and second law analysis of energy conversion processes. Reaction and multiphase equilibrium. Power generation. Low temperature refrigeration and the third law of thermodynamics. Thermodynamic design. Instructor: Bejan. 3 units.

207. Transport Phenomena in Biological Systems. 3 units. C-L: Biomedical Engineering 207, Civil Engineering 207.

209. Soft Wet Materials and Interfaces. The materials science and engineering of soft wet materials and interfaces. Emphasis on the relationships between composition, structure, properties and performance of macromolecules, self assembling colloidal systems, linear polymers and hydrogels in aqueous and nonaqueous liquid media, including the role of water as an "organizing" solvent. Applications of these materials in biotechnology, medical technology, microelectronic technology, and nature's own designs of biological materials. Instructor: Needham. 3 units.

210. Intermediate Dynamics. Comprehensive treatment of the dynamic motion of particles and rigid bodies with an introduction to nonlinear dynamics and the vibration of continuous systems. Topics include: conservation of linear and angular momentum, superposition applied to linear systems, motion in inertial and noninertial frames of reference, Hamilton's principle and Lagrange's equations, and generalized coordinates. Instructor: Hall or Knight. 3 units.

211. Theoretical and Applied Polymer Science. Structural organization and hardware design of digital computer systems. Arithmetic unit, switching matrices, memory organization, central processing unit (CPU), I/O unit, and microprogram control. Detailed design and simulation of a general-purpose computer system. Computer systems based on cellular structures, hardware compilers, and parallel processing architectures are also discussed. {.75 ED/.25 ES} Prerequisite: Electrical Engineering 157 and Computer Science 104 or consent of instructor. Instructor: Marinos. 3 units. C-L: Biomedical Engineering 208.

212. Electronic Materials. An advanced course in materials science and engineering dealing with the various materials important for solid-state electronics including semiconductors, ceramics, and polymers. Emphasis on thermodynamic concepts and on defects in these materials. Materials preparation and modification methods for technological applications. Prerequisite: Engineering 83L. Instructor: Tan. 3 units.

213. Physical Metallurgy. An advanced materials science course focusing on the relationships between structure and properties in metals and alloys. Conceptual and mathematical models developed and analyzed for crystal structures, elastic and plastic deformation, phase transformations, thermodynamic behavior, and electrical and magnetic properties. Prerequisite: Engineering 83L and Mechanical Engineering 101L. Instructor: Pearsall. 3 units.

214. Corrosion and Corrosion Control. Environmental aspects of the design and utilization of modern engineering alloys. Theory and mechanisms of corrosion, particularly in seawater and atmospheric environments. Microstructural aspects of diffusion, oxidation, hot corrosion, and stress corrosion. Prerequisite: Engineering 83L. Instructor: Jones. 3 units.

215. Biomedical Materials and Artificial Organs. 3 units. C-L: Biomedical Engineering 215.

216. Mechanical Metallurgy. An advanced materials science course dealing with the response of materials to applied forces. Mechanical fundamentals; stress-strain relationships for elastic behavior; theory of plasticity. Metallurgical fundamentals; plastic deformation, dislocation theory; strengthening mechanisms. Mechanical behavior of polymers. Applications to materials testing. Prerequisite: Engineering 75L and Engineering 083L. Instructor: Jones. 3 units.

217. Fracture of Engineering Materials. Conventional design concepts and their relationship to the occurrence of fracture. Linear elastic and general yield fracture mechanics. Microscopic plastic deformation and crack propagation. The relationship between macroscopic and microscopic aspects of fracture. Time dependent fracture. Fracture of specific materials. Prerequisite: Engineering 83L and Mechanical Engineering 115L. Instructor: Jones. 3 units.

218. Thermodynamics of Electronic Materials. Basic thermodynamic concepts applied to solid state materials with emphasis on technologically relevant electronic materials such as silicon and GaAs. Thermodynamic functions, phase diagrams, solubilities and thermal equilibrium concentrations of point defects; nonequilibrium processes and the kinetic phenomena of diffusion, precipitation, and growth. Instructor: Tan. 3 units.

221. Compressible Fluid Flow. Basic concepts of the flow of gases from the subsonic to the hypersonic regime. One-dimensional wave motion, the acoustic equations, and waves of finite amplitude. Effects of area change, friction, heat transfer, and shock on one-dimensional flow. Moving and oblique shock waves and Prandtl-Meyer expansion. Instructor: Shaughnessy. 3 units.

225. Mechanics of Viscous Fluids. Equations of motion for a viscous fluid, constitutive equations for momentum and energy transfer obtained from second-law considerations, general properties and exact solutions of the Navier-Stokes and Stokes (creeping-flow) equations, applications to problems of blood flow in large and small vessels. Instructor: Hochmuth. 3 units.

226. Intermediate Fluid Mechanics. A survey of the principal concepts and equations of fluid mechanics, fluid statics, surface tension, the Eulerian and Lagrangian description, kinematics, Reynolds transport theorem, the differential and integral equations of motion, constitutive equations for a Newtonian fluid, the Navier-Stokes equations, and boundary conditions on velocity and stress at material interfaces. Instructor: Shaughnessy or Thompson. 3 units.

227. Advanced Fluid Mechanics. Flow of a uniform incompressible viscous fluid. Exact solutions to the Navier-Stokes equation. Similarity methods. Irrotational flow theory and its applications. Elements of boundary layer theory. Prerequisite: Mechanical Engineering 226 or consent of instructor. Instructor: Shaughnessy. 3 units.

228. Lubrication. Derivation and application of the basic governing equations for lubrication; the Reynolds equation and energy equation for thin films. Analytical and computational solutions to the governing equations. Analysis and design of hydrostatic and hydrodynamic slider bearings and journal bearings. Introduction to the effects of fluid inertia and compressibility. Dynamic characteristics of a fluid film and effects of bearing design on dynamics of machinery. Prerequisite: Mathematics 111 and Mechanical Engineering 126L. Instructor: Knight. 3 units.

229. Computational Fluid Mechanics and Heat Transfer. An exposition of numerical techniques commonly used for the solution of partial differential equations encountered in engineering physics. Finite-difference schemes (which are well-suited for fluid mechanics problems); notions of accuracy, conservation, consistency, stability, and convergence. Recent applications of weighted residuals methods (Galerkin), finite-element methods, and grid generation techniques. Through specific examples, the student is guided to construct and assess the performance of the numerical scheme selected for the particular type of transport equation (parabolic, elliptic, or hyperbolic). Instructor: Howle. 3 units.

230. Modern Control and Dynamic Systems. Dynamic modeling of complex linear and nonlinear physical systems involving the storage and transfer of matter and energy. Unified treatment of active and passive mechanical, electrical, and fluid systems. State-space formulation of physical systems. Time and frequency-domain representation. Controllability and observability concepts. System response using analytical and computational techniques. Lyapunov method for system stability. Modification of system characteristics using feedback control and compensation. Emphasis on application of techniques to physical systems. Instructor: Garg. 3 units.

231. Adaptive Structures: Dynamics and Control. Integration of structural dynamics, linear systems theory, signal processing, transduction device dynamics, and control theory for modeling and design of adaptive structures. Classical and modern control approaches applied to reverberant plants. Fundamentals of adaptive feedforward control and its integration with feedback control. Presentation of a methodical design approach to adaptive systems and structures with emphasis on the physics of the system. Numerous MATLAB examples provided with course material as well as classroom and laboratory demonstrations. Instructor: Clark. 3 units.

232. Optimal Control. 3 units. C-L: Electrical Engineering 246.

234. Energy Flow and Wave Propagation in Elastic Solids. Prerequisites: Engineering 123L and Mathematics 111 or consent of instructor. Instructor: Franzoni. 3 units. C-L: Civil Engineering 211.

235. Advanced Mechanical Vibrations. Analytical and experimental procedures applied to the design of machines and systems for adequate vibration control. Determination of eigenvalues and eigenvectors by iteration and computer techniques, transfer matrices applied to lumped and distributed systems, analytical and numerical methods of obtaining the pulse response of plane and three-dimensional multimass systems, convolution and data processing, introduction to random vibration. Instructor: Knight or Wright. 3 units.

236. Engineering Acoustics. Fundamentals of acoustics including sound generation, propagation, reflection, absorption, and scattering. Emphasis on basic principles and analytical methods in the description of wave motion and the characterization of sound fields. Applications including topics from noise control, sound reproduction, architectural acoustics, and aerodynamic noise. Occasional classroom or laboratory demonstration. Prerequisite: Engineering 123L and Mathematics 111 or consent of instructor. Instructor: Bliss. 3 units.

237. Aerodynamics. Fundamentals of aerodynamics applied to wings and bodies in subsonic and supersonic flow. Basic principles of fluid mechanics and analytical methods for aerodynamic analysis. Two- and three-dimensional wing theory, slender-body theory, lifting surface methods, vortex and wave drag. Brief introduction to vehicle design, performance, and dynamics. Special topics such as unsteady aerodynamics, vortex wake behavior, and propeller and rotor aerodynamics. Instructor: Bliss. 3 units.

238. Advanced Aerodynamics. Advanced topics in aerodynamics. Conformal transformation techniques. Three-dimensional wing theory, optimal span loading for planar and nonplanar wings. Ground effect and tunnel corrections. Propeller theory.

Slender wing theory and slender body theory, transonic and supersonic area rules for minimization of wave drag. Numerical methods in aerodynamics including source panel and vortex lattice methods. Prerequisite: Mechanical Engineering 237. Instructor: Hall. 3 units.

239. Unsteady Aerodynamics. Analytical and numerical methods for computing the unsteady aerodynamic behavior of airfoils and wings. Small disturbance approximation to the full potential equation. Unsteady vortex dynamics. Kelvin impulse and apparent mass concepts applied to unsteady flows. Two-dimensional unsteady thin airfoil theory. Time domain and frequency domain analyses of unsteady flows. Three-dimensional unsteady wing theory. Introduction to unsteady aerodynamic behavior of turbomachinery. Prerequisite: Mechanical Engineering 237. Instructor: Hall. 3 units.

240. Patent Technology and Law. The use of patents as a technological data base is emphasized including information retrieval in selected engineering disciplines. Fundamentals of patent law and patent office procedures. Consent of instructor required. Instructor: Cocks. 3 units.

245. Applications in Expert Systems. A comprehensive introduction to the key practical principles, techniques, and tools being used to implement knowledge-based systems. The classic MYCIN system studied in detail to provide historic perspective. Current systems employing combinations of production rules, prototypical knowledge, and frame-based case studies. Student term projects consist of the development of individual, unique expert systems using the Texas Instruments Personal Consultant. Knowledge of LISP not a prerequisite. Instructor: Wright. 3 units.

252. Buckling of Engineering Structures. 3 units. C-L: Civil Engineering 252.

263. Multivariable Control. 3 units. C-L: Civil Engineering 263, Electrical Engineering 263.

265. Advanced Topics in Mechanical Engineering. Opportunity for study of advanced subjects related to programs within mechanical engineering tailored to fit the requirements of a small group. Approval of director of undergraduate or graduate studies required. Instructor: Staff. 1 to 4 units. Variable credit.

268. Cellular and Biosurface Engineering. A combination of fundamental concepts in materials science, colloids, and interfaces that form a basis for characterizing: the physical properties of biopolymers, microparticles, artificial membranes, biological membranes, and cells; and the interactions of these materials at biofluid interfaces. Definition of the subject as a coherent discipline and application of its fundamental concepts to biology, medicine, and biotechnology. Prerequisite: Mechanical Engineering 208 or consent of instructor. Instructor: Needham. 3 units.

270. Robot Control and Automation. Review of kinematics and dynamics of robotic devices; mechanical considerations in design of automated systems and processes, hydraulic and pneumatic control of components and circuits; stability analysis of robots involving nonlinearities; robotic sensors and interfacing; flexible manufacturing; man-machine interaction and safety consideration. Prerequisite: Mechanical Engineering 230 or equivalent and consent of instructor. Instructor: Garg. 3 units.

275. Product Safety and Design. An advanced engineering design course that develops approaches to assessing and improving the safety of products and product systems. Safety is presented in terms of acceptable risk and analyzed through legal case studies. Probabilistic decision making; risk economics; risk analysis and assessment. Corequisite: Mechanical Engineering 160L. Instructor: Pearsall. 3 units.

276. Designs and Decisions. Successful engineering entrepreneurship requires both the creation of new devices and processes and the ability to make rational selections among design alternatives. Design methodology is presented that fosters creativity and introduces TRIZ (the Russian acronym for Theory of Inventive Problem Solving). Decisions among design alternatives are structured and analyzed in graphical

and probabilistic terms: tree diagrams; sampling theory; hypothesis testing; and confidence levels. Corequisite: Mechanical Engineering 160L or consent of instructor. Instructor: Pearsall. 3 units.

277. Optimization Methods for Mechanical Design. Definition of optimal design. Methodology of constructing quantitative mathematical models. Nonlinear programming methods for finding "best" combination of design variables: minimizing steps, gradient methods, flexible tolerance techniques for unconstrained and constrained problems. Emphasis on computer applications and term projects. Consent of instructor required. Instructor: Wright. 3 units.

280. Convective Heat Transfer. Models and equations for fluid motion, the general energy equation, and transport properties. Exact, approximate, and boundary layer solutions for laminar flow heat transfer problems. Use of the principle of similarity and analogy in the solution of turbulent flow heat transfer. Two-phase flow, nucleation, boiling, and condensation heat and mass transfer. Instructor: Bejan. 3 units.

281. Fundamentals of Heat Conduction. Fourier heat conduction. Solution methods including separation of variables, transform calculus, complex variables. Green's function will be introduced to solve transient and steady-state heat conduction problems in rectangular, cylindrical, and spherical coordinates. Microscopic heat conduction mechanisms, thermophysical properties, Boltzmann transport equation. Prerequisite: Mathematics 111 or consent of instructor. Instructor: Bejan. 3 units.

282. Fundamentals of Thermal Radiation. Radiative properties of materials, radiation-materials interaction and radiative energy transfer. Emphasis on fundamental concepts including energy levels and electromagnetic waves as well as analytical methods for calculating radiative properties and radiation transfer in absorbing, emitting, and scattering media. Applications cover laser-material interactions in addition to traditional areas such as combustion and thermal insulation. Prerequisite: Mathematics 111 or consent of instructor. Instructor: Staff. 3 units.

290. Physical Oceanography. Introduction to the dynamic principles of ocean circulation with an emphasis on large temporal and spatial scales of motion. Topics include wind-driven and density-driven flow, western boundary intensification, mid-ocean, shelf, and tropical circulations. Prerequisite: Mathematics 31 and 32 or consent of instructor. Instructor: Lozier. 3 units. C-L: Earth and Ocean Sciences 203, Environment 290.

For Graduates

325. Aeroelasticity. A study of the statics and dynamics of fluid/structural interaction. Topics covered include static aeroelasticity (divergence, control surface reversal), dynamic aeroelasticity (flutter, gust response), unsteady aerodynamics (subsonic, supersonic, and transonic flow), and a review of the recent literature including nonlinear effects such as chaotic oscillations. Prerequisite: Mathematics 230 and consent of instructor. Instructor: Dowell. 3 units.

331. Nonlinear Control Systems. Analytical, computational, and graphical techniques for solution of nonlinear systems; Krylov and Bogoliubov asymptotic method; describing function techniques for analysis and design; Liapounov functions and Lure's methods for stability analysis; Aizerman and Kalman conjectures; Popov, circle, and other frequency-domain stability criteria for analysis and synthesis. Prerequisite: Mechanical Engineering 230 or consent of instructor. Instructor: Garg or Wright. 3 units.

335. Nonlinear Mechanical Vibration. A comprehensive treatment of the role of nonlinearities in engineering dynamics and vibration. Analytical, numerical, and experimental techniques are developed within a geometrical framework. Prerequisite: Mechanical Engineering 210 or 235 or equivalent. Instructor: Virgin. 3 units.

399. Special Readings in Mechanical Engineering. Individual readings in advanced study and research areas of mechanical engineering. Approval of director of graduate studies required. 1 to 3 units. Instructor: Staff. 1 to 3 units. Variable credit.

COURSES CURRENTLY UNSCHEDULED

208. Introduction to Colloid and Surface Science

224. An Introduction to Turbulence

322. Mechanics of Viscous Fluids

English (ENGLISH)

Professor Quilligan, *Chair* (312 Allen); Professor Porter, *Director of Graduate Studies* (316 Allen); Professors Aers, Applewhite, Baker, Butters, Clum, Davidson, DeNeef, Holloway, Pope, Price, Smith, Strandberg, Torgovnick, and Williams; Professor of the Practice Gopen; Adjunct Professor Andrews; Associate Professors Beckwith, Ferraro, Gaines, Jones, Moses, Pfau, and Willis; Associate Professors of the Practice Cox and Malouf; Adjunct Associate Professor Pierce-Baker; Assistant Professors Baucom, Shannon, Schmitt, and Thorn; Assistant Professor of the Practice Hillard; Professor Emeritus Jackson

The department offers graduate work leading to the A.M. and Ph.D. degrees, although only students seeking the doctorate are admitted to the department. The A.M. degree, if not already earned elsewhere, may be taken by students en route to the Ph.D. (although it is not required) and by those who elect to leave the doctoral program. The department requires completion of a minimum of eleven courses, a reading proficiency of at least one foreign language (the specific language to be determined by the student's major areas of academic concentration), a preliminary examination of three subfields (one major, two minor) which consists of both a written and oral part, and a dissertation chapter meeting with the thesis committee by the end of the third year of study. The interests of the English department faculty range historically from medieval and Renaissance to postmodern and postcolonial literatures. Methodological approaches encompass historicist and new historicist, text-based, feminist, cultural materialist, legal, and gay and lesbian criticism. Faculty research engages related disciplines such as film and visual, African American, cultural, and ethnic studies. The principal concern of members of the English department faculty nonetheless remains the training of new scholars, teachers, and critics in both traditional and noncanonical fields of literary study. Recent surveys by the National Research Council and U.S. News and World Report rank the graduate program among the top five in the nation, and as a leading program in the fields of critical theory, Third World literature, and nineteenth- and twentieth-century American literature.

For additional information, contact our web site at <http://www.duke.edu/web/english/>

For Seniors and Graduates

202S. Narrative Writing. The writing of short stories, memoirs, tales, and other narrations. Readings from ancient and modern narrative. Close discussion of frequent submissions by class members. Consent of instructor required. Instructor: Porter or Price. 3 units.

203S. Advanced Narrative Writing. The writing of extended narrative prose—long stories, novellas, substantive memoirs. Students should be proficient in the writing of short narratives. Consent of instructor required. Instructor: Porter or Price. 3 units.

205. Semiotics and Linguistics. 3 units. C-L: Russian 205, Linguistics 205.

206. Semiotics of Culture. 3 units. C-L: Russian 202, Cultural Anthropology 202.

212. Middle English Literature: 1100 to 1500. Selected topics. Instructor: Aers or Beckwith. 3 units. C-L: Medieval and Renaissance Studies 209.

213. Chaucer. The first two-thirds of his career, especially *Trailus and Criseyde*. Instructor: Aers or Beckwith. 3 units. C-L: Medieval and Renaissance Studies 213.

214. Chaucer. Continuation of English 213. *The Canterbury Tales*. Instructor: Aers or Beckwith. 3 units.

221. Renaissance Prose and Poetry: 1500 to 1660. Selected topics. Instructor: DeNeef or Shannon. 3 units. C-L: Medieval and Renaissance Studies 221B.

235. Restoration and Eighteenth-Century Literature: 1660 to 1800. Selected topics. Instructor: Jackson or Thorn. 3 units.

241. Romantic Literature: 1790 to 1830. Selected topics. Instructor: Applewhite, Jackson, or Pfau. 3 units.

245. Victorian Literature: 1830 to 1900. Selected topics. Instructor: Schmitt. 3 units.

251. British Literature since 1900. Selected topics. Instructor: Baucom, Moses, or Torgovnick. 3 units.

263. American Literature to 1865. Selected topics. Instructor: Davidson or Jones. 3 units.

267. American Literature: 1865 to 1915. Selected topics. Instructor: Davidson or Williams. 3 units.

269. American Women Writers. Selected topics. Instructor: Davidson or Pope. 3 units.

271S. Special Topics Seminar. Instructor: Staff. 3 units.

275. American Literature since 1915. Selected topics. Instructor: Ferraro, Pope, Strandberg, or Torgovnick. 3 units.

280. Twentieth-Century Reconceptions of Knowledge and Science. 3 units. C-L: Literature 260.

281. Studies in Genre. History, criticism, and theory of literary genres such as the novel, pastoral, epic, and drama. Instructor: Staff. 3 units.

288. Special Topics. Subjects, areas, or themes that cut across historical eras, several national literatures, or genres. Instructor: Staff. 3 units.

290. Methods of Composition Pedagogy. A philosophical and practical exploration of developments in the field of composition studies. Cognition, concept formation, psycholinguistics, interpretation, and the making of meaning. Works by Burke, Richards, Kitzhaber, Berlin, Berthoff, Bizzell, Elbow, Corbett, Macrorie, Williams, Coles, and others. Instructor: Gopen or Hillard. 3 units.

For Graduates

312. Studies in Middle English Literature. Instructor: Aers or Beckwith. 3 units.

315. Studies in Chaucer. Instructor: Aers or Beckwith. 3 units.

321. Studies in Renaissance Literature. Instructor: DeNeef, Porter, Quilligan, or Shannon. 3 units.

324. Studies in Shakespeare. Instructor: Porter. 3 units.

329. Studies in Milton. Instructor: DeNeef or Quilligan. 3 units.

337. Studies in Augustanism. Instructor: Jackson or Thorn. 3 units.

338. Studies in a Major Augustan Author. Instructor: Jackson or Thorn. 3 units.

341. Studies in Romanticism. Instructor: Applewhite, Jackson, or Pfau. 3 units.

347. Studies in Victorianism. Instructor: Schmitt. 3 units.

348. Studies in a Major Nineteenth-Century British Author. Instructor: Jackson or Pfau. 3 units.

353. Studies in Modern British Literature. Instructor: Baucom, Moses, or Torgovnick. 3 units.

361. Studies in American Literature before 1915. Instructor: Holloway, Jones, or Williams. 3 units.

368. Studies in a Major American Author before 1915. Instructor: Davidson, Holloway, Jones, or Williams. 3 units.

375. Studies in Modern American Literature. Instructor: Applewhite, Ferraro, Holloway, or Strandberg. 3 units.

376. Studies in a Modern Author (British or American). Instructor: Staff. 3 units.

381. Special Topics Seminar. Instructor: Staff. 3 units.

385. Studies in Literary Criticism. Instructor: Graduate faculty. 3 units.

386. Problems in the Theory of Value and Judgment. An advanced seminar dealing with classic problems relating to the concept of value and evaluative behavior (e. g., standards, judgments, canon-formation, taste), as illuminated by contemporary work in critical theory, anthropology, economics, sociology, etc. Instructor: B. H. Smith. 3 units. C-L: Literature 300, Philosophy 300.

388. The History of Rhetoric: Classical to Renaissance. The foundations of rhetorical studies from Plato, Aristotle, Cicero, and Quintilian through Longinus, Augustine, and Erasmus to Bacon and Ramus. No prerequisites. Instructor: Gopen or Hillard. 3 units.

389. The History of Rhetoric: Eighteenth to Twentieth Centuries. Continuing study of the major texts in the history of rhetoric with special attention paid to J. Q. Adams, Campbell, Blair, Whately, Bain, Perelman, and Burke. Prerequisite: English 388. Instructor: Gopen or Hillard. 3 units.

390. Composition Theory and Pedagogy. Methodologies of teaching composition, with special emphasis on the theories of structural stylistics employed in the University Writing Program (UWP). All students registering in the course must hold a tutorship in the UWP, must attend the UWP training seminar and all scheduled UWP staff meetings, and will be observed teaching by a UWP director. Ungraded. Instructor: Gopen or Hillard. 3 units.

391. Tutorial in Special Topics. Directed research and writing in areas unrepresented by regular course offerings. Consent of instructor required. Instructor: Staff. 3 units.

392. Tutorial in Journal Editing. Systematic exposure to all phases of academic journal editing. Restricted to holders of journal editing internships. Ungraded. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

207A. Introduction to Old English

207B. Old English Literature

208. History of the English Language

209. Present-Day English

220. Shakespeare: Selected Topics

284. Contemporary Film Theory

289. The Theory of the Novel

310. Studies in Old English Literature

383. Studies in Textual Criticism

393. Professionalism, Theory, and Power in Legal and Literary Studies

Environment (ENVIRON)

Norman Christensen, *Dean*; Professor Knoerr, *Director of Graduate Studies (A309A Levine Science Research Center)*; Professors Barber, C. Bonaventura, J. Bonaventura,

Crowder, Di Giulio, Forward, Healy, R. Keohane, Kramer, Orbach, Ramus, Reckhow, Richardson, Schlesinger, Terborgh, van Schaik, and Wiener; Associate Professors Kasi-bhatla, Katul, Kirby-Smith, Lavine, Maguire, Miranda, Oren, Richter, Rittschof, and Wolpert; Assistant Professors Freedman, Garcia-Johnson, Halpin, Read, Urban, and Vasudevan; Visiting Assistant Professor Stow; Adjunct Professors Heath, Sharma, and Wear; Adjunct Associate Professors Ellsworth, Sigmon, and Tulis; Adjunct Assistant Professors Ahmann, Cooper, Mansfield, McClellan-Green, and Vandenberg.

Major and minor work is offered in the areas of natural resource and environmental science/ecology, systems science, and economics/policy through the Divisions of Environmental Social Sciences, Ecology, Aquatic and Atmospheric Sciences, and Environmental Toxicology and Chemistry in the School of the Environment. (For information about the graduate work offered by the Division of Earth and Ocean Sciences, see the Earth and Ocean Sciences section in this chapter.) College graduates who have a bachelor's degree in one of the natural or social sciences, forestry, engineering, business, or environmental science will be considered for admission to a degree program. Students will be restricted to the particular fields of specialization for which they are qualified academically. Graduate School programs usually concentrate on some area of natural resource and environmental science/ecology, systems science, or economics/policy, while study in resource and environmental management is more commonly followed in one of the professional master's degree programs of the School of the Environment. For more complete program descriptions and information on professional training in forestry or environmental studies, the *Bulletin of Duke University: School of the Environment* should be consulted.

School of the Environment faculty normally accept to the academic degree program only those students who wish to pursue a Ph.D. degree. Applicants are strongly encouraged to contact the individual faculty member under whose supervision they are interested in pursuing graduate study. Information about each faculty member's area of research interest can be found in the Nicholas School of the Environment's bulletin and on the school's web site located at <http://www.env.duke.edu>. The M.A. degree is available for students enrolled in the joint law program, and the M.S. degree may be awarded as part of the doctoral program. Students generally are not admitted to the M.A. and M.S. tracks as stand alone programs in the Nicholas School with the exception of the Division of Earth and Ocean Sciences which accepts students to a M.S. track. (See the Earth and Ocean Sciences section in this chapter for additional information.)

200. Integrated Case Studies. A group of two to four students may plan and conduct integrated research projects on a special topic, not normally covered by courses or seminars. A request to establish such a project should be addressed to the case studies director with an outline of the objectives and methods of study and a plan for presentation of the results to the school. Each participant's adviser will designate the units to be earned (up to six units) and evaluate and grade the work. Instructor: Staff. Variable credit.

201. Forest Resources Field Skills. Introduction to field techniques commonly used to quantify and sample forest resources: trees, soils, water, and animal resources. Dendrology, vegetation sampling, soil mapping, river flow estimation, field water quality sampling, surveying, and use of compass. Instructor: Richter. 2 units.

202. Microbial Ecology. Interactions of microorganisms with the biotic and abiotic components of their aquatic, terrestrial, and atmospheric environments. Topics include membrane structure, motility and chemotaxis, biodegradation of organic compounds, aerobic and anaerobic respiration, biogeochemical cycling, phototrophy, and specialized symbioses of nitrogen-fixing bacteria with legumes, cellulolytic bacteria with termites and ruminants, and chemolithotrophic bacteria with hydrothermal vent organisms. Prerequisite: university-level general chemistry and biology. Instructor: Staff. 3 units.

203. Conservation Biology: Theory and Practice. An overview of biological diversity, its patterns, and the current extinction crisis. Historical and theoretical foundations of conservation, from human values and law to criteria and frameworks for setting conservation priorities; island biogeography theory, landscape ecology, and socioeconomic considerations in reserve design; management of endangered species in the wild and in captivity; managing protected areas for long term viability of populations; the role of the landscape matrix around protected areas; and techniques for conserving biological diversity in semiwild productive ecosystems like forests. Three field trips. Prerequisite: one ecology course or consent of instructor. Instructor: Staff. 3 units.

205L. Ecological Management of Forest Systems (Silviculture). The aim of the course is to equip future resource managers and environmental consultants with knowledge allowing them to propose lower impact practices to individuals and organizations who need to balance wood production with maintenance of environmental quality. Underlying principles of growth, from seed to mature trees, and stand dynamics are explored. Various alternative methods of manipulating growth, stand structure and development, ranging from little to large perturbations of forest systems, are presented and assessed in terms of their effect on resource quality. Includes laboratory. Instructor: Oren. 4 units.

206. Forest Vegetation Sampling. Theory and application of forest vegetation sampling. Direct and indirect estimation methods that range from timber cruising and inventory to sampling for species composition. Laboratory applications in Duke Forest to include over- and understory vegetation. Instructor: Staff. 3 units.

207. Forest Pest Management. Fundamentals of entomology and plant pathology as appropriate to understanding the impacts of insects and diseases on forest productivity and their assessment for integration into forest management. Regional case examples and complexes are evaluated in terms of pest-population, forest-stand dynamics; economic and societal constraints; treatment strategies; monitoring systems; and benefit-cost analysis. This approach seeks to develop predictive capabilities in long-range pest management and decision making. Instructor: Staff. 3 units.

207L. Forest Pest Management. Same as 207 with laboratory which is largely field oriented to focus on diagnostics and impact analysis. Instructor: Staff. 4 units.

208. Estuarine Ecosystem Processes. A study of the physical, chemical, geological, and biological processes that control the structure of estuarine communities. Includes readings, oral presentations, and discussion of current literature from the journal *Estuaries*. Discussions focus on the management and policy implications of the science. Restricted to graduate students. (Given at Beaufort.) Prerequisite: ecology, systematics, or field biology course or consent of instructor. Instructor: Kirby-Smith. 3 units. C-L: Marine Sciences

209. Conservation Biology and Policy. Introduction to the key concepts of ecology and policy relevant to conservation issues at the population to ecosystems level. Focus on the origin and maintenance of biodiversity and conservation applications from both the biology and policy perspectives (for example, endangered species, captive breeding, reserve design, habitat fragmentation, ecosystem restoration/rehabilitation). Open to undergraduates only under Biology 109. (Given at Beaufort.) Prerequisite: introductory biology; suggested: a policy and/or introductory ecology course. Instructors: Crowder (Beaufort) and Rubenstein (visiting summer faculty). 3 units. C-L: Marine Sciences

212. Environmental Toxicology. Study of environmental contaminants from a broad perspective encompassing biochemical, ecological, and toxicological principles and methodologies. Discussion of sources, environmental transport and transformation phenomena, accumulation in biota and ecosystems. Impacts at various levels of organization, particularly biochemical and physiological effects. Prerequisite: organic chemistry and vertebrate physiology or consent of instructor. Instructor: Di Giulio. 3 units.

213. Forest Ecosystems. Emphasis on the processes by which forests circulate, transform, and accumulate energy and materials through interactions of biologic organisms and the forest environment. Ecosystem productivity and cycling of carbon, water, and nutrients provide the basis for lecture and laboratory. Instructor: Richter. 3 units.

214. Landscape Ecology. Emphasis on the role of spatial heterogeneity in terrestrial systems: its detection and description, agents of pattern formation, landscape dynamics and models, and the implications of heterogeneity of populations, communities, and ecosystems. Prerequisites: an intermediate-level ecology course and the equivalent of introductory applied statistics, or consent of instructor. Instructor: Urban. 3 units.

215. Environmental Plant Physiology. Examination of tolerance, limiting factors, nutrition, and other ecological physiology concepts used in evaluating plant responses to multiple environmental stresses. Discussion of procedures for and examples of monitoring physiological responses to environmental perturbations and resource manipulation. Instructor: Oren. 3 units.

216. Applied Population Ecology. Population dynamics of managed and unmanaged populations. A quantitative approach to exploitation and conservation of animal and plant populations, including harvesting, population viability analysis, population genetics. Prerequisite: introductory statistics, calculus, and computer programming or consent of instructor. Instructor: Staff. 3 units.

217. Tropical Ecology. Ecosystem, community, and population ecology of tropical plants and animals with application to conservation and sustainable development. Prerequisite: a course in general ecology. Instructor: Terborgh. 3 units. C-L: Biology 215.

218L. Barrier Island Ecology. An integration of barrier island plant and animal ecology within the context of geomorphological change and human disturbance. Experimental evidence supporting the theory of barrier island formation and migration; plant and animal adaptations and their evolution, succession ecology and conservation and restoration ecology. Strong emphasis in labs on independent use of quantitative field observation and research techniques. Prerequisite: Biology 25L or equivalent; suggested: course in botany or ecology. (Given at Beaufort.) Instructors: Evans, Peterson, and Wells (visiting summer faculty). 4 units. C-L: Biology 218L, Marine Sciences.

219L. Marine Ecology. Factors that influence the distribution, abundance, and diversity of marine organisms. Course structure integrates lectures and field excursions. Topics include characteristics of marine habitats, adaptation to environment, species interactions, biogeography, larval recruitment, and communities found in rocky shores, tidal flats, beaches, mangrove, coral reefs, and subtidal areas. Not open to students who have taken Biology 203L. Open to undergraduates only under Biology 129L. (Given at Beaufort fall and summer and at Bermuda, spring.) Prerequisite: introductory biology. Instructors: Crowder or Kirby-Smith (Beaufort); Lipschultz, McKenna, and Smith (Bermuda). 4 units. C-L: Biology 203L, Marine Sciences.

221. Soil Resources. Emphasis on soil resources as central components of terrestrial ecosystems, as rooting environments for plants, and as porous media for water. Soil physics and chemistry provide the basis for the special problems examined through the course. Laboratory emphasizes field and lab skills, interpretive and analytical. Instructor: Richter. 3 units.

222L. Physical Processes in Coastal Environments. The physical processes of beaches, the inner continental shelf, and in estuaries, in the context of their implications for the biological and geological environments. Topics drawn from the origin of waves, currents, tides, turbulence, and mixing transport of sand and larvae. Applications to biomechanics and coastal erosion, and to marine ecology, coastal zone management, and water quality. (Given at Beaufort.) Prerequisite: Mathematics 31 and 32. Instructor: Staff. 4 units. C-L: Earth and Ocean Sciences 201L, Marine Sciences.

223L. Behavioral Ecology. How ecological factors shape foraging, mating, aggressive, and social behavior. Laboratory experiments and field observations from the Outer

Banks environment. Independent projects and seminars. Not open to undergraduates. (Given at Beaufort.) Prerequisite: introductory biology (Biology 25L). Instructor: Rubenstein (visiting summer faculty). 6 units. C-L: Biology 213L, Marine Sciences.

224L. Coastal Ecosystem Processes. Physical, chemical, and biological processes in the coastal zone of the Carolinas. A unifying theme will be the coupling of watersheds, river basins, estuaries, and the coastal ocean through the movement of ground and surface waters. Topics include hydrology, nutrient cycles, sediment-water column interactions, primary and secondary production, and food web dynamics. Sustaining coastal ecosystems in the face of land use change. (Given at Beaufort). Instructors: Ramus and staff. 4 units. C-L: Biology 219L, Marine Sciences.

225L. Coastal Ecotoxicology and Pollution. Principles of transport, fates, food-web dynamics and biological effects of pollutants in the marine environment. Laboratory to stress standard techniques for assessing pollutant levels and effects. (Given at Beaufort.) Prerequisite: introductory chemistry and biology. Instructor: Kenney. 4 units. C-L: Marine Sciences

226. Marine Mammals. Ecology, social organization, behavior, acoustic communication, and management issues. Focused on marine mammals in the southeastern United States (for example, bottlenose dolphin, right whale, West Indian manatee). Only open to undergraduates under Biology 126. (Given at Beaufort.) Prerequisite: introductory biology. Instructor: Read or staff. 3 units. C-L: Marine Sciences

226L. Marine Mammals. Laboratory version of Environment 226. Laboratory exercises consider social organization and acoustic communication in the local bottlenose dolphin population. (Given at Beaufort.) Prerequisite: introductory biology. Instructor: Read or staff. 4 units. C-L: Marine Sciences

227L. Biology and Conservation of Sea Turtles. Biology including the anatomy, physiology, behavior, life histories, and population dynamics of sea turtles linked to conservation issues and management. Focus on threatened and endangered sea turtle species, with special attention to science and policy issues in United States waters. Includes field experience with the animals and with their habitat requirements. Sea turtle assessment and recovery efforts, fishery-turtle interactions, population modeling and state/national/international management efforts. Only open to undergraduates under Biology 125L. (Given at Beaufort.) Prerequisite: introductory biology. Instructors: Crowder, Wyneken (visiting summer faculty), or staff. 4 units. C-L: Marine Sciences

228L. Physiology of Marine Animals. Environmental factors, biological rhythms, and behavioral adaptations in the comparative physiology of marine animals. Open to undergraduates only under Biology 150L. Four units (fall); six units (summer). (Given at Beaufort.) Prerequisite: introductory biology and chemistry. Instructor: Forward. Variable credit. C-L: Biology 253L, Marine Sciences.

229L. Biochemistry of Marine Animals. Functional, structural, and evolutionary relationships of biochemical processes of importance to marine organisms. Open to undergraduates only under Biology 155L. Four units (fall and spring); six units (summer). (Given at Beaufort.) Prerequisite: Biology 25L; and Chemistry 11L, 12L. Instructors: McClellan-Green (spring); Rittschof (fall and summer). Variable credit. C-L: Biology 255L, Marine Sciences.

230L. Weather and Climate. Overview of the science of meteorology and principles of climatology, especially as applied to problems in ecology and natural resource management. Emphasis on the processes and characteristics of weather phenomena and local and regional climates. General introduction to sources of climatic data and climatic data analysis. Includes laboratory. Instructor: Knoerr. 4 units.

231. Ecological Theory and Data. Goals and contributions of ecological theory. Formulation of models and applications to data. Topics include demography, population growth, community interactions, food webs, metapopulations, disturbance, structure,

stochasticity, chaos, and patchiness. Model development, analysis, and interpretation. Discussions focus on classical and current primary literature. Analysis of data using SPLus, making use of likelihood models, bootstrapping, and Bayesian approaches. Prerequisite: one year each of calculus and statistics. Instructor: Clark. 3 units. C-L: Biology 268

232. Microclimatology. Introduction to the micrometeorological processes. Discussion of the integration of these processes and the resulting microclimates in the rural (forest, field, and water surface) and urban environments. Methods for modification of the microclimate. Offered on demand. Instructor: Knoerr. 3 units. Variable credit. C-L: Biology 232.

233. Soil Chemistry and Contamination. Composition, structure, and chemistry of inorganic and organic soil components. Includes study of sorption/desorption, mineral weathering, oxidation-reduction reactions, and kinetics of soil chemical processes as related to contamination evaluation and remediation. Standard and innovative techniques for soil and groundwater cleanup will be discussed. Prerequisite: Environment 221 or 240 or 242 or consent of instructor. Instructor: Vasudevan. 3 units.

234L. Watershed Hydrology. Introduction to the hydrologic cycle with emphasis on the influence of land use, vegetation, soil types, climate, and land forms on water quantity and quality and methods for control. Development of water balance models. Analysis of precipitation patterns, rainfall and runoff, and nonpoint source impacts. Statistical handling and preparation of hydrologic data, simulation and prediction models, introduction to groundwater flow, laboratory and field sampling methods. Instructor: Katul. 4 units.

235. Air Quality Management. Types, sources, effects of air pollutants. Regulatory framework emphasizing the Clean Air Act Amendments of 1990 and federal, state, local agency implementation. Application of risk assessment, technology, market incentives to air management. Scientific, policy aspects of acid deposition, global climate change, indoor air, mobile sources control. Dispersion modeling, exposure assessment. Instructor: Vandenberg. 3 units.

236. Water Quality Management. Types, sources, and effects of pollutants. Water quality standards and criteria. Engineering approaches to water management. Mathematical models and their application to water quality management. Federal regulations, in particular, the Federal Water Pollution Control Act and the Safe Drinking Water Act. Policy analysis for water quality management planning. Instructor: Stow. 3 units.

237L. Field Botany of North Carolina's Wetlands. A survey of the flora of North Carolina's wetland habitats with emphasis on plant identification in the field. Field trips to mountain, piedmont, and coastal wetlands. Examination of all groups of plants including bryophytes, ferns, and seed plants. Wetland habitats include swamps, bogs, pocosins, and brackish sites. Information on the floristics of the southeastern United States botanical nomenclature, systematic relationships of wetland plants, and an overview of wetland vegetation. Prerequisite: one course in plant diversity or systematics, or consent of instructor. Instructors: Shaw and Wilbur. 3 units. C-L: Biology 242L.

238. Bryology and Peatland Ecology. Ecology, morphology, and systematics of mosses, liverworts, and hornworts. Emphasis on the identification of dominant species and on their habitat relationships. Special attention to peatmosses and the ecology of *Sphagnum*-dominated ecosystems. Involves a field trip during Fall break. Instructor: Shaw. 3 units.

239. Human Health and Ecological Risk Assessment. Topics central to both health and ecological risk assessment are explored. Basic concepts of hazard identification, dose-response relationships, exposure assessment, and risk characterization and communication are discussed in the context of both human health and environmental assessment. The basis and rationale for using specific, as well as extrapolated, scientific

information and expert judgment, and the strengths and weaknesses of alternative approaches, are evaluated. Applications emphasizing real cases are used to illustrate the interdisciplinary process and products of risk assessment, as well as the regulatory use of the information. Group projects emphasized. Instructors: Mihaich and McMasters. 3 units.

240. Chemical Fate of Organic Compounds. Equilibrium, kinetic, and analytical approaches applied to quantitative description of processes affecting the distribution and fate of anthropogenic and natural organic compounds in surface and groundwaters, including chemical transfers between air, water, soils/sediments, and biota; and thermochemical and photochemical transformations. The relationships between organic compound structure and environmental behavior will be emphasized. Sampling, detection, identification, and quantification of organic compounds in the environment. Prerequisites: university-level general chemistry and organic chemistry within last four years. Instructors: Dubay and Vasudevan. 3 units. C-L: Civil Engineering 240.

242. Environmental Aquatic Chemistry. Principles of chemical kinetics and equilibria applied to quantitative description of the chemistry of lakes, rivers, oceans, groundwaters, and selected treatment processes. Equilibrium and steady state models applied to processes such as acid-base chemistry, the carbonate system, coordination chemistry, precipitation and dissolution, oxidation-reduction, adsorption. Prerequisite: university-level general chemistry within last four years. Instructor: Staff. 3 units. C-L: Civil Engineering 242.

243. Environmental Biochemistry. Introduction to the (macro)molecules of life and fundamental metabolic pathways. Topics are presented in the context of environmental perturbations. Fundamental aspects of energetics, proteins, enzymes, carbohydrates, lipids, and nucleic acids. Emphasis on mechanisms of adaptation, molecular controls, and responses to toxicants. (Given at Beaufort.) Prerequisite: organic chemistry. Instructor: C. Bonaventura. 3 units. C-L: Cell Biology 243, Marine Sciences.

244L. Molecular and Cellular Processes in Marine Organisms. Joint research projects on the adverse effects of environmental pollutants on marine organisms at the cellular and molecular level. Research methodologies include: spectroscopy (UV/VIS, fluorescence, and atomic absorption); subcellular fractionation; protein purification and characterization using chromatography and electrophoresis; analysis of pollutant-induced damage to proteins, membranes, and DNA; measurement of activity of enzymatic defense systems. Lectures cover molecular mechanisms of damage and damage control, and concepts that underlie the methods to be used. (Given at Beaufort.) Prerequisite: organic chemistry. Instructors: C. Bonaventura and McClellan-Green. 4 units. C-L: Cell Biology 244L, Marine Sciences.

246. Survey of Occupational Health and Safety. Occupational risks associated with biological, chemical, ergonomic, radiation, and toxic hazards. The nature and scope of occupational hazards, health effects, and risk assessment and management strategies. Open to undergraduates by consent. Instructor: Staff. 3 units.

247. Survey of Environmental Health and Safety. Environmental risks from the perspective of global ecology, biology, chemistry, and radiation. The nature and scope of environmental hazards, environmental impacts and health effects, and risk assessment and management strategies. Open to undergraduates by consent. Instructor: Staff. 3 units.

248. Solid Waste Engineering. Engineering design of material and energy recovery systems including traditional and advanced technologies. Sanitary landfills and incineration of solid wastes. Application of systems analysis to collection of municipal refuse. Major design project in solid waste management. Prerequisite: Civil Engineering 124L or consent of instructor. Instructor: Vesilind. 3 units. C-L: Civil Engineering 248

249. Environmental Molecular Biology. Introduction to molecular techniques and gene regulation as they apply to environmental issues. Topics include basic cloning strategies and methods, DNA/RNA/protein separation and hybridization, polymerase chain reaction, *in vitro* mutagenesis, and protein expression. Student presentations illustrate how molecular technologies such as the creation of genetically engineered organisms address environmental problems. Prerequisite: introductory biology. Instructor: Freedman. 3 units.

250L. Form, Function, and Adaptation of Plants. The structural and developmental basis for the major functions of the plant body including energy harvest, mechanical support, transport, and storage. Structural adaptations to important environmental stresses. Emphasis on underlying biomechanical/physical principles. Prerequisite: Biology 25L; suggested: either Biology 110L, 140L, 149, or 152. Instructor: Staff. 4 units. C-L: Biology 250L

253L. Sensory Physiology and Behavior of Marine Animals. Sensory physiological principles with emphasis on visual and chemical cues. Laboratories will use behavior to measure physiological processes. Only open to undergraduates under Biology 156L. (Given at Beaufort.) Prerequisites: Biology and Chemistry. 4 units. Instructors: Forward and Rittschof. C-L: Marine Sciences.

255. Applied Regression Analysis. Linear regression using both graphical and numerical methods. Model construction, critique, and correction using graphical residual analysis. One-way and two-way analysis of variance; introduction to design of experiments. Use of a standard statistical software package. Applications and examples drawn from various sources, emphasizing the biological and environmental sciences. Prerequisite: Statistics 210B or equivalent. Instructor: Staff. 3 units. C-L: Statistics and Decision Sciences 242.

256S. Seminar in Ocean Sciences. Biological, chemical, physical, and geological aspects of the ocean and their relation to environmental issues. Consent of instructor required. (Given at Beaufort.) Instructor: Staff. 2 units. C-L: Marine Sciences

257. Environmental Experimental Design. The principles of statistical experimental design used to set up experiments in environmental science and to analyze data from such experiments. Topics include analysis of variance and covariance, blocking, random versus fixed effects, repeated measures, power, impact assessment, and adaptive management. Prerequisite: Statistics 210B or equivalent. Instructor: Burdick. 3 units. C-L: Statistics and Decision Sciences 241.

260. Western Field Trip. One-week trip to observe land management and utilization practices in the western United States. Exposure to ecological, economic, and policy issues, as well as watershed, wildlife, and land use questions. May be repeated for credit. Consent of instructor required. Instructor: Edeburn. 1 unit.

262. Forest Management Traveling Seminar. Covers current topics in the broad field of forest management. Taught as a set of coordinated field trips with expert contacts in sites in the Carolina piedmont, coastal plain, and mountains. Topics of past seminars include fiber utilization, best management practices, forest regeneration, the chip mill issue, forest-pest management, and forest preservation management. May be repeated for credit. Instructor: Richter. 1 unit.

263. Environmental Economics: Quantitative Methods and Applications. Uses envirometrics (mathematical programming, multivariate statistics, and simulation techniques) to address environmental problems; properties of economic instruments for externality problems developed with programming models; regression and maximum likelihood techniques used in nonmarket valuation; and simulation in applied benefit and cost analysis. Prerequisite: Economics 149. Instructor: Staff. 3 units. C-L: Economics 263.

264. Applied Differential Equations in Environmental Sciences. General calculus and analytic geometry review; numerical differentiation and integration; analytic and

exact methods for first and second order ordinary differential equations (ODE); introduction to higher order linear ODE, numerical integration of ODEs and systems of ODEs; extension of Euler's method to partial differential equations (PDE) with special emphasis on parabolic PDE. Example applications include population forecasting, soil-plant-atmosphere water flow models, ground water and heat flow in soils, and diffusion of gases from leaves into the atmosphere. Prerequisite: Mathematics 31 or equivalent or consent of instructor. Instructor: Katul. 2 units.

266. Ecology of Southern Appalachian Forests. Field trips to various forest ecosystems in the southern Appalachian Mountains. Species identification, major forest types, field sampling, and history of effects of human activities. Consent of instructor required. Instructor: Richter. 1 unit.

269S. Advanced Topics in Marine Ecology. Theoretical concepts from population, community, and evolutionary ecology will be linked to observations and experiments to enhance understanding of the structure and function of marine systems. Current topics in marine ecology (for example, marine food web dynamics, species interactions, life history strategies, fisheries ecology, conservation biology). Discussions based on readings from the primary literature with emphasis on developing critical and synthetic skills. Each student will prepare a research proposal in NSF format. May be repeated. (Given at Beaufort.) Instructor: Crowder. 2 units. C-L: Biology 264S, Marine Sciences.

270. Resource and Environmental Economics. The application of economic concepts to private- and public-sector decision making concerning natural and environmental resources. Intertemporal resource allocation, benefit-cost analysis, valuation of environmental goods and policy concepts. Prerequisite: introductory course in microeconomics. Instructor: Kramer. 3 units. C-L: Economics 270, Public Policy Studies 272.

271. Economic Analysis of Resource and Environmental Policies. Case and applications oriented course examining current environmental and resource policy issues. Benefits and costs of policies related to sustaining resource productivity and maintaining environmental quality will be analyzed using economic and econometric methods. Topics include benefit-cost analysis, intergenerational equity, externalities, public goods, and property rights. Prerequisite: Environment 270 or equivalent; Economics 149 recommended. Instructor: Staff. 3 units. C-L: Economics 272.

272. Evaluation of Public Expenditures. Basic development of cost benefit analysis from alternative points of view, for example, equity debt, and economy as a whole. Techniques include: construction of cash flows, alternative investment rules, inflation adjustments, optimal timing and duration of projects, private and social pricing. Adjustments for economic distortions, foreign exchange adjustments, risk and income distribution examined in the context of present value rules. Examples and cases from both developed and developing countries. Instructor: Conrad. 3 units. C-L: Public Policy Studies 261, Economics 261.

273. Marine Fisheries Policy. Principles, structure, and process of public policy-making for marine fisheries. Topics include local, regional, national, and international approaches to the management of marine fisheries. A social systems approach is used to analyze the biological, ecological, social, and economic aspects of the policy and management process. (Given at Beaufort.) Instructor: Orbach. 3 units. C-L: Marine Sciences

274. Resource and Environmental Policy. Development of a policy analysis framework for studying resource and environmental policy. Political institutions, interest group theory, public choice theory, role of economics in policy analysis, ethics and values. Application to current and historical United States policy issues. Instructor: Staff. 3 units. C-L: Public Policy Studies 274.

275S. Protected Areas, Tourism, and Local Development. Investigates issues of establishing and managing national parks, biosphere reserves, and other protected areas

in situations where local populations compete for the same resources. Tourism is considered as a possible source of negative impacts on the protected area and as a source of local economic development. Includes consideration of tourism policy, resource protection strategies, microenterprise development, sustainable agriculture, and forestry. Instructor: Healy. 3 units.

276. Marine Policy. Formal study of policy and policy-making concerning the coastal marine environment. History of specific marine-related organizations, legislation, and issues and their effects on local, regional, national, and international arenas. Topics explored through use of theoretical and methodological perspectives, including political science, sociology, and economics. Consent of instructor required. (Given at Beaufort.) Instructor: Orbach. 3 units. C-L: Marine Sciences, Public Policy Studies 197

279. Atmospheric Chemistry: Principles and Processes. Provides a broad overview of the science of oxidant chemistry in the atmosphere. Basic physical and chemical concepts relevant to the understanding of atmospheric chemistry will be presented and several contemporary topics will be discussed from a process-level perspective. Topics include atmospheric structure and chemical composition; atomic structure and chemical bonds; chemical thermodynamics and kinetics; atmospheric radiation and photochemistry, tropospheric and stratospheric ozone chemistry; aqueous-phase atmospheric chemistry; atmospheric aerosols; and air quality modeling. Prerequisite: one college-level course each in chemistry and calculus. Instructor: Kasibhatla. 3 units.

280. Social Science Surveys for Environmental Management. Social science research methods for collecting data for environmental management and policy analysis. Sampling, survey design, focus groups, pretesting, survey implementation, coding, and data analysis. Team projects emphasize development and practice of survey skills. Prerequisite: introductory applied statistics or equivalent. Instructor: Kramer. 3 units.

281. Environmental Law. Examination of contemporary environmental law and its common law antecedents in the context of the American legal system. Objectives are to provide basic training in analyzing cases and statutes, applying knowledge in a classroom setting, and using a law library. Instructor: Heath. 3 units.

282S. Environmental Ethics. Selected topics involving values and the environment, for example, extending morality to nature, rights of future generations, environmental aesthetics, diversity and stability, ideological biases in ecological knowledge. Consent of instructor required. Instructor: Staff. 3 units. C-L: Philosophy 289S.

283. Corporate Environmental Management and Strategy. Examines management theories, frameworks, tools, and concepts which can be used to gain the value-added from environmental performance. The course is organized around three themes: competitive aspects of environmental performance; management systems, tools, and approaches to integrate business and the environment; and environmental stakeholder management. Instructor: Staff. 3 units. C-L: Management 435

284S. Seminar in Land Use Policy. Selected topics in United States land policy. Content varies each offering, but may include regulatory innovations, management of public lands, urban growth management, and landscape protection. Term paper and class presentations required. 1 to 3 units. Instructor: Healy. Variable credit.

285. Land Use Principles and Policy. Consideration of four major roles of land in the United States: as a producer of commodities, financial asset, component of environmental systems, and location of development. Analysis of market allocation of land, market failure, role of public planning and regulation. Instructor: Healy. 3 units. C-L: Public Policy Studies 285.

290. Physical Oceanography. Introduction to the dynamic principles of ocean circulation with an emphasis on large temporal and spatial scales of motion. Topics include wind-driven and density-driven flow, western boundary intensification, mid-ocean, shelf, and tropical circulations. Prerequisite: Mathematics 31 and 32 or consent of instructor. Instructor: Lozier. 3 units. C-L: Earth and Ocean Sciences 203.

291. Geological Oceanography. The geology of ocean basins, including origin, bottom physiography, sediment distribution, and sedimentary processes. Not open to students who have taken Earth and Ocean Sciences 206S. (Given at Beaufort.) Instructor: Staff. 3 units. C-L: Earth and Ocean Sciences 205, Marine Sciences.

292L. Biological Oceanography. Physical, chemical, and biological processes of the oceans, emphasizing special adaptations for life in the sea and factors controlling distribution and abundance of organisms. Only open to undergraduates under Biology 114L. Four units (spring); six units (summer). (Given at Beaufort and Bermuda.) Prerequisite: introductory biology. Instructor: Ramus or staff (Beaufort); Nelson and Steinberg (Bermuda). Variable credit. C-L: Marine Sciences.

293. Analysis of Ocean Ecosystems. The history, utility, and heuristic value of the ecosystem; ocean systems in the context of Odum's ecosystem concept; structure and function of the earth's major ecosystems. Open to undergraduates only under Biology 123. (Given at Beaufort.) Prerequisite: one year of biology, one year of chemistry, or consent of instructor. Instructor: Barber. 3 units. C-L: Marine Sciences

294. Water Quality Skills. Introduction to field and laboratory techniques for monitoring water quality characteristics including heat properties, BOD, flow, dissolved oxygen, nutrients, benthic invertebrates, and coliform indicators. Emphasis on technical report writing. Prerequisite: Environment 236. Instructor: Stow. 3 units.

295L. Marine Invertebrate Zoology. Structure, function, and development of invertebrates collected from estuarine and marine habitats. Not open to students who have taken Biology 176L or Biology 274L. Open to undergraduates only under Biology 176L. Four units (fall, spring, and Summer Term II); six units (Summer Term I). (Given at Beaufort fall and summer or at Bermuda, spring.) Prerequisite: Biology 25L. Instructors: Dimock or Kirby-Smith (Beaufort); Barnes and Coates (Bermuda). Variable credit. C-L: Biology 274L, Marine Sciences.

296. Environmental Conflict Resolution. Practical techniques and scholarly underpinnings of environmental conflict resolution, including interest-based negotiation, mediation, public disputes, and negotiation analysis. Instructor: Maguire. 2 units.

298. Special Topics. Content to be determined each semester. May be repeated. Instructor: Staff. Variable credit.

299. Independent Studies and Projects. Directed readings or research at the graduate level to meet the needs of individual students. Consent of instructor required. Units to be arranged. Instructor: Staff. 3 units. Variable credit.

303. Principles of Ecological Modeling. Design, implementation, analysis, and interpretation of ecological models. Combination of lectures, student-moderated discussions, and computer lab exercises. Prerequisite: Biology 110L or equivalent and introductory applied statistics or equivalent. Instructors: Reynolds and Urban. 3 units. C-L: Biology 303.

307. Ecophysiology of Productivity and Stress. Exploration of principles governing stand growth and its response to a variety of stresses. Emphasis on climate, soil resources, and competition. Stresses and their reliefs determined by pollution and the availability of resources as modifiers of the physiological properties of trees. Instructor: Oren. 3 units.

309. Seminar on Key Wetland Ecology Issues. Wetland functions, hydrology, biogeochemistry, decomposition, community habitat, and productivity are discussed in an ecosystem context along with current management issues. Topics vary each semester and cover such areas as wetland restoration, constructed wetlands for wastewater treatment, and wetland delineation. Students will be expected to make oral presentations as well as critique advanced readings in class. May be repeated. Instructor: Richardson. 2 units.

312. Wetlands Ecology and Management. The study of bogs, fens, marshes, and swamps. Emphasis on processes within the ecosystem: biogeochemical cycling, decomposition, hydrology, and primary productivity. Ecosystem structure, the response of these systems to perturbations, and management strategies are discussed. A research project is required. Prerequisites: one course each in ecology and chemistry. Instructor: Richardson. 3 units.

313. Advanced Topics in Environmental Toxicology. Discussion of current issues. Topics vary but may include chemical carcinogenesis in aquatic animals; biomarkers for exposure and sublethal stress in plants and animals; techniques for ecological hazard assessments; and means of determining population, community, and ecosystem level effects. Lectures and discussions led by instructor, guest speakers, and students. Prerequisite: Environment 212. Instructor: Di Giulio. 3 units.

314. Integrated Case Studies in Toxicology. Students are assigned topics relative to their chosen research discipline in toxicology and are asked to develop case studies to present at a roundtable workshop. Emphasis on review and analysis of toxicological problems from a holistic (multidisciplinary) viewpoint. Offered on demand. Instructor: Abou-Donia. 1 unit. C-L: Pharmacology 314.

315. Focused Topics in Toxicology. A contemporary advanced toxicology research area covered with readings from the current primary literature. An integrative review of the topic prepared as a collaborative effort. Consent of instructor required. Prerequisite: Pharmacology 233 and 347. Instructor: Levin. 1 unit. C-L: Pharmacology 315.

316. Case Studies in Environmental and Forest Management. Drawing on their previous course work, students will analyze environmental problems from ecological, economic, ethical, and sociopolitical perspectives. Students work in teams to (1) research and present to the class reviews of selected topics in environmental problem solving, and (2) develop and analyze management alternatives for local environmental problems. The teams present their projects in written and oral form. Prerequisite: second-year graduate/professional; ecology or forestry, economics, quantitative methods; or consent of instructor. Instructor: Maguire. 4 units.

317. Topics in Tropical Ecology and Conservation. Discussion of current issues and ideas at the interface between basic and applied science. Lectures, seminars, and discussion with student participation. Prerequisite: Environment 217 or equivalent. Instructor: Terborgh. 2 units.

319. Mechanisms in Environmental Toxicology. Provides an in-depth examination of key molecular and biochemical mechanisms by which organisms defend themselves against environmental pollutants. Cellular mechanisms by which chemicals produce toxicity when the defense systems are overwhelmed will be addressed. Includes examinations of "state of the art" approaches for experimentally elucidating these phenomena. Course format will be that of a graduate seminar, with lectures given and discussions led by the instructors, guest speakers, and course participants. Prerequisite: one course in biochemistry and one course in toxicology. Instructors: Di Giulio and Freedman. 3 units.

321. Advanced Readings in Soil Science. An advanced discussion course based on readings that concern current critical topics in the soil sciences. Readings are selected from both basic and applied aspects of the field. Instructor: Richter. 1 unit.

330L. Environmental Monitoring and Instrumentation. Methods of measuring and monitoring the earth's physical environment with emphasis on water and air resources. Characteristics and uses of contemporary sensors, measurement and data acquisition systems. Methods of obtaining and processing computer compatible data records. Includes laboratory. Offered on demand. Instructor: Knoerr. 4 units.

335. Water Quality Modeling. Development and evaluation of simulation models of surface water quality. Mechanistic descriptions of aquatic ecosystems and materials

transport. Statistical methods for monitoring design and trend detection. Uncertainty analysis. Prerequisite: Environment 236 and 350. Instructor: Reckhow. 2 units.

340. Biohazard Science. Philosophy of safety; etiology, infectivity, and transmissibility of disease; immunity and resistance; occupational and nosocomial infections; aerobiology; biotechnology; disinfection and sterilization; biocontainment and facility design; and safety management. Prerequisite: general microbiology or consent of instructor. Instructor: Tulis. 3 units.

341L. Methods in Biohazard Science. Fundamentals of disinfection, sterilization, and biocidal materials methodology, inactivation kinetics and dosimetry; medical waste management; mutagenicity, pyrogenicity, and PCR testing; laminar flow cabinet certification; microbiologic surface and air sampling; respirator assessment; laboratory audits and regulatory compliance. Prerequisite: Environment 340 or consent of instructor. Instructor: Staff. 4 units.

342. Bioaerosols. Principles of aerobiology; sick-building syndrome and building-related illness; ventilation, filtration, and humidification systems; chemical and biological pollutants; health effects; sampling and assessment of bioaerosols; remediation measures; handling indoor air quality perceptions. Consent of instructor required. Instructor: Thomann and Tulis. 2 units.

343. Hazard Management, Law, and Ethics. Economics and ecology; survey of federal and state laws; legal basis for regulation; enforcement, including inspections and audits, permits and licensing, and citations, injunctions, and penalties; management accountability; ethics in science and medicine; risk assessment and management; policy development and implementation. Consent of instructor required. Instructor: Warren. 3 units.

351. Computer-Based Map Analysis with Geographic Information Systems. Introduction to computer-based map analysis systems (geographic information systems). Use of map algebra in computer analyses of spatially distributed map information. Applications in analyzing and solving natural resource management problems. Instructor: Halpin. 3 units.

352. Spatial Analysis in Ecology. Techniques of spatial analysis as applied to ecological data, including scaling techniques, pattern analysis, indices of patchiness (adjacency, contagion), and inferential methods (cross-correlation, permutation procedures). Emphasis on hands-on applications in computer lab. Prerequisite: Environment 214 or consent of instructor. Instructor: Urban. 3 units.

353. Advanced Topics in Landscape Ecology. Small groups of students working together to complete a project in landscape analysis integrating remote sensing, geographic information systems, spatial analysis, and simulation modeling. Expectation is that each student will have experience in at least one of these areas. Consent of instructor required. Offered on demand. Instructors: Halpin and Urban. Variable credit.

354. GIS Analysis for Conservation Management. This course explores applications of geographic and spatial analysis to conservation management issues such as habitat analysis, biodiversity protection assessments, and nature reserve design. The primary goals of the course are: (1) to critically assess the theoretical underpinnings of conservation analysis techniques; and (2) to develop a high level of proficiency in the application of geographic and spatial analysis techniques for conservation management problems. Prior experience with GIS systems and consent of instructor required. Instructors: Halpin and Urban. 3 units.

356. Environmental Fluid Mechanics. Introduction to turbulent fluid flow and Navier Stokes equations; basic concepts in statistical fluid mechanics; development of prognostic equations for turbulent fluxes, variances, and turbulent kinetic energy; Monin and Obukhov similarity theory for stratified turbulent boundary layer flows; applications to CO₂, water vapor, and heat fluxes from uniform and nonuniform surfaces; the

local structure of turbulence and Kolmogorov's theory; turbulent energy transfer and energy cascade between scales; turbulence measurements in the natural environment. Prerequisite: Civil Engineering 122L, Mathematics 111 or 135, or equivalent. Instructor: Katul. 3 units.

357. Satellite Remote Sensing for Environmental Analysis. Environmental analysis using satellite remote sensing. Theoretical and technical underpinnings of remote sensing (multi-spectral image analysis, classification, and georectification) coupled with practical applications (land cover mapping, change analysis, ground truth techniques). Strong emphasis on hands-on processing and analysis of satellite and digital photogrammetric imagery in a UNIX workstation environment. Consent of instructor required. Instructor: Halpin. 3 units.

358. Multivariate Analysis in Community and Landscape Ecology. Assembly in a lab setting portfolios of strategies for interpreting multivariate ecological datasets such as those relating species abundance to environmental variables, focusing on techniques commonly used by vegetation scientists (for example, ordination, classification, etc.). Emphasis on using and interpreting UNIX and PC-based software. Consent of instructor required. Instructor: Urban. 3 units.

363. Economics of Natural Resource Damage Assessment. Topics vary each semester offered. Instructor: Staff. 3 units. C-L: Economics 363.

372. Advanced Theory of Environmental and Natural Resource Economics. The application of economic concepts to private- and public-sector decision making concerning natural and environmental resources. Topics include modeling externalities and public goods, design of policy instruments, management of renewable and nonrenewable resources, welfare theory and valuation methods, and environmental risk. Prerequisites: Economics 301 and 302 or consent of instructor. Instructor: Staff. 3 units. C-L: Economics 372.

373. Topics in Environmental and Natural Resource Economics. Examination of current research in environmental and natural resource economics, building on the theory of environmental and natural resource economics developed in Economics/Environment 372. Includes selected topics from Economics/Environment 372 and other quantitative and theoretical issues pertinent to prevailing research in environmental economics. Prerequisite: Economics/Environment 372 or consent of instructor. Instructor: Staff. 3 units. C-L: Economics 373.

385. Environmental Decision Analysis. Quantitative methods for analyzing environmental problems involving uncertainty and multiple, conflicting objectives. Topics include subjective probability, utility, value of information, multiattribute methods. Students will apply these tools to an environmental policy decision in a group project. Prerequisite: introductory applied statistics or equivalent. Instructor: Maguire. 3 units.

388. Seminar in Resource and Environmental Policy. Discussion of the political, legal, and socioeconomic aspects of public and private action in environmental quality control and management. Consent of instructor required. Instructor: Staff. Variable credit.

389. Seminar in Conservation and Environmental History. Traces the evolution of conservation and environmental movements and the development of environmental ethics. History of agencies, industries, associations, and citizen groups as well as overall policies for land and resources. Comparison of parallel developments in Canada. Consent of instructor required. Instructor: Staff. 3 units. C-L: History 389.

COURSES CURRENTLY UNSCHEDULED

252L. Statistics and Data Analysis in Earth and Ocean Science

Genetics

Professor Nevins, *Chair* (366 CARL); Professor Cullen, *Director of Graduate Studies* (426 CARL); Professors Chen and Pericak-Vance; Associate Professors Garcia-Blanco, Heitman, Marchuk, and Vance; Assistant Professors Amalfitano, Lew, Riggins, Speer, Sul-lenger, Wharton, and Zhang

The Department of Genetics offers graduate training in a variety of areas of genetics leading to the Ph.D. degree. The admission of students and the operation of the first-year graduate program is administered jointly by the Department of Genetics and the interdepartmental University Program in Genetics. The department is also home to centers that facilitate the structural and functional analysis of the human and mouse genome.

The department provides a focus for research activities ranging from the genetic analysis of cell growth control and signal transduction pathways, to the study of pattern formation during mouse and drosophila development, to the identification of genes responsible for inherited human disease. In addition to formal course work and ongoing independent research, students in the department participate in a variety of activities that enhance their training experience including ongoing research seminars, a monthly joint research meeting that involves all members of the department, and a yearly departmental retreat.

GENETICS COURSES (GENETICS)

222. Genetic Analysis of Cellular Function. Classical and molecular genetic approaches to understanding eukaryotic cell function using unicellular organisms such as yeasts and dictyostelium. Experimental approaches as well as illustrative studies of secretion, cell cycle, signal transduction, and cytoskeleton. Discussion of current literature and student presentations. Consent of instructor required. Instructor: Heitman. 3 units. C-L: University Program in Genetics 222.

232. Human Genetics. Topics include segregation, genetic linkage, population genetics, multifactorial inheritance, biochemical genetics, cytogenetics, somatic cell genetics, neurogenetics, cancer genetics, clinical genetics, positional cloning, complex disease. Lectures plus weekly discussion of assigned papers from the research literature. Prerequisite: University Program in Genetics 278 or equivalent, and graduate status or consent of instructor. Instructors: Marchuk, Pericak-Vance, and Speer. 3 units. C-L: University Program in Genetics 232.

242. Developmental Genetics. Genetic approaches to developmental problems, with a focus on invertebrate systems. Discussion of current literature with student presentations. Preparation of a research proposal. Consent of instructor required. Prerequisite: Biology 119; University Program in Genetics 278, or equivalent. Instructor: Wharton. 3 units.

252. Genetic Analysis for Human Disease. Quantitative and molecular aspects in the identification of human disease genes, implications for genetic counseling and risk assessment, and legal and social issues associated with the human genome initiative. Extensive use of scientific literature to illustrate concepts of linkage analysis in Mendelian and complex disease, molecular approaches to disease gene cloning, molecular mechanisms of disease gene expression, gene therapy, and the utility of animal models for understanding human disease. Prerequisite: University Program in Genetics 278 or equivalent, and graduate status or consent of instructor. Instructors: Marchuk, Pericak-Vance, Speer, and Vance. 3 units.

260. Gene Regulatory Mechanisms. Recent advances in the understanding of gene regulatory events, including transcriptional and posttranscriptional control, are addressed through discussions of current literature. Instructors: Cullen and Nevins. 3 units.

340. Systems for Genetic Analysis. Second-year students beginning independent research projects are introduced to the various systems available for genetic analysis. Faculty present the basic principles of genetic analysis in yeast, *Drosophila*, the mouse, and humans, and discuss recent developments. Credit/no credit grading only. Instructors: Nevins and staff. 2 units.

The University Program in Genetics (UPGEN)

Associate Professor Kiehart, *Director* (cell biology), Professor Nevins, *Co-Director* (genetics); Associate Professor Garcia-Blanco, *Director of Graduate Studies* (genetics); Professors Bastia (microbiology), Cullen (genetics and microbiology), Endow (microbiology), Greenleaf (biochemistry), Hsieh (biochemistry), Keene (microbiology), Kredich (medicine and biochemistry), Linney (microbiology), Modrich (biochemistry), Nevins (genetics and microbiology), Nicklas (biology), Nijhout (biology), Pericak-Vance (genetics), Raetz (biochemistry), Rausher (biology), Shaw (chemistry), Steege (biochemistry), Uyenoyama (biology), Ward (immunology) and Webster (biochemistry); Associate Professors Been (biochemistry), Boustany (neurobiology), Dong (biology), Fehon (biology), Greene (biochemistry), Heitman (genetics and pharmacology), Kohorn (biology), Kreuzer (microbiology), Pickup (microbiology), Schachat (cell biology), Vance (genetics), and Vilgalys (biology); Assistant Professors Amrein (genetics), Capel (cell biology), Counter (pharmacology and cancer biology), Cunningham (biology), Hershfield (biochemistry), Kaufman (biochemistry), Klingensmith (pharmacology and cancer biology), Kornbluth (pharmacology and cancer biology), Kuehn (biochemistry), Lew (pharmacology and cancer biology), Lin (cell biology), Marchuk (genetics and cell biology), Markert (immunology), McCusker (microbiology), McHeyzer-Williams (immunology), Riggins (pathology), Speer (genetics), Sullenger (genetics), Sun (biology), Wharton (genetics and microbiology), York (pharmacology and cancer biology), and Zhuang (immunology); Adjunct Professors Drake (National Institute of Environmental Health Sciences), Kunkel (National Institute of Environmental Health Sciences), and Resnick (National Institute of Environmental Health Sciences)

The graduate program in genetics provides study and research opportunities in a wide array of experimental systems. The integrated program is administered jointly by the Department of Genetics and the interdepartmental University Program in Genetics, with a faculty drawn from several of the biological sciences departments (Biochemistry, Biology, Cell Biology, Chemistry, Genetics, Immunology, Microbiology, Neurobiology, Pathology, and Pharmacology and Cancer Biology). Graduate students registered in any of the biological sciences departments may apply to the faculty of the genetics program to pursue study and research leading to an advanced degree. The program in genetics provides integrated graduate study in all facets of genetics. Faculty laboratories provide diverse research opportunities in such fields as biochemical and molecular genetics, evolutionary and population genetics, human genetics, immunogenetics, organelle genetics and human genetics.

The University Program in Genetics provides an unusual degree of flexibility to students for designing their Ph.D. program. New students are admitted directly to the program and are not committed to a particular department. In addition to taking courses, students typically rotate through three different laboratories to gain experience and explore their interests. At the end of the first year, the student selects an advisor and chooses one of the following academic paths to obtain the Ph.D.: (1) The student may earn a Ph.D. in genetics either through the University Program in Genetics or the Department of Genetics; (2) The student may obtain the Ph.D. in an affiliated department such as Biochemistry or Biology with a concentration in genetics.

200. Genetic Analysis for Human Disease. Quantitative and molecular aspects in the identification of human disease genes, implications for genetic counseling and risk

assessment, and legal and social issues associated with the human genome initiative. Concepts of linkage analysis in Mendelian and complex disease, molecular approaches to disease gene cloning, molecular mechanisms of disease gene expression, gene therapy, and the utility of animal models for understanding human disease. Prerequisite: University Program in Genetics 278 or equivalent, and graduate status or consent of instructor. Instructor: Marchuk, Pericak-Vance, Speer, or Vance. 3 units.

222. Genetic Analysis of Cellular Function. 3 units. C-L: Genetics 222.

232. Human Genetics. 3 units. C-L: Genetics 232.

247. Macromolecular Synthesis. 2 units. C-L: Cell and Molecular Biology 247.

258. Structural Biochemistry I. 2 units. C-L: Biochemistry 258, Cell Biology 258, Cell and Molecular Biology 258, Immunology 258, Microbiology 258, Molecular Biophysics 258.

259. Structural Biochemistry II. 2 units. C-L: Biochemistry 259, Cell Biology 259, Immunology 259, Microbiology 259, Molecular Biophysics 259.

263. Molecular Genetics of Drosophila Development. 2 units. Cell Biology 263, Biology 263.

268. Nucleic Acids. 3 units. C-L: Biochemistry 268, Cell Biology 268, Immunology 268, Microbiology 268.

278. Genetic Approaches to the Solution of Biological Problems. Use of genetic approaches to address research problems in cell and developmental biology. Genetic fundamentals build up to modern molecular genetic strategies including genetic screens, reverse genetics, genetic interactions, dominant negative mutants, and more. Several major genetic model organisms used to illustrate general principles. Consent of instructor required for undergraduates. Instructor: Staff. 4 units. Cell and Molecular Biology 278.

281. DNA, Chromosomes, and History. 3 units. C-L: Biology 281.

285S. Ecological Genetics. Interaction of genetics and ecology and its importance in explaining the evolution, diversity, and distribution of plants and animals. Instructor: Staff. 3 units.

286. Evolutionary Mechanisms. 3 units. C-L: Biology 286.

287. Evolutionary Genetics. An introduction to the principles of evolutionary genetics, with discussion of the current literature. Levels of selection; neutral theory; variation in populations; speciation. Reconstructing evolutionary history; genomic evolution. Instructor: Staff. 2 units.

288. Mathematical Population Genetics. 3 units. C-L: Biology 288.

316. Genetics Student Research. Presentations by genetics program students on their current research. Required course for all graduate students specializing in genetics. Credit grading only. Instructor: Kohorn. 1 unit.

350. Genetics Colloquium. Lectures, discussion sections, and seminars on selected topics of current interest in genetics. Required of all students specializing in genetics. Prerequisite: a course in genetics and consent of instructor. Instructor: Garcia-Blanco. 1 unit.

COURSES CURRENTLY UNSCHEDULED

215. Genetic Mechanisms

German Studies Program

Professor Rolleston, *Chair* (116L Old Chemistry); Associate Professor Pfau, *Director of Graduate Studies* (502 Allen); Professors Bernstein (law), Borchardt (German), Brandon (philosophy), Gillespie (political science), Hacoen (history), Hillerbrand (religion),

Jameson (literature), Kitschelt (political science), Klopfer (biology), Koonz (history), Lahusen (Slavic), Silbiger (music), Steinmetz (divinity), Surin (literature), and Todd (music); Associate Professors Berger (divinity), Coles (political science), Gilliam (music), Morton (German), Pfau (English), Rasmussen (German), Robisheaux (history), Stiles (art), and Van Miegroet (art); Assistant Professors Denman (German), Fischer (literature), McIsaac (German), and Walther (German); Adjunct Associate Professor Ward (philosophy)

The Graduate Program in German Studies is an interdisciplinary doctoral program. Students develop two distinct areas of expertise, one in a traditional area of German literary and cultural history and one in a discipline such as German social history, religious studies, political science, music history, literary theory, philosophy, film studies, or art history. A total of 16 classes are required. For their courses students work with core faculty in the German Department and with faculty in adjacent departments and programs.

At the end of their third year, students take their preliminary exam. The preliminary exam has both an oral and a written component. It is based on two equally weighted lists, one of which covers a literary period (broadly defined) or a genre across several periods. The other list concentrates on an area such as art history, music, religious history, theory/philosophy, political science, or history in relation to German culture. For the preliminary exam students select a committee of three faculty, including their faculty advisor. At least one committee member must be selected from the German studies core faculty, while the other two may be selected from among faculty associated with German studies.

The dissertation's topic, methodology, and scope are developed in close consultation with the student's advisor. At the end of their fourth year, students prepare their dissertation chapter review. The chapter review is a substantial piece of writing (approx. 45 pp.), usually a chapter and bibliography for their dissertation. The oral review lasts approximately 2 to 2 ½ hours. The dissertation chapter review committee consists of the student's faculty advisor and three other faculty members selected by the student (at least two of the committee members must be from the German studies core faculty).

For additional information, email leca31@duke.edu.

Courses in the Department of Germanic Languages and Literature (GERMAN)

203S. Sex, Gender, and Love in Medieval German Literature. Historical contexts for emergence of courtly love and the role of desire and interpretation in Gottfried von Strassburg's *Tristan und Isolde*, courtly love lyric, 'maere.'. Instructor: Rasmussen. 3 units. C-L: Medieval and Renaissance Studies 203S.

204S. Advanced Business German. Examination of current German economic and business debates and events. Emphasis on vocabulary acquisition as well as intercultural conduct in business situations. Topics include state of Germany's industry and energy resources, monetary policies and banking systems, environmental issues, trade and import/export, taxes and the social safety net, with particular attention to Germany's self-understanding as a "soziale Marktwirtschaft," and its (non?)compatibility with current trends in globalization. Prerequisite: German 100S or consent of instructor. Instructor: Dowell. 3 units.

225S. Introduction to Goethe. Major works of lyric, narrative, drama, and theory, throughout Goethe's career. Readings and discussions in German. Instructor: Morton. 3 units.

226S. Goethe's Faust. Goethe's masterpiece and life's work, conceived as a summation of Western literature and mythology for the modern age. Readings and discussions in German. Instructor: Borchardt or Morton. 3 units.

230S. German Romanticism. The emergence in the 1790s of a new cultural language: categories of self, history, interpretation, irony, and revolution. Theory, fiction, and poetry by Novalis, the brothers Schlegel, Tieck, Brentano, Eichendorff, Hoffmann, and Heine. Readings and discussions in German. Instructor: Rolleston. 3 units.

235S. Nineteenth-Century German Literature. Topics may include: poetry, prose, drama and culture; Kleist, Heine, Büchner, Keller, Meyer, Gotthelf, Grillparzer, Mörike, Stifter, Storm, Freytag, Hebbel, Fontane. Readings and discussions in German. Instructor: Staff. 3 units.

245S. The Twentieth Century. The major movements and writers from the expressionists, Thomas Mann, Kafka, Rilke, and Brecht, to Böll, Grass, Handke, and Christa Wolf. Emphasis on relations between text and history: World War I, Weimar, Third Reich, and the struggle to integrate past and present in post-Holocaust literature. Readings and discussions in German. Instructor: Rolleston. 3 units.

247S. Postwar German Literature. The development of German literature after 1945. Topics vary: German literature between 1945 and the founding of the two states; the GDR novel and the question of realism; GDR drama after Brecht; West German literature. Readings and discussions in German. Instructor: Staff. 3 units.

256S. Inventing the Museum: Collecting and Cultural Discourses of the Nineteenth Century. Examines the rise of the German public museum in its European cultural contexts in the nineteenth century. Uses history and theories of collecting and exhibiting to explore intersecting discourses of architecture, art history, cultural history, literature, and politics that constitute the museum and delineate its privileged place in nineteenth-century German and European culture. Introduces methods for using primary sources in cultural studies research and the study of literature in terms of collecting and exhibiting. Instructor: McIsaac. 3 units. Art History 256S.

258S. Special Topics in German Literature and Cultural Studies. 3 units.

260. History of the German Language. Phonology, morphology, and syntax of German from the beginnings to the present. Instructor: Rasmussen. 3 units. C-L: Medieval and Renaissance Studies 260B.

261. Second Language Acquisition Theory and Practice. Overview of current research in the fields of second language acquisition and foreign language pedagogy, and its implications for the teaching of the German language, literature, and culture at all levels. Readings and discussions on competing theories of language acquisition and learning, issues of cultural identity and difference, learner styles, and the teaching of language as culture; training in contemporary teaching techniques and approaches. Instructor: Walther. 3 units. C-L: Linguistics 261S.

261S. Second Language Acquisition Theory and Practice. Overview of current research in the fields of second language acquisition and foreign language pedagogy, and its implications for the teaching of the German language, literature, and culture at all levels. Readings and discussions on competing theories of language acquisition and learning, issues of cultural identity and difference, learner styles, and the teaching of language as culture; training in contemporary teaching techniques and approaches. Instructor: Walther. 3 units. C-L: Linguistics 261S.

270. Consciousness and Modern Society. The German tradition of political theory conceptualizing social transformation through consciousness both of alienation and of ethical ideals; the ongoing debate between activist and radically critical perspectives. Marx, Nietzsche, Lukacs, Freud, Benjamin, Adorno, Marcuse, and Habermas. Taught in English. Instructor: Rolleston. 3 units.

276S. Nietzsche's Political Philosophy (C-N). 3 units. C-L: Political Science 226S.

298S. Special Topics. Special Topics in German literature and cultural studies. Taught in English. Instructor: Staff. 3 units.

299S. Seminar in German Studies. Review of current debates and historical perspectives in the German cultural field, structured through contributing disciplines: social and economic history, political theory and history, literature, fine arts, music, philosophy, and religion. Team-taught, involving a wide range of faculty in the German Studies Program. Taught in English. Instructors: Morton or Rolleston and staff. 3 units.

300S. The Discipline of *Germanistik*: A Historical Survey. A study of trends in scholarly criticism within the context of German culture and politics beginning in the 1810s with the origins of *Germanistik* as a university discipline. Topics may include: the invention of philology and the romantic enterprise; positivism and; the politics of *Germanistik*, 1933-45; in Europe and the United States after 1945. Instructor: Borchardt or Rasmussen. 3 units.

301. German Studies: Theory and Practice. German studies at the intersection of various discourses (such as feminism, psychoanalysis, new historicism), questioning traditional concepts such as national identity, history, and language. Interdisciplinary issues may include: the relationship of literature, the unconscious and technology; the cinematic representation of Nazi history; architecture, monuments, and "German" space. Texts might include works by Kafka, Freud, Marx, Spengler, and Schinkel as well as texts by individuals whose work has been excluded from more traditional "Germanistik" courses. Instructor: Risholm or staff. 3 units.

302. Topics in Literary Theory. Literary theories and methods in their history and philosophical contexts. Issues include canonicity, German identity debates, and the claims of aesthetic language. Instructor: Staff. 3 units.

303. Topics in Literary History. Relations between an established German literature and its competing cultural centers; classical and popular cultures, literary conventions, and nonliterary discourses (religious, national, scientific), the construction of Austrian and Swiss traditions. Instructor: Staff. 3 units.

304. Topics in Genre Theory. The construction of German literature through generic frameworks: Minnesang, epic, baroque lyric and drama, classical ballad, folk-song, Bildungsroman, expressionist film, others. Instructor: Staff. 3 units.

321. Germanic Seminar. Instructor: Staff. 3 units.

322. Germanic Seminar. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

200S. Proseminar: Introduction to Literary Criticism

201S. Introduction to Medieval German: The Language of the German Middle Ages and Its Literature

210S. Renaissance and Reformation

215S. German Baroque Literature

220S. Reason and Imagination: The German Eighteenth Century

227S. Goethe Seminar

232S. Poetry and Modernity

244A. International Expressionism

244B. International Modernism

249S. German Cinema: Weimar to Present

254S. Literature by Women

265. Elementary German for Business and Law

266. Elementary German for Business and Law

271S. Contemporary Theory and the German Tradition

Graduate Studies (GS)

200. English Language for International Students. Written and oral communication for international graduate students, with emphasis on research papers and presentations.

A. Composition and Research

B. Oral Communication.

Instructor: Brett and DiPietro. 3 units.

300. Colloquium on the Academic Profession. This course is designed to explore faculty roles and responsibilities at various types of colleges and universities. It will bring together faculty from schools in the Triad and Triangle area to discuss such topics as: how teaching is evaluated and weighed at different institutions; what counts as service; what are different schools looking for in new faculty appointments; how can you maintain a research career in a school whose priorities are undergraduate teaching; what makes a good mentor; departmental politics. The course is restricted to Preparing Future Faculty Fellows and will meet monthly on the campuses of Durham Technical Community College, Duke, Elon College, Guilford College, and Meredith College. Instructor: Staff. 1 unit.

Center for Health Policy, Law and Management

Christopher Conover, Ph.D., *Program Director*

Duke University, through the Center for Health Policy, Law and Management and Education, offers an interdisciplinary certificate in health policy. The program speaks to the needs of students preparing for careers in health care policy, management, and the associated professions as the American health care industry enters into a period of rapid and profound change.

Courses in the health policy certificate program address three interrelated goals: (1) to investigate the machinery of contemporary health policy-making and to understand the broad political dynamics which have conditioned American health policy, past and present; (2) to familiarize students with the institutional and economic complexity of the American health care system through the study of the interaction between the key players in health care financing and organization—employers, private insurance carriers, government regulators, health care providers and consumers; and, (3) to explore the cultural and ideological underpinnings of modern conceptions of health and the recurrent ethical dilemmas facing health care providers, patients, and policymakers.

The program draws upon established research programs relating to health services centered in economics, political science, public policy, and sociology, but recognizes the inspired contributions to health care debates originating in the disciplines of anthropology, history, law, medical arts, philosophy, psychology, and religion.

Program Requirements

The health policy certificate program is open to all graduate students. Successful candidates must complete the prescribed combination of five courses: two courses drawn from the core set of health policy offerings; any two additional elective courses; and the capstone course. Appropriate courses may come from the list given below or may include other courses (new courses, special topics courses, independent study, and, under special circumstances, courses offered through the UNC School of Public Health) as approved by the director.

* Subject to regulations governing interinstitutional registration. Note that the School of Public Health semesters and daily schedules differ from those of Arts and Sciences. Interested students should check with the Law School to find exact course times.

The following briefly lists courses which qualify towards completion of the graduate certificate. For more detailed course descriptions, see individual departmental listings in this bulletin or our web page at <http://www.hpolicy.duke.edu/certificate>.

Core Courses (any two courses)

Regularly Scheduled Courses

Economics 215S. Applied Cost Benefit Analysis. Prerequisite: Economics 149. *Staff*
Economics 356. Graduate Health Economics 1. Prerequisites: Economics 243 and 301. *Sloan*
Economics 357. Seminar in Health Economics. Prerequisites: Economics 243 and 301. *Sloan*
Law 347. Health Care Law and Policy. *Havighurst*
Public Policy Studies 253/Political Science 249. The Politics of Health Care. *Staff*

Special Topics Courses, Offered Periodically

Public Policy Studies 264S.07. Getting Value for Money in Health Care: Rationing in Theory and Practice. *Lipscomb*
Public Policy Studies 264S.53. Health Policy: Prevention and Management. *Whetten-Goldstein*
Public Policy 264S.72. Managed Care. *Lin*
Sociology 227S. C. Organization and Financing of Health Care. *Staff*

Elective Courses (any 2 courses)*

African American Studies 299S.01/Psychology 262S. Minority Mental Health. *Staff*
African American Studies 299S.01/History 299S.05. Race/Medicine: Historical Perspective. *Staff*
Biometry 217. Clinical Decision Analysis. Prerequisite: BTP 211.
Business Administration. 408. Health Care Policy. *Staff*
Business Administration. 490.31. Practicum Health Care Sector. *Staff*
Community and Family Medicine 247B. Medicine in America. *Gifford*
Community and Family Medicine 256C. Ethical Issues in Medicine. *H. Smith*
Community and Family Medicine 258C. Legal Issues in Medicine. *Warren*
Christian Ethics 130. Dying and Death. *H. Smith and staff*
Christian Ethics 266. Ethics and Health Care. *H. Smith*
Economics 372. Advanced Theory of Environmental and Natural Resource Economics. Prerequisites: Economics 301 or 302 or consent of instructor. *Mansfield and Smith*
Environment 270L. Resource and Environmental Economics. Prerequisite: introductory course in microeconomics. *Kramer*
Environment 271. Economic Analysis of Resource and Environmental Policies. Prerequisite 270L or equivalent. Economics 149 recommended. *Staff*
Environment 274. Resource and Environmental Policy. Prerequisite: Environment 251 or equivalent. *Macquire and Reckhow*
Environment 343. Hazard Management, Law and Ethics. Consent of instructor required. *Warren*
Environment 385. Decision Theory and Risk Analysis. Prerequisite: Environment 251 or equivalent. *Macquire and Reckhow*
Interdisciplinary Course/Law 580. Interdisciplinary Seminar in Medical-Legal-Ethical Issues. *Gianturco (medicine), Shimm (law), Smith (divinity), and staff*
Interdisciplinary Course 302C. Exploring Medicine: Cross-Cultural Challenges to Medicine in the Twenty-First Century. *Hage*
Law 235. Environmental Law. *Weiner*
Law 301. AIDS Law. *McAllaster*
Law 400.01. AIDS Legal Assistance Project. *Staff*
Law 529.01. Genetics and the Law. *Staff*
Law 547. Food and Drug Law (seminar). *Staff*
Law 550. Health Care Financing and Competition (Seminar). *Havighurst*
Law 555. International Environmental Law (Seminar). *Kingsbury*
Law 590. Risk Assessment and Management. *Staff*
Law 596. Toxic Substance Regulation (Seminar). *Staff*
Law 598. Violence, the Media, and the Law (Seminar). *Staff*
Liberal Studies 270.21. Genes, Medicine, and Money. *Balber*
Liberal Studies 290.45. Health Care, Narrative, and Social Theory. *Rudy*
Liberal Studies 290.53. Aging and Health. *Gold]*

* Candidates for the Master's of Public Policy degree seeking the certificate need only complete one elective course if they write their master's memo on some aspect of health policy.

Nursing 303. Issues in Contemporary Health Care Organizations. *Staff*
 Nursing 362. Ethics in Nursing. *Staff*
 Nursing 480. Social Issues, Health, and Illness in the Aged Years. *Wallsten*
 Physicians Assistant 250. Health Systems Organization
 Political Science 176A,B. Perspectives on Food and Hunger. *Johns*
 Public Policy Studies 264S.32. Matters of Life and Death. *Staff*
 Public Policy Studies 264S.70. Social Policy Implementation. *Staff*
 Public Policy Studies 266S. Comparative Social Policy. *Staff*
 Religion 388. Ethics and Medicine. *Staff*
 Sociology 171. Comparative Health Care Systems. *Staff*
 Sociology 227S, B. Social Behavior and Health. *George, Gold, Jackson, Lin, or Thornton*
 Sociology 227S, D. Health and Aging. *George, Gold, Jackson, Lin, or Thornton*
 Capstone Course (required)
 Public Policy Studies 255S.01. Health Policy Analysis. Consent of instructor required. *Staff*

History (HISTORY)

Professor Thompson, *Chair* (216A Carr); Professor Cell, *Director of Graduate Studies* (221 Carr); Professors Boatwright, Chafe, Dirlik, English, Gaspar, Gavins, Goodwyn, Herrup, Keyssar, Koonz, Kuniholm, Lerner, Mauskopf, Miller, Oates, Payne, Petroski, Reddy, Richards, Rigsby, Roland, Shatzmiller, Witt, and Wood; Associate Professors Ewald, French, Green, Hachohen, Humphreys, James, Mazumdar, Nathans, Neuschel, Robisheaux, Thorne, and Wigen; Assistant Professors Balleisen, Biddle, Grandin, Partner, Peyroux, and Wall; Professors Emeriti Cahow, Colton, Davis, Durden, Franklin, Holley, Parker, Preston, Ropp, A. Scott, TePaske, Watson, and Young

The Department of History offers graduate work leading to the A.M. and Ph.D. degrees. Candidates for the A.M. degree must have a reading knowledge of at least one ancient or modern foreign language related to their programs of study and have completed successfully a substantial research paper, or two seminar papers, normally the product of a year's seminar or two semester courses. The paper(s) must be examined and approved (at a required A.M. meeting) by three readers: the supervising professor and two other professors from the graduate staff.

Candidates for the degree of Doctor of Philosophy prepare themselves for examinations in four fields, at least three of which shall be in history. The choice of fields is determined in consultation with the student's supervisor and the director of graduate studies. The department offers graduate instruction in the broad historical areas of North America; Latin America; Great Britain and the Commonwealth; ancient, medieval, and Renaissance Europe; modern Europe; Russia; Japan; China; South Asia; military; history of science, technology, and medicine; and in the comparative and thematic fields of women's history, environmental history, diplomatic history, labor history, and slave societies.

The candidate for the Ph.D. degree must demonstrate a reading knowledge of one foreign language, ancient or modern, prior to the preliminary examination. All students are expected to take History 301-302 in their first year, unless entering with an A.M. in history. In addition, each student must fulfill a general methodology requirement, by completing at least one course which would appreciably increase the candidate's methodological proficiency. With the approval of the director of graduate studies, options include taking a graduate class in methodology, such as demography, statistics, oral history, archaeology, cartography, or a summer training program for developing specific methodological skills. Students who need to master a second foreign language may substitute that language for the methodology requirements.

Ancient History. For courses in ancient history which may be taken for credit in either history or classical studies, see Classical Studies.

For Seniors and Graduates

Students may receive credit for either semester of a hyphenated course at the 200

level without taking the other semester if they obtain written consent from the instructor.

201S. The Russian Intelligentsia and the Origins of the Revolution. Origin and dynamics of the Russian revolutionary movement, the intelligentsia, and the emergence of the labor movement. Instructor: M. Miller. 3 units.

202S. The Russian Revolution. An analysis of the Bolshevik seizure of power in 1917 and the establishment of a revolutionary society and state during the 1920s. Instructor: M. Miller. 3 units.

203S. Topics in Modern World Environmental History. Human effects upon the natural environment across regions, cultures, and nations; analytical case studies and a synthetic global perspective. Instructor: Richards. 3 units.

204S. Technology, Economic Development, and Social Change, 1750 to the Present. The role of technology in initiating both economic development and social change, and the dynamic relationship between these phenomena. Theories of technology development; technology in theories of social change; and technology in theories of economic development. Comparative cases from the United States, Europe, Japan, and other areas. Instructor: Partner. 3 units.

207AS. Geographic Perspectives in History I: Atlantic Worlds. A variety of geographical perspectives in history, drawing on studies of western Europe, North America, and the north Atlantic basin. Analysis of maps and atlases, as both tools and objects of historical inquiry. Major themes include: maps and power; contact, conquest, and the "creative destruction" of landscapes; the spatial logics of capital; geographies of identity; the production of regions; and historical-geographic perspectives on modernity. Instructor: Wigen. 3 units.

207BS. Geographic Perspectives in History II: Asian and Pacific Worlds. A broad range of spatial, regional, environmental, and landscape approaches to Asian history. Major themes include: orientalism and the search for "Asia"; Asian history as world history; the formation of local, regional, and national identities; indigenous cartographies; state-making and boundary-making; and the conceptual shift from "Asia" to "Pacific." Instructor: Wigen. 3 units.

208AS. Decentering the Cultural Map: Boundary Zones as Counter-Cores. The boundary zones between major world regions and the extent to which so-called "natural barriers" of oceans, deserts, steppes, and mountain ranges have historically fostered communication, creating interstitial spaces for experimentation, exchange, and cultural resistance. Instructors: Lewis and Wigen. 3 units.

209S. Race, Class, and Gender in Modern British History. The intersection among gender, race, and class identities in British history since the eighteenth century, a period of tremendous economic, social, and political change resulting from industrialization and imperial expansion. Issues include the impact of industrialization on gender and class consciousness, the role of women, the middle classes and the working classes in the campaign against slavery, British workers' reactions to colonization, British women in the empire, and sexuality and the evolution of racialist discourse. Instructor: Thorne. 3 units. C-L: African and African American Studies 209S.

210S. Anthropology and History. 3 units. C-L: Cultural Anthropology 207S.

211S. History of Poverty in the United States. A history of poverty and poverty policy in the United States from the colonial era to the present. The changing experience of poverty, efforts to analyze and measure poverty, and attempts to alleviate or eliminate it. Attention paid to the reasons for the durability of poverty in a wealthy nation and to the forces shaping the contours of anti-poverty policy. Instructor: Keyssar. 3 units. C-L: Public Policy Studies 270S.

214. Class, Public Opinion, and the French Revolution. The current state of the ongoing controversies over the origins and character of the first modern social revolution. Instructor: Reddy. 3 units.

218. Problems in British Imperialism. Selected readings on significant aspects of the history of the British Empire-Commonwealth: for example, Ireland, South Africa, and India. Instructor: Cell. 3 units.

221. Special Topics in the History of Europe, 1200-1700. Investigation of selected aspects of the economic, social, and cultural history of premodern Europe in all of its cultural and linguistic diversity. Topics have included the social history of religion, gender and society, and traditional society and the origins of capitalism. Instructor: Neuschel or Robisheaux. 3 units. C-L: Medieval and Renaissance Studies 221A.

222A. The Humanist as Reformer: Petrarch, Machiavelli, and Erasmus. Humanism as a movement dedicated to moral, political, and ecclesiastical reform. Prerequisite: History 151A and reading knowledge of German, French, or Italian. Instructor: Witt. 3 units. C-L: Medieval and Renaissance Studies 222A.

222B. Florence: Renaissance City. Instructor: Witt. 3 units. C-L: Medieval and Renaissance Studies 222B.

222CS. Petrarch. Focuses on the major works of fourteenth-century Italian humanist, Francesco Petrarch. Instructor: Witt. 3 units. C-L: Medieval and Renaissance Studies 222CS.

223S. The World Wars. The causes, course, and consequences of World Wars I and II, from military, political, technological, and economic perspectives; the legacy of World War II; special emphasis on understanding the experience of total war, not only for the individual soldier but for whole societies. Instructor: Biddle. 3 units.

224S. The World Wars. Continuation of History 223S. Instructor: Biddle. 3 units.

226. Topics in the Labor History of the United States. Instructor: Keyssar. 3 units.

232AS. Historical and Anthropological Approaches to Emotion. Examines emotion as a collective and historical phenomenon prompted by dissatisfaction with rigid notions of culture and current concern about the social construction of the self and identity. Instructor: Reddy. 3 units. C-L: Cultural Anthropology 232S.

235S. The Antebellum South. The economic, political, and social aspects of life in the South, 1820-1860. Instructor: S. Nathans. 3 units. African and African American Studies 235S.

236A. Topics in the History of Monasticism. The development of western medieval monasticism from its third-century origins in the Egyptian desert through the twelfth-century explosion of devotional communities. Varied topics include monastic anxiety and optimism about the nature of the human will; the origins, meaning, and practical experience of vows to poverty, chastity, stability, and obedience; and the growth of a monastic culture. Designed to guide advanced students through the professional study of monastic institutions and monastic historiography. French, German, or Latin necessary. Instructor: Peyroux. 3 units. C-L: Medieval and Renaissance Studies 235.

236B. Special Topics in Early Medieval History. Topics may vary by semester. Instructor: Peyroux. 3 units. C-L: Medieval and Renaissance Studies 236B.

238S. Europe in the High Middle Ages. Western Europe; the agricultural revolution, the re-emergence of city civilization, and the strengthening central governments and bureaucracies across people and cultures. Instructor: Shatzmiller. 3 units. C-L: Medieval and Renaissance Studies 238S.

239. History of Socialism and Communism. The origins and development of socialist and communist movements from pre-Marxian times to the present. Not open to students who have taken History 120. Instructor: Lerner. 3 units.

240A. Multinationalism and Multiculturalism: Eastern Europe Example. Instructor: Lerner. 3 units.

242B. The Soviet 1920s: The Road to a New Synthesis. 3 units. C-L: Russian 281.

251B. Topics in Intellectual History of Europe, 1450-1650. Instructor: Witt. 3 units. C-L: Medieval and Renaissance Studies 251B.

255AS. Development of United States Courts in the Mid-Atlantic South (A). The impact of international, international policing and domestic wars relating to national security on the United States courts of the Fourth Circuit (Maryland, Virginia, West Virginia, North and South Carolina), and the role played by these courts in the Mid-Atlantic South from the American Founding into the Cold War Era. The American Constitution, laws and treaties of the United States, and principles of admiralty and international law which figure in assigned published and unpublished judicial decisions of the region's United States district and old circuit courts and of the post-1891 Fourth Circuit Court of Appeals. Research paper required. Instructor: Fish. 3 units. C-L: Political Science 238S.

255B. War and the National State. 3 units. C-L: Political Science 288.

255C. The Culture of American Capitalism, 1750-1860. Cultural responses to the economic transformations that reshaped American society in the century after 1750. Pre-capitalist ethics of exchange; the emergence of market values; attitudes toward consumption and speculation; controversies surrounding wage labor and slavery; debates over banking, corporation, and the credit system; and cultural models of "success" and "failure." Instructor: Balleisen. 3 units.

255ES. Topics in Cold War History. A study of key Cold War issues from the atomic bomb to the collapse of the Soviet Union. Particular attention to post-World War II technological development and the moral and ethical dilemmas they pose. Instructor: Biddle. 3 units.

256. Modern Literature and History. C-L: French 256.

260. Fifth- and Fourth-Century Greece. 3 units. C-L: Classical Studies 222.

261. The Hellenistic World. 3 units. C-L: Classical Studies 223.

262. The Soviet Experience. A survey of the history of Russia and the Soviet Union and its people and cultures, from the eve of the Revolution to the present day with particular emphasis on political, social, and cultural change and continuity. Not open to students who have taken History 180. Instructor: Lerner. 3 units.

263. The Roman Republic. 3 units. C-L: Classical Studies 224.

264. The Roman Empire. 3 units. C-L: Classical Studies 225.

266. Late Antiquity. 3 units. C-L: Classical Studies 226.

267S. Britain in the Sixteenth Century. Consent of instructor required. Instructor: Herrup. 3 units. C-L: Medieval and Renaissance Studies 267S.

268S. England in the Seventeenth Century. Instructor: Herrup. 3 units. C-L: Medieval and Renaissance Studies 268S.

273S. Topics in the History of Science. Critical stages in the evolution of scientific thought. Instructor: Mauskopf. 3 units.

274S. History of Science. Continuation of History 273S. Instructor: Mauskopf. 3 units.

276A. Labor, Immigration, and the Asian American Experience. History of Asian Americans in the United States to World War II, focusing on immigration, conditions in the homeland which fostered immigration, and the legislative barriers such as the exclusion acts which prevented the immigration of Asians. The United States in the context of a global political economy; the impact of colonialism and imperialism in the shaping of Asian-American experience. Instructor: Mazumdar. 3 units.

279. Health, Healing, and History. The first part of a two-course sequence studying the development of medicine within the broader cultural context from prehistory to the twentieth century. Instructor: English. 3 units.

280. Health, Healing, and History. Continuation of History 279. Instructor: English. 3 units.

282S. Canada. 3 units. C-L: Canadian Studies 282S, Cultural Anthropology 282S, Political Science 282S, Sociology 282S.

287A. Popular Religion. 3 units. C-L: Religion 287.

287BS. American History and Social Theory. Contemporary theories of social order, social change, and revolution. Instructor: Goodwyn. 3 units.

292. Research Methods in Japanese. 3 units. C-L: Japanese 291, Cultural Anthropology 290, Political Science 291, Sociology 291.

293. French Liberalism: An Intellectual History, 1815-1981. Historical study of the moral and political works of major French liberal thinkers in their political, social, and intellectual contexts. Readings in De Stal, Constant, Guizot, Tocqueville, Durkheim, Halvy, and Aron and historiography. Major themes: revolution, restoration, and the origins of liberalism; liberals, the July Monarchy, and 1848; Durkheim, the Third Republic, and the new liberalism; World War I, totalitarianism, and contemporary French liberalism. Instructor: Hacoheh. 3 units.

294S. Women and Medicine in the United States. The history of women as patients and practitioners from the colonial era to the present. The concept of "practitioner" broadly defined, to include domestic medicine, midwives, nurses, physicians, and other alternative medical women. Themes include birth control, women's control of their own bodies, sources of authority for medical practice, race and health, and the underlying general history of medicine in the United States. Instructor: Humphreys. 3 units.

295S. Slavery and Freedom in Africa, to 1960. How Africans created variations on the global themes of servility, slavery, and freedom. Includes various forms of slavery in Africa; gender and slavery; slave trades; the impact of the Atlantic economy on slavery in Africa; colonial policies of "emancipation," labor control, and labor coercion; African intellectual responses to the problem of slavery and African expressions of freedom, including freedom from colonial rule. Instructor: Ewald. 3 units. African and African American Studies 292S.

299. Lectures in Special Topics. Lectures in advanced topics, designed for seniors and graduate students. In some semesters open to seniors and graduate students; in other semesters limited to graduate students only. Instructor: Staff. 3 units.

299S. Special Topics. Seminars in advanced topics, designed for seniors and graduate students. Some semesters open to seniors and graduate students; some semesters limited to graduate students only. Instructor: Staff. 3 units.

Required Courses for Graduates

301. Research Seminar in History. This seminar is required of all entering first-year doctoral candidates in history. Instructor: Staff. 3 units.

302. Research Seminar in History. This seminar is required of all entering first-year doctoral candidates in history. Instructor: Staff. 3 units.

Colloquia and Seminars for Graduates

305. The British Empire: Recent Interpretations. Colloquium emphasizes recent interpretations of the following topics: (1) the imperialism of free trade; (2) nineteenth-century India; (3) the new imperialism; (4) nationalism and decolonization (India and Africa); (5) Empire to Commonwealth; (6) imperialism and gender. Instructor: Staff. 3 units.

308. Seminar in U. S. History. Either this seminar or History 301-302 is required of all entering first-year doctoral candidates in history. Instructor: Staff. 3 units.

309S. Seminar in African-American History, 1870s to the Present. Historiography and research on the black experience and race relations after the general emancipation, in the age of segregation, during the Civil Rights Movement, and in the post-civil rights era. Instructor: Gavins. 3 units. African and African American Studies 309S.

310S. Seminar in African-American History, 1870s to the Present. Historiography and research on the black experience and race relations after the general emancipation, in the age of segregation, during the Civil Rights Movement, and in the post-civil rights era. Instructor: Gavins. 3 units. African and African American Studies 310S.

311A. Activism, African Americans, and American Democracy in the Eighteenth and Nineteenth Centuries. An examination of the impact of race-based insurgencies on democratic practice from the Revolution through the populist period. Instructors: Goodwyn and Payne. 3 units.

311B. Activism, African Americans, and Democratic Practice in the Twentieth Century. An examination of race-based insurgencies from the end of Reconstruction through the Black Power period. Instructors: Goodwyn and Payne. 3 units.

312. Seminar in the Teaching of History in College. This course is intended to acquaint students with the problems involved in teaching history in college. Required of all candidates for the degree of Doctor of Philosophy who are in residence for two years at Duke. As an alternate method of meeting this requirement, a graduate student may, in cooperation with a member of the faculty, serve a one-semester teaching apprenticeship. Supervised by director of graduate studies. 3 units.

315. Topics in British History. Instructor: Thorne. 3 units.

316. Topics in Early Modern German History between 1400 and 1750. Emphasis on issues in current research, research methods and tools, and analysis of primary texts. Selected readings from books, pamphlets, broadsheets, and other materials in the Harold Jantz Collection of German Baroque Literature. Prerequisite: background in early modern German history, and a reading knowledge of German and Latin. Instructor: Robisheaux. 3 units.

317. Topics in Legal History. A reading course on various aspects of English and/or United States legal history. Specific topics vary with the year, but in addition to traditional explorations of the Anglo-American legal system, themes such as the history of trials and narrative, changing perspectives on punishment and the body, or using legal sources for more than legal history might be the focus. Instructor: Balleisen or Herrup. 3 units.

320S. The Working Class in the United States. Instructor: Keyssar. 3 units.

325S. Topics in Modern American Political and Social History. Instructor: Keyssar. 3 units.

326S. Introduction to Military History. Critical reading and discussion of classic works and studies representative of the major genres in the field. Instructor: Biddle and Roland. 3 units.

327S. History of Sexuality in Europe. Instructor: Koonz. 3 units.

328S. War and Society in Early Modern Europe. A study of the relationship between war, state formation, economic developments, social structures, gender relations, and art and literature between 1500 and 1789. Instructor: Neuschel. 3 units.

330S. Selected Topics in Brazilian History. Instructor: French. 3 units. African and African American Studies 330S.

335S. Comparative Labor History. Selected topics and methodological and historiographical controversies in the labor history of two or more world regions. Instructor: Fink and French. 3 units.

340S. Topics in Modern Latin American Social and Political History. Empirical case studies and methodological and historiographical themes in nineteenth- and twentieth-century Latin America. Instructor: James. 3 units.

343A. Before Modern Japan. This seminar introduces the major research paradigms that have shaped debates in classical, medieval, and early modern Japanese history. In addition to primary sources (in English translation), readings include inter-

pretive essays from Marxist, Weberian, feminist, and cultural history perspectives. Offered in the fall semester. Instructor: Partner or Wigen. 3 units.

343B. Modernity in the Japanese Archipelago. Advanced readings on the formation of modern Japanese state and society, from the Meiji Restoration through the devastation of World War II and postwar rebuilding. Examines the place of emperor-centered ideology in the production of prewar Japanese nationhood, and the role of the United States-Japan alliance as the keystone of postwar development in the Pacific. Offered in the spring semester. Instructor: Partner or Wigen. 3 units.

345. Latin American Oral History. Instructor: James. 3 units.

350. The Words and Works of Peronismo. Explores practices and discourses associated with Peronismo in twentieth-century Argentina. Addresses questions by examining a variety of elements of Peronist archive, from literary to history accounts, from journalistic to political documents, from cinematic to plastic renderings. Instructor: James. 3 units.

351. Colloquia. Each colloquium deals with an aspect of history by means of readings, oral and written reports, and discussion, with attention to bibliography. *Ad hoc* colloquia may be worked out during registration in the various fields represented by members of the graduate faculty; these colloquia do not appear on the official schedule of courses. In some instances, students may take the equivalent of a research seminar in conjunction with the colloquium and will be credited with an additional 6 units by registering for 371. 1-372. 1, etc. 3 units.

352. Colloquia. Each colloquium deals with an aspect of history by means of readings, oral and written reports, and discussion, with attention to bibliography. *Ad hoc* colloquia may be worked out during registration in the various fields represented by members of the graduate faculty; these colloquia do not appear on the official schedule of courses. In some instances, students may take the equivalent of a research seminar in conjunction with the colloquium and will be credited with an additional 6 units by registering for 371. 1-372. 1, etc. 3 units.

356. History and Culture of Islamic Cairo. 3 units. C-L: Religion 356.

357S. Labor Systems in African History. A survey of various forms of labor in Africa, during the precolonial, colonial, and postcolonial eras, focusing on a central historical problem—the formation of a working class—in an African context. Beginning with an examination of precapitalist forms of labor, the course then explores how men and women became—or did not become—wage workers; how they conceptualized their work and created—or did not create—new identities and cultural expressions; how workers organized and agitated—or, again, did not—for social and political change. Instructors: Ewald and Newbury. 3 units.

371. Research Seminars. To be taken either in conjunction with colloquia listed above or by special arrangement with appropriate graduate instructors when research seminars in a desired area are not offered. These seminars do not appear on the official schedule of courses. Instructor: Staff. 3 units.

376. Women in Nineteenth and Twentieth Century from a Comparative Perspective. Explores the physiology of gender and sex; the domestic servant; the origins of the women's suffrage movement; the emergence of "bourgeois" family values and "Victorian" notions of sexuality; gender in reactionary political movements; the use of memory as historical evidence; and women factory workers. Students may choose topics in two national settings. Instructor: Koonz. 3 units.

389. Seminar in Conservation and Environmental History. 3 units. C-L: Environment 389.

391S. United States History to 1877. Examination of the study and teaching of American history from its beginnings to the end of Reconstruction. Focus on major issues and themes. Participants also attend the lectures and do the reading for History

91D. Introduction for those wishing to study or teach American history before 1877. Instructor: Nathans and Wood. 6 units.

399. Special Readings. Supervised independent study and reading. Consent of instructor required. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

- 205S. Gender and War**
- 213S. Early Modern France**
- 219S. History of Science and Technology**
- 220S. History of Science and Technology**
- 225S. Problems in Comparative Labor History**
- 228. Recent United States History: Major Political and Social Movements**
- 230S. Populism in Latin America**
- 231S. Readings in Latin American Colonial History**
- 241A. The Origins of Totalitarianism, 1924-1954**
- 245. Social and Intellectual History of China**
- 246. Social and Intellectual History of China**
- 250. Social and Intellectual History of the United States**
- 252A. Construction of China in European and American Literature**
- 254S. European Diplomatic History, 1871-1945**
- 257. Comparative Latin America Labor**
- 259. Archaic Greece**
- 270S. British History, Seventeenth Century to the Present**
- 272S. *Fin-de-siècle* and Interwar Vienna: Politics, Society, and Culture**
- 275S. Asian and Asian-American Women in Comparative Perspective**
- 285S. Oral History**
- 286S. Oral History**
- 288S. Germany and Japan in World War II**
- 289S. War, Revolution, and Society in the Caribbean, 1700-1815**
- 290S. Theoretical Bases of Social Interpretation**
- 296. United States Policy in the Middle East**
- 314. Historical and Social Science Methodology**

The Master of Arts in Humanities

Professor A. Leigh DeNeef, *Director* (English)

The Master of Arts Program in Humanities is an interdepartmental program tailored to the needs of individual students. The candidate defines a theme and selects appropriate course work with the aid and approval of a supervising committee. Thirty units of course work is required for completion of the program. The degree may be earned with or without a thesis. The candidate who chooses not to submit a thesis will submit instead at least two substantial papers arising from course work for review by committee members, and meets with them to discuss his or her program in a final master's colloquium.

The program is open to holders of undergraduate degrees in any discipline who can demonstrate sufficient background in humanities to permit study at the graduate level. Admission is by regular application to the Graduate School. Students may enroll full time or part time. The program also participates in the general set of joint J.D.-M.A. programs offered at Duke. This allows law students to develop and broaden a complementary field of interest—women's studies, for example, or contemporary literature and hermeneutic theory—or to maintain an intellectual focus already developed in their undergraduate careers.

Center for Hydrologic Science

Stuart Rojstaczer, Ph.D., *Director*, Professors Baker (earth and ocean sciences), Boadu (civil engineering), Haff (earth and ocean sciences), Medina (civil engineering), Schlesinger (biology), and Trangenstein (mathematics); Associate Professors Kabala (civil engineering), Katul (environment), Medina, Oren (environment), Peirce (civil engineering), and Richter (environment); Assistant Professor Vasudevan (environment)

The Center for Hydrologic Science is an active group of faculty engaged in a broad suite of hydrology research. Faculty and their associated students and postdoctoral researchers are from three schools at Duke: Arts and Sciences, Engineering, and the Environment. The interdisciplinary nature of the center reflects the interdisciplinary nature of the field of hydrology and most faculty hold joint professorships in at least two of the three schools. The center is designed to provide a cohesive program for research and graduate level education in hydrology. Research specialties of the faculty include contaminant hydrology, crustal fluids, environmental geophysics, hydrogeology, mathematical models of multiphase transport, waste treatment, and watershed hydrology. The broad range of faculty expertise in hydrology allows graduate students to obtain well-balanced training in the classroom.

The center offers fellowships for graduate study in hydrology and organizes a lecture series that attracts speakers of international stature. Monthly brown bag colloquia are organized for student and faculty presentations from Duke, as well as from nearby University of North Carolina and North Carolina State University. For students engaged in Ph.D. research, the center offers a certificate in hydrology that is granted in addition to the Ph.D. in their host department. Further information on the Center for Hydrologic Science and its certificate program may be obtained via mail (Stuart Rojstaczer, Director, Center for Hydrologic Science, Box 90230, Duke University, Durham, NC 27708), email (hydro@eos.duke.edu) or the web (<http://www.hydro.duke.edu>).

Immunology (IMMUNOL)

Professor Tedder, *Chair* (353 Jones); Professor Kelsoe, *Director of Graduate Studies* (117 Jones); Professors Abraham, Buckley, Dawson, Gilboa, Haynes, McClay, and Ward; Associate Professor Krangel, Patel, Pissetsky, and Weinhold; Assistant Professors Doyle, Markert, McHeyzer-Williams, Zhang, and Zhuang; Research Assistant Professors Kostyu, Sarzotti-Kelsoe, and Steeber; Professors Emeriti Amos and Metzgar

The department offers graduate work leading to the Ph.D. degree. Research programs are available in various aspects of molecular and cellular immunology, including immunochemistry and immunogenetics. Immunology is the study of the cells and proteins that comprise the complex biological defense mechanisms protecting vertebrate species from their environment. It encompasses both natural, nonspecific defense mechanisms and acquired, specific immune responses that lead to the development of immunologic memory. The department's focus is on lymphocytes and their products that amplify molecular and cellular mechanisms of immunity. Immunology is by its nature a bridging science. As a discipline, it has its roots in the defense against infectious disease, the development of vaccines, organ transplantation, immune responses to malignancy, and a variety of immunotherapies. Modern research in immunology draws on recent advances in cell and molecular biology, protein chemistry, and virology to determine how the components of the immune system function. In turn, the study of cells in the immune system has contributed to our understanding of protein structure, eukaryotic gene organization and regulation, and intracellular protein transport and assembly.

The department is a participating member in the interdisciplinary University Programs in Cell and Molecular Biology and Genetics, and the Medical Scientist Training Program.

The department has excellent facilities for carrying out all aspects of immunologic, cell biologic, and genetic research. A brochure describing the Ph.D. program, prerequisites for admission, and research in the department may be obtained by writing to the Director of Graduate Studies, Department of Immunology, Box 3010, Duke University Medical Center, Durham, NC 27710.

209. Independent Study. A laboratory or library project. Consent of director of undergraduate studies and instructor required. Instructor: Staff. 1 to 4 units. Variable credit.

210. Independent Study. A laboratory or library project. Consent of director of undergraduate studies and instructor required. 1 to 4 units. Variable credit.

244. Principles of Immunology. An introduction to the molecular and cellular basis of the immune response. Topics include anatomy of the lymphoid system, lymphocyte biology, antigen-antibody interactions, humoral and cellular effector mechanisms, and control of immune responses. Prerequisite: Biology 119 and Chemistry 151L or equivalents. Instructors: Kostyu (immunology), McClay, and staff. 3 units. C-L: Biology 244.

252. General Virology and Viral Oncology. Molecular biology of mammalian viruses, with emphasis on mechanisms of virus replication, virus-host interactions, viral pathogenicity, and the relationship of virus infection to neoplasia. Consent of instructor required. Instructors: Keene and staff. 4 units. C-L: Microbiology 252.

258. Structural Biochemistry I. 2 units. C-L: Biochemistry 258, Cell Biology 258, Cell and Molecular Biology 258, University Program in Genetics 258, Microbiology 258, Molecular Biophysics 258.

259. Structural Biochemistry II. 2 units. C-L: Biochemistry 259, Cell Biology 259, University Program in Genetics 259, Microbiology 259, Molecular Biophysics 259.

268. Nucleic Acids. 3 units. C-L: Biochemistry 268, Cell Biology 268, University Program in Genetics 268, Microbiology 268.

269. Advanced Cell Biology. 3 units. C-L: Biology 269, Cell Biology 269.

291. Comprehensive Immunology. An intensive course in the biology of the immune system and the structure and function of its component parts. Major topics discussed are: properties of antigens; specificity of antibody molecules and their biologic functions; cells and organs of the lymphoid system; structure and function of complement; inflammation and nonspecific effector mechanisms; cellular interactions and soluble mediators in lymphocyte activation, replication, and differentiation; regulation of immune responses; neoplasia and the immune system; molecular structure and genetic organization of immunoglobulins, histocompatibility antigens, and T-cell receptor. Required course for all students specializing in immunology. Consent of instructor required. Prerequisite: recommended, Immunology 244 or equivalent. Instructor: Krangel and staff. 4 units. C-L: Microbiology 291.

300. Tumor Immunology. An advanced seminar based on original literature. Topics include a general introduction to malignancy and immune responses associated with them, regulation of the immune response to tumor, vaccine development, the role of gene therapy, the use of tumor-reactive monoclonal antibodies, and characteristics of tumor antigens. Prerequisite: Immunology 291. Instructors: Gilboa, Tedder, and staff. 2 units.

330. Medical Immunology. A brief review of basic concepts in immunology followed by in-depth discussions of the role of immune mechanisms in the pathogenesis and treatment of human diseases. Principle emphasis on immune deficiency diseases, hypersensitivity, alloimmunity, transplantation, infectious diseases, autoimmunity, tumor immunology, and immunohematology. Instructors: Ward and staff. 5 units.

332. Immunology Seminar. Research topics in immunology with seminars presented by students, faculty, and outside speakers. Required course for all students specializing in immunology. Instructors: Doyle and staff. 1 unit.

335. Current Topics in Immunology. Focus on current immunology research, emphasizing emerging research areas and new directions in established areas. Students present recent papers in selected subjects. Credit/no credit grading only. Instructors: Dawson and staff. 1 unit.

336. Topics In Immunology. Focus on current immunology research, emphasizing emerging research areas and new directions in established areas. Students present recent papers in selected subjects. Credit/no credit grading only. Instructors: Dawson and staff. 1 unit.

COURSES CURRENTLY UNSCHEDULED

214. Fundamentals of Electron Microscopy

219. Molecular and Cellular Bases of Differentiation

246S. Parasitic Diseases

304. Molecular Membrane Biology

Program in International Development Policy

The Program in International Development Policy (PIDP) is offered through the Center for International Development Research at Duke's Sanford Institute of Public Policy. The PIDP provides from one semester to two years of training in policy analysis and problems related to sustainable economic development. Most participants in the program—known as PIDP fellows—have at least five years' experience as practitioners or applied researchers in a development related field. They represent diverse nationalities, academic interests, and professional backgrounds.

The PIDP admits both degree and nondegree participants. Degree candidates normally spend two academic years fulfilling the requirements for the Master of Arts in International Development Policy. Degree candidates with a significant amount of previous graduate-level course work may be eligible to complete the A.M. in one calendar year. Certificates of graduate study are awarded to nondegree candidates and to graduate students from other departments who complete satisfactorily the required number of PIDP seminars.

All participants are required to take at least two PIDP seminars each semester and two additional graduate-level courses in related fields (e.g., public policy, economics, political science, environment, business). Participants in their first year are required to take two core seminars: one in economic development and one in either environmental or institutional development policy. Those participants who do not have sufficient preparation in economics are required to take an economics course their first semester. All degree candidates are required to complete a master's project in their final semester. Only two-year degree candidates are required to have an internship or in exceptional circumstances to conduct independent research during the summer between their first and second year of the program. Limited scholarships are available. For further information and application materials, contact the Program in International Development Policy, Duke University, Box 90237, Durham, North Carolina, 27708-0237; telephone (919) 613-7333; fax (919) 684-2861; or email cidr@pps.duke.edu.

Latin American Studies (LATAMER)

Associate Professor Orin Starn, *Director*, Center For Latin American and Caribbean Studies (2114 Campus Drive); Deborah Jakubs, Ph.D., *Director*, Duke-UNC Program in Latin American Studies (2114 Campus Drive); Associate Professor Alberto Moreiras, *Director*, University Graduate Program in Latin American Cultural Studies

The Center for Latin American and Caribbean Studies oversees and coordinates graduate education in Latin American, and promotes research and dissemination of knowledge about the region. The council is made up of Latin Americanist faculty and

staff members representing Arts and Sciences disciplines and the professional schools. Graduate students in Arts and Sciences as well as professional school students may concentrate their studies on Latin America. In addition to fulfilling the requirements of their departments, students of Latin American studies may undertake special courses of interdisciplinary study, or those offered by other departments, to broaden their knowledge of the region and to earn one of two Graduate School certificates offered under the auspices of the Council on Latin American Studies.

Graduate Certificate in Latin American Studies

1. six graduate courses on Latin America;
2. an approved thesis prospectus or departmental equivalent on a Latin American topic; and
3. a working knowledge of Spanish, Portuguese, or other language of Latin America or the Caribbean, such as Yucatec Maya or Quechua. Such working knowledge must be demonstrated by taking a proficiency test in one of the above languages.

For additional information about the graduate certificate in Latin American studies, contact the academic coordinator for Latin American Studies, 2114 Campus Drive, Box 90254, Duke University, Durham, NC 27708-0254, telephone (919) 681-3980, email: las@acpub.duke.edu.

University Graduate Program in Latin American Cultural Studies

This certificate program will operate through joint admission of doctoral candidates into the University Graduate Program in Latin American Cultural Studies (LACS) and the department of their choice. Students who are admitted into LACS must have secured their admission as doctoral candidates in a Ph.D.-granting department or program at Duke. LACS certificate requirements include:

1. four courses from the Latin American Cultural Studies core offerings;
2. three courses from the Latin American Cultural Studies-related offerings;
3. a working knowledge of Spanish, Portuguese, or other language of Latin America or the Caribbean, such as Yucatec Maya or Quechua. Such working knowledge must be demonstrated by taking a proficiency test in one of the above languages.
4. participation in the LACS Graduate Colloquium for at least two semesters;
5. an approved dissertation proposal incorporating a significant amount of Latin Americanist interdisciplinary work.

For additional information about the University Graduate Program in Latin American Cultural Studies, contact the University Graduate Program in Latin American Cultural Studies, 2114 Campus Drive, Box 90254, Duke University, Durham, NC 27708-0254, telephone 919-681-3980, email: lacs@acpub.duke.edu.

The Council on Latin American Studies sponsors a speakers series which provides a forum for presentations by visiting Latin Americanists from throughout the U.S. and overseas, as well as by Duke and UNC faculty and graduate students. Each year the council also co-sponsors a number of conferences and other special events, including the annual Latin American Labor History Conference. Moreover, the council and the Institute of Latin American Studies at Chapel Hill sponsor the Duke-UNC Program in Latin American Studies, which provides opportunities for collaboration with faculty and students from the University of North Carolina who are interested in Latin America.

The interdisciplinary focus of the graduate program is enhanced by the numerous activities of the Duke-UNC program, which offers graduate students at Duke an array of intellectually challenging opportunities to broaden their disciplinary training. The

single most important initiative of the Duke-UNC program is the sponsorship of interdisciplinary working groups that bring together faculty and graduate students from both campuses to conduct research and training in areas of central concern to Latin American studies. The objective is to move beyond the seminar format that dominates graduate education in the social sciences and humanities, and to focus instead upon training graduate students in a manner similar to the direct research collaboration that typically characterizes training in the natural sciences. The groups focus on topics such as political economy, Cuba, the environment, culture, theater, gender issues, religion and politics, and labor issues in Latin America.

In 1991 the Duke-UNC program was designated a National Resource Center for Latin American Studies by the U.S. Department of Education. This honor is accompanied by funding for a number of new activities as well as Foreign Language and Area Studies (FLAS) Fellowships for graduate students. The council and the program together administer a competition for graduate student travel grants each spring. These awards provide Duke students with the opportunity to deepen their disciplinary interests in the region through relatively brief periods of research in Latin America.

More detailed information on the various components of the Latin American Studies program at Duke is also available on the program's web site: <http://www.duke.edu/web/las>.

200S. Seminar in Latin American Studies. Interdisciplinary study of geographical, historical, economic, governmental, political, and cultural aspects of modern Latin America and the current issues facing the region. Specific topics will vary from year to year. For seniors and graduate students. Instructor: Staff. 3 units.

202S. Research Methods and Bibliographic Instruction in Latin American Studies. Students develop and refine research skills in Latin American Studies, increasing familiarity with print and electronic resources and evaluating relevant resources in all formats. Students may develop bibliographic projects in support of other course work and research. Instructor: Calvo. 3 units.

298. Introduction to Latin American Cultural Studies. A problem-oriented course, but also covering theoretical issues, integrating approaches from two or more disciplines. Topics vary from year to year. Instructor: Staff. 3 units.

350. Colloquium. Weekly presentations on various professional and intellectual issues relating to Latin American Cultural Studies. Credit/no credit grading only. Prerequisite: enrollment in Latin American Cultural Studies certificate program. Instructor: Moreiras or staff. 1 unit.

Courses with Latin American Content Offered by Departments

Art History 257S. Topics in Pre-Columbian Art and Culture. *Staff*
Botany 215. Tropical Ecology. *Terborgh*
Botany 300. Tropical Biology: An Ecological Approach. *Staff*
Business Administration 495. Travel Experience: Latin America. *Staff*
Cultural Anthropology 280S. Seminar in Selected Topics. *Silverblatt and Starn*
Economics 231S. Economic Development in Latin America. *Staff*
Economics 286S. Current Issues in International and Development Economics. *Staff*
Economics 366. Seminar in International Monetary Theory. *Mendoza*
Education 205. Selected Topics. *DiBona*
English 381. Special Topics Seminar. *Staff*
Environment 203. Conservation Biology: Theory and Practice. *Staff*
Environment 274. Resource and Environmental Policy. *Staff*
Environment 275S. Protected Areas, Tourism, and Development. *Healey*
Environment 298. Special Topics. *Healy*
Environment 317. Topics in Tropical Ecology and Conservation. *Terborgh*
French 141S. French Literature. *Jonaissant*
History 225S. Problems in Comparative Labor History. *Fink or French*

History 233S. Slave Resistance and Social Control in New World Societies. *Gaspar*
 History 257. Comparative Latin American Labor. *French*
 History 265S. Problems in Modern Latin American History. *Staff*
 History 289S. War, Revolution, and Society in the Caribbean, 1700-1815. *Gaspar*
 History 330S. Selected Topics in Brazilian History. *French*
 History 340S. Topics in Latin American Social and Political History. *French*
 History 351. Colloquia. *Gaspar*
 Literature 251. History of Criticism. *Moreiras*
 Literature 281. Paradigms of Modern Thought. *Moreiras*
 Literature 285. Literature and Ideology. *Staff*
 Literature 287. Problems in Narrative Analysis. *Staff*
 Literature 291. Topics in Popular Culture and Media. *Staff*
 Literature 292. Topics in Non-Western Literature and Culture. *Perez-Firmat*
 Literature 293. Special Topics in Literature and History. *Moreiras*
 Literature 295. Representation in a Global Perspective. *Hardt, Mignolo, Moreiras*
 Literature 302. Seminar in Emergent Literatures. *Dorfman*
 North American Studies 283S. Seminar in North American Studies. *Mayer and Shanahan*
 Political Science 200 Special Topics. *Staff*
 Political Science 253S. Comparative Government and the Study of Latin America. *Morgenstern*
 Political Science 267S. Policy Making in International Organizations. *Staff*
 Political Science 284S. Public Policy Process in Developing Countries. *Ascher*
 Political Science 299. Advanced Topics in Government and Politics. *Staff*
 Political Science 299B. Special Topics. *Staff*
 Political Science 399. Special Readings. *Archer*
 Portuguese 200S. Seminar in Luso-Brazilian Literature and Culture. *Damasceno or staff*
 Portuguese 202S. Topics in Lusophone Literature and Culture. *Damasceno or staff*
 Public Policy Studies 267S. Policy-Making in International Organizations. *Ascher*
 Public Policy Studies 274. Resource Environmental Policy. *Staff*
 Public Policy Studies 284S. Public Policy Process in Developing Countries. *Ascher*
 Public Policy Studies 286S. Economic Policy-Making in Developing Countries. *Conrad*
 Public Policy Studies 306S. Special Topics in Public Policy. *Staff*
 Public Policy Studies. 325G. Institutional Design for Managing the Environment. *Lethem*
 Public Policy Studies 326. National Resources and Environmental Policymaking. *Ascher*
 Public Policy Studies 326E. Privatization and the Role of the State in Development. *Arcia*
 Public Policy Studies 326F. Designing Human Resource Development Programs. *Lethem*
 Public Policy Studies 327. Special Topics. *Staff*
 Public Policy Studies 327E. Structural Adjustment and Poverty. *Staff*
 Religion 252. Feminist Theology from the Third World. *Berger*
 Religion 263. Third World Theology. *Berger*
 Romance Studies 310. Critical Frameworks. *Damasceno or Mignolo*
 Sociology 222. Special Topics. *Gereffi*
 Sociology 222B. Special Topics. *Gereffi*
 Sociology 224C. Special Topics. *Muschkin*
 Sociology 224F. Special Topics. *Parrado*
 Sociology 225. Special Topics. *Gereffi*
 Spanish 244. Topics in Twentieth-Century Latin-American Fiction. *Staff*
 Spanish 245. Latin-American Poetry. *Staff*
 Spanish 248. Studies in Spanish-American Literature. *Dorfman or staff*
 Spanish 341. Indigenous Chronicles of the Colonial Period. *Staff*
 Spanish 344. Philosophy, Cultural History, and Literature in Latin America. *Mignolo*
 Spanish 346. Modern Spanish-American Fiction. *Perez-Firmat*
 Spanish 375. Hispanic Literature, Mass Culture, and Theory. *Sieburth*
 Spanish 391. Hispanic Seminar. *Moreiras and Nouzeilles*
 Spanish 392. Hispanic Seminar. *Dorfman, Fischer, Mignolo, Moreiras, or Perez Firmat*
 Zoology 215. Tropical Ecology. *Terborgh*

The Master of Arts in Liberal Studies Program

Donna Zapf, *Director*

This interdisciplinary program allows individuals with a variety of professional and personal educational interests the flexibility to pursue their goals across traditional disciplinary boundaries. The program is managed by an interdepartmental committee

which admits students, selects courses, and determines policy. Students study primarily on a part-time basis and choose from an array of interdisciplinary courses developed specifically for this program. In addition to the special liberal studies courses, students may select courses from other departments in the Graduate School.

The MALS program consists of nine courses and a final project. These courses are offered during three academic terms (fall, spring, and summer) and may be taken either on a full-time or part-time basis. The final project, which may take the form of academic research, applied research, or creative work, provides an opportunity for the student to apply the knowledge and skills gained through the program to an independent activity of the student's own design.

To request a separate publication on the Master of Arts in Liberal Studies, including descriptions of specific courses and other program requirements, contact the Program Director (Box 90095, Duke University, Durham, North Carolina 27708, (919) 684-3222), email: dukemals@acpub.duke.edu. Additional information on the MALS program is available on the world wide web at <http://www.mals.duke.edu>.

The Program in Literature (LIT)

Professor Jameson, *Chair* (Graduate Program in Literature and French); Associate Professor Moreiras, *Director of Graduate Studies* (Spanish and Graduate Program in Literature); Professors Kaplan (French and Graduate Program in Literature), Lentricchia (Graduate Program in Literature and English), Mignolo (Spanish and Graduate Program in Literature), Moi (Graduate Program in Literature and French), Mudimbe (Graduate Program in Literature, French, and cultural anthropology), Radway (Graduate Program in Literature and religion), Rolleston (Germanic languages and literature), B. H. Smith (Graduate Program in Literature and English), Stewart (French and Graduate Program in Literature), and Surin (Graduate Program in Literature); Associate Professors Gaines (Graduate Program in Literature and English), Lahusen (Slavic languages and literature and Graduate Program in Literature), Lubiano (Graduate Program in Literature), and Willis (English and Graduate Program in Literature); Assistant Professors Fischer (Graduate Program in Literature and Spanish), Hardt (Graduate Program in Literature), and Viego (Graduate Program in Literature and Romance studies), Research Professor Dorfman (Graduate Program in Literature and Latin American studies)

The interdepartmental program leading to a Ph.D. in Literature offers to qualified students the opportunity to develop individual courses of study with a strong emphasis on interdisciplinary work, literary theory, and cultural studies, while at the same time allowing students to specialize in one or more of the national literatures. The program offers both introductory courses (the 250 series) and more specialized seminars (The 280 series), as well as tutorials (300) in specific research projects or problems.

For tutorials, advising, and dissertation supervision the program draws also on the expertise of other faculty such as Professors C. Davidson, Moses, Pfau, Torgovnick (English); Abe and Wharton (art history); Burian and Davis (classical studies); Orr and Tetel (Romance studies); Morton (German); Cooke (AAandLL); Flanagan (philosophy); and Stone (philosophy and law).

Students entering the program must present evidence of ability to read one language other than English, and must acquire reading competence in a second language before taking their preliminary examinations.

Students in the literature program are normally expected to take a minimum of fifteen courses, six of which should be in literature and six in a "teaching field" of their choice. All first-year students take Literature 251 on the history of aesthetics and criticism through the nineteenth century. More information on the program and a full descriptive brochure is available from Professor Moreiras, Director of Graduate Studies, Art Museum 104, Duke University, Durham, North Carolina 27708-0670.

200S. Seminar in Asian and African Cultural Studies. 3 units. C-L: Asian and African Languages and Literature Studies 200S, African and African American Studies 200S, Cultural Anthropology 288S, Women's Studies.

251. History of Criticism. A historical survey of critical and philosophical concepts affecting the definition and evaluation of literature from Plato through the nineteenth century. Instructor: Hardt, Jameson, Lentricchia, Moreiras, or Stewart. 3 units.

252. Criticism and Literary Theory in the Twentieth Century. Introduction to critical movements, philosophies, and strategies forming contemporary theories of literature: deconstruction, feminism, formalism, Marxism, New Criticism, phenomenology, psychoanalysis, structuralism. May be repeated for credit according to change of content or instructor. Instructor: Jameson or Rolleston, with guest lecturers. 3 units.

260. Twentieth-Century Reconceptions of Knowledge and Science. Key texts and crucial issues in contemporary history, sociology, and philosophy of science—or, as the assemblage is sometimes called, 'science studies.' Focus on theoretical and methodological problems leading to (a) critiques of classical conceptions of knowledge and scientific truth, method, objectivity, and progress, and (b) the development of alternative conceptions of the construction and stabilization of knowledge and the relations between scientific and cultural practices. Readings include L. Fleck, K. Popper, P. Feyerabend, T. Kuhn, S. Shapin and S. Schaffer, and B. Latour. Instructor: Herrnstein Smith. 3 units. C-L: English 280.

280. Semiotics for Literature. 3 units. C-L: French 223.

281. Paradigms of Modern Thought. Specialized study of the work of individual thinkers who have modified our conceptions of human reality and social and cultural history, with special emphasis on the form and linguistic structures of their texts considered as 'language experiments.' Topics vary from year to year, including: Marx and Freud, J. P. Sartre, and Walter Benjamin. Instructor: Jameson, Moi, Mudimbe, or Surin. 3 units.

284. The Intellectual as Writer. History and theory of the literary role of the intellectual in society (e. g., in Augustan Rome, the late middle ages, the Renaissance, America, Latin America). Instructor: Jameson, Lentricchia, Moi, Mudimbe, or Surin. 3 units.

286. Topics in Legal Theory. A consideration of those points at which literary and legal theory intersect (e. g., matters of intention, the sources of authority, the emergence of professional obligation). Instructor: Fish. 3 units.

289. Topics in Feminist Theory. Instructor: Moi, Radway, or Tompkins. 3 units.

292. Topics in Non-Western Literature and Culture. Instructor: Mudimbe. 3 units.

293. Special Topics in Literature and History. Relationship of literary texts to varieties of historical experience such as wars, periods of revolutionary upheaval, periods of intense economic growth, "times of troubles," or stagnation. Literary texts and historical content posed in such formal ways as the theoretical problem of the relationship between literary expression and form and a range of historical forces and phenomena. Instructor: Jameson, Kaplan, or Orr. 3 units.

294. Theories of the Image. Different methodological approaches to theories of the image (film, photography, painting, etc.), readings on a current issue or concept within the field of the image. Examples of approaches and topics are feminism, psychoanalysis, postmodernism, technology, spectatorship, national identity, authorship, genre, economics, and the ontology of sound. Instructor: C. Davidson, Gaines, or Jameson. 3 units.

295. Representation in a Global Perspective. Problems of representation approached in ways that cross and question the conventional boundaries between First and Third World. Interdisciplinary format, open to exploration of historical, philosophical, archeological, and anthropological texts as well as literary and visual forms of representation. Instructor: Dorfman, Jameson, or Mignolo. 3 units.

297. Topics in Cultural Studies. Instructors: Gaines, Radway, Surin, and staff. 3 units.

298. Topics in Philosophy and Literature. Exploration of problems common to literary theory and philosophy. Examples of topics include: problems of identity, consciousness, foundationalism, interpretation, or ethics, or schools of thought such as pragmatism, phenomenology, and existentialism. Instructors: Flanagan, Jameson, Mudimbe, and Surin. 3 units.

299. Universalism in Twentieth-Century Thought. The Enlightenment tradition and its critical reception in the twentieth century. Readings range from classic Enlightenment texts to contemporary texts. Instructor: Staff. 3 units.

300. Problems in the Theory of Value and Judgment. An advanced seminar dealing with classic problems relating to the concept of value and evaluative behavior (e. g. standards, judgments, canon-formation, taste), as illuminated by contemporary work in critical theory, anthropology, economics, sociology, etc. Instructor: B. H. Smith. 3 units. C-L: English 386, Philosophy 300.

301. Language and Theory in the Twentieth Century. A seminar examining some of the most significant analyses, controversies, and achievements of the various disciplinary approaches to language during the past century and their implications for cultural study. Topics include the question of linguistics as a science, the muddle of meaning and interpretation, approaches to communication as social interaction, the Chomskian episode, and poststructural/postanalytic conceptions and contributions. Instructors: Fish, B. H. Smith, and Tetel. 3 units.

302. Seminar in Emergent Literatures. An advanced seminar in the literature of Third World or nonwestern countries. Specific topics vary from year to year. Instructor: Dorfman. 3 units.

303. Topics in Criticism and Aesthetics. Selected readings in traditional and contemporary criticism, philosophical aesthetics, and literary theory. Instructor: Visiting faculty or staff. 3 units.

353. Special Topics in Literature. Contents and methods vary with instructors and from semester to semester. Instructor: Staff. 3 units.

353S. Seminars in Literature. Contents and methods vary with. Instructors and from semester to semester. Instructor: Staff. 3 units.

391. Tutorial in Special Topics. Directed research and writing in areas unrepresented by regular course offerings. Consent of instructor required. Instructor: Staff. 3 units.

399. Special Readings. Consent of instructor required. Instructor: Staff. 1 to 4 units. Variable credit.

COURSES CURRENTLY UNSCHEDULED

211. Theory and Practice of Literary Translation

212. Studies in Narrative

214. Gender, Nationalities, and Russian Literary Traditions

253. Philology, Linguistics, and the Roots of Literature

254. Introduction to Feminism

279. The Bestseller: Cultural Populism in the 1990s' China

282. Contemporary Literary Theory

283. Modernism

285. Literature and Ideology

287. Problems in Narrative Analysis

288. Basic Issues in the History of Literary Theory

290. Topics in Psychoanalytic Criticism

291. Topics in Popular Culture and the Media

296. Feminist Thought Before 1970

The University Program in Marine Sciences

FALL, SPRING, OR SUMMER PROGRAM AT BEAUFORT

Associate Professor Rittschof (biology and environment), *Director of Graduate Studies*; Professors Barber (biology, environment, and earth and ocean sciences), C. Bonaventura (cell biology and environment), J. Bonaventura (cell biology and environment), Crowder (environment), Forward (biology and environment), and Ramus (biology and environment); Professor Emeritus Bookhout (biology); Professor in the Practice of Marine Affairs and Policy Orbach (environment); Associate Professor in the Practice of Marine Ecology Kirby-Smith (environment); Assistant Professor in the Practice of Marine Conservation Ecology Read (environment); Assistant Research Professor McClellan-Green (environment)

Graduate students from any and all academic disciplines are encouraged to take training at the Marine Laboratory. The program operates year-round, providing course work in the Marine Sciences, an active seminar program, and facilities supporting dissertation research. Resident graduate students represent the Departments of Biology, Cell Biology, University Program in Ecology, and Environment (Divisions of Earth and Ocean Sciences and Environment). Ordinarily, dissertation advisors are resident as well, although this need not be the case. The Marine Laboratory has graduate student instructional assistantships and endowed fellowships. Tuition credits obtained from fellowship support may be applied to courses given at the Marine Laboratory, the Durham campus, and at UNC and NCSU.

Persons interested in graduate work in the Marine Sciences should apply through one of the appropriate departments (Biology, Cell Biology, Environment, Earth and Ocean Sciences, or Mechanical Engineering). Graduate students planning to enroll in academic course work at the Marine Laboratory during the fall or spring semester should notify the Admissions Office of the Marine Laboratory of such intent at the time of preregistration for the respective semester and must register as normally prescribed. Students planning to enroll in academic course work or graded graduate research at the Marine Laboratory during the summer must submit the appropriate application form to the Admissions Office, Duke University, Nicholas School of the Environment, Marine Laboratory, 135 Duke Marine Lab Road, Beaufort, North Carolina 28516-9721. The application form for enrollment in summer courses is found in the Marine Laboratory bulletin or on the web site at <http://www.env.duke.edu/marinelab/marine.html>. Students registering for graded research in the fall, spring, or summer should do so under the appropriate departmental numbers.

The following courses are offered at Beaufort. See the Marine Laboratory bulletin or web for the current schedule of courses.

FALL, SPRING, OR SUMMER PROGRAM AT BEAUFORT

Biology 203L. Marine Ecology. Not open to students who have taken Biology 203L. Open to undergraduates only under Biology 129L. (Given at Beaufort fall and summer and at Bermuda, spring.) Prerequisite: introductory biology. Instructors: Crowder or Kirby-Smith (Beaufort); Lipschultz and Smith (Bermuda). 4 units. C-L: Environment 219L.

Biology 218L. Barrier Island Ecology. Prerequisite: Biology 25L or equivalent; suggested: course in botany or ecology. Instructors: Evans, Peterson, and Wells (visiting summer faculty). 4 units. C-L: Environment 218L.

Biology 219L. Coastal Ecosystem Processes. (Given at Beaufort.) Instructors: Ramus and staff. 4 units. C-L: Environment 224L.

Biology 253L. Physiology of Marine Animals. 4 units (fall); 6 units (summer). (Given at Beaufort.) Prerequisite: introductory biology and chemistry. Instructor: Forward. C-L: Environment 228L.

Biology 255L. Biochemistry of Marine Animals. 4 units (fall and spring); 6 units (summer). (Given at Beaufort.) Prerequisite: Biology 25L; and Chemistry 11L, 12L. Instructor: McClellan-Green (spring); Rittschof (fall and summer). C-L: Environment 229L

Biology 264S. Advanced Topics in Marine Ecology. (Given at Beaufort.) Instructor: Crowder. 2 units. C-L: Environment 269S.

Biology 274L. Marine Invertebrate Zoology. Not open to students who have taken Biology 176L, Biology 274L, or Zoology 274L. Open to undergraduates only under Biology 176L. 4 units (fall, spring, and Summer Term II); 6 units (Summer Term I). (Given at Beaufort fall and summer or at Bermuda, spring.) Prerequisite: Biology 25L. Instructors: Dimock (Beaufort) or Kirby-Smith (Beaufort); Barnes and Coates (Bermuda). C-L: Environment 295L.

Biology 295S. Seminar in Biology. Instructor: Staff

Biology 296S. Seminar in Biology. Instructor: Staff

Biology 351. Tutorial. Consent of instructor required. Hours and credit to be arranged. Instructor: Staff

Biology 352. Tutorial. Consent of instructor required. Hours and credit to be arranged. Instructor: Staff

Biology 353. Research. To be carried on under the direction of the appropriate staff members. Consent of instructor required. Hours and credit to be arranged. Instructor: Staff. 3 units.

Biology 354. Research. To be carried on under the direction of the appropriate staff members. Consent of instructor required. Hours and credit to be arranged. Instructor: Staff. 3 units.

Cell Biology 210. Independent Study. Consent of director of graduate studies required. 3 to 9 units each. Instructor: Staff

Cell Biology 243. Environmental Biochemistry. (Given at Beaufort.) Prerequisite: organic chemistry. Instructor: C. Bonaventura. 3 units. C-L: Environment 243.

Cell Biology 244L. Molecular and Cellular Processes in Marine Organisms. (Given at Beaufort.) Prerequisite: organic chemistry. Instructors: C. Bonaventura and McClellan-Green. 4 units. C-L: Environment 244L.

Earth and Ocean Sciences 202. Beach and Island Geological Processes. Consent of instructor required. (Given at coast on two weekends.). Instructor: Pilkey. 2 units.

Earth and Ocean Sciences 205. Geological Oceanography. Not open to students who have taken Earth and Ocean Sciences 206S. (Given at Beaufort.). Instructor: Staff. 3 units.

Environment 213. Modern and Ancient Oceanic Environments. Includes field trip. Research paper required. Instructors: Corliss, Klein, and staff. 3 units.

Environment 218L. Barrier Island Ecology. Prerequisite: Biology 25L or equivalent; suggested: course in botany or ecology. Instructors: Peterson and Wells (visiting summer faculty) 4 units. C-L: Biology 218L.

Environment 219L. Marine Ecology. Not open to students who have taken Biology 203L. Open to undergraduates only under Biology 129L. (Given at Beaufort fall and summer and at Bermuda, spring.) Prerequisite: introductory biology. Instructor: Crowder or Kirby-Smith (Beaufort); Lipschultz, Smith (Bermuda). 4 units. C-L: Biology 203L.

Environment 224L. Coastal Ecosystem Processes. (Given at Beaufort). Instructors: Ramus and staff. 4 units. C-L: Biology 219L.

Environment 225L. Coastal Ecotoxicology and Pollution. (Given at Beaufort.) Prerequisite: introductory chemistry and biology. Instructor: Kenney. 4 units.

Environment 226. Marine Mammals. (Given at Beaufort.) Prerequisite: introductory biology. Instructor: Read or staff. 3 units.

Environment 226L. Marine Mammals. (Given at Beaufort.) Prerequisite: introductory biology. Instructor: Read or staff. 4 units.

Environment 228L. Physiology of Marine Animals. Four units (fall); six units (summer). (Given at Beaufort.) Prerequisite: introductory biology and chemistry. Instructor: Forward C-L: Biology 253L. 3 units.

Environment 229L. Biochemistry of Marine Animals. Four units (fall and spring); six units (summer). (Given at Beaufort.) Prerequisite: Biology 25L; and Chemistry 11L, 12L. Instructor: McClellan-Green (spring); Rittschof (fall and summer) C-L: Biology 255L. 3 units.

Environment 243. Environmental Biochemistry. (Given at Beaufort.) Prerequisite: organic chemistry. Instructor: C. Bonaventura. 3 units. C-L: Cell Biology 243.

Environment 244L. Molecular and Cellular Processes in Marine Organisms. (Given at Beaufort.) Prerequisite: organic chemistry. Instructors: C. Bonaventura and McClellan-Green. 4 units. C-L: Cell Biology 244L.

Environment 253L. Sensory Physiology and Behavior of Marine Animals. (Given at Beaufort.) Prerequisites: introductory biology and chemistry. Instructors: Forward and Rittschof. 4 units.

Environment 256S. Seminar in Ocean Sciences. Consent of instructor required. (Given at Beaufort.) Instructor: Staff. 2 units.

Environment 267S. Conservation Biology of Marine Mammals. Consent of instructor required. (Given at Beaufort.) Instructor: Read. 2 units.

Environment 269S. Advanced Topics in Marine Ecology. (Given at Beaufort.) Instructor: Crowder. 2 units. C-L: Biology 264S.

Environment 273. Marine Fisheries Policy. (Given at Beaufort.) Instructor: Orbach. 3 units.

Environment 276. Marine Policy. Consent of instructor required. (Given at Beaufort.) Instructor: Orbach. 3 units.

Environment 291. Geological Oceanography. Not open to students who have taken Earth and Ocean Sciences 206S. (Given at Beaufort.) Instructor: Staff. 3 units. C-L: Earth and Ocean Sciences 205.

Environment 292L. Biological Oceanography. 4 units (spring); 6 units (summer). (Given at Beaufort and Bermuda.) Prerequisite: introductory biology. Instructor: Ramus or staff (Beaufort); Nelson and Steinberg (Bermuda).

Environment 293. Analysis of Ocean Ecosystems. (Given at Beaufort.) Prerequisite: one year of biology, one year of chemistry, or consent of instructor. Instructor: Barber. 3 units.

Environment 295L. Marine Invertebrate Zoology. Not open to students who have taken Biology 176L, Biology 274L, or Zoology 274L. Open to undergraduates only under Biology 176L. 4 units (fall, spring, and Summer Term II); 6 units (Summer Term I). (Given at Beaufort fall and summer or at Bermuda, spring.) Prerequisite: Biology 25L. Instructor: Dimock (Beaufort) or Kirby-Smith (Beaufort); Barnes and Coates (Bermuda). 4 units. C-L: Biology 274L.

Environment 298. Special Topics. Content to be determined each semester. May be repeated. Instructor: Staff. 4 units.

Environment 299. Independent Studies and Projects. Consent of instructor required. Units to be arranged. Instructor: Staff.

Environment 398.02. Program Area Symposium. Required symposium in each program area. Students present master's project research. Pass/fail grading only. Instructor: Staff

Environment 399. Master's Project. Undertaken with the guidance of the student's adviser. Consent of instructor required. Pass/fail grading only. Instructor: Staff

Mathematics (MATH)

Professor Hain, *Chair* (132A Physics); Professor Allard, *Director of Graduate Studies* (024B Physics); Professors Beale, Bertozzi, Bryant, Harer, Lawler, Morrison, Pardon, M. Reed, Rose, Schaeffer, Schoen, Stern, Trangenstein, Venakides and Zhou; Associate Professors Aspinwall, Burdick, R. Hodel, Kitchen, Kraines, Layton, Moore, Petters, Saper, and Smith; Assistant Professors Plesser and Witelski; Assistant Research Professors Carmack, Shipman, Sreekantan and Vybornov; Adjunct Professors Kimbell, Shearer and Wall.

Graduate work in the Department of Mathematics is offered leading to the A.M. and Ph.D. degrees. Admission to these programs is based on the applicant's undergraduate academic record, level of preparation for graduate study, the Graduate Record Examination, and letters of recommendation.

All A.M. and Ph.D. candidates are required to pass a qualifying examination; most students take this examination shortly after completing their first year of graduate study. The A.M. degree with a major in mathematics is awarded upon completion of 30 units of graded course work and passing the qualifying examination. A thesis may be substituted for 6 units of course work with the approval of the director of graduate studies.

The department offers research training in both pure and applied mathematics. Major areas of research specialization include applied mathematics and scientific computing, algebra and algebraic geometry, analysis and partial differential equations, differential geometry, geometry and physics, mathematical biology, probability and stochastic processes, and topology. Interdisciplinary programs with connections to the department include the Center for Geometric Computing, the Center for Hydrologic Science, the Center for Mathematics and Computation in the Life Sciences and Medicine, the Center for Multi-Scale Modeling and Distributed Computing, and the Center for Nonlinear and Complex Systems.

Candidacy for the Ph.D. is established by passing an oral preliminary examination. The preliminary examination is normally taken during the third year. By this time the student should have chosen a thesis advisor and demonstrated any computer skills or reading skills in a foreign language judged to be necessary for work in the chosen area.

The original research which begins after successful completion of the preliminary examination should culminate in the writing and defense of a dissertation. The dissertation is the most important requirement for the Ph.D.

For Seniors and Graduates

200. Introduction to Algebraic Structures I. Groups: symmetry, normal subgroups, quotient groups, group actions. Rings: homomorphisms, ideals, principal ideal domains, the Euclidean algorithm, unique factorization. Not open to students who have had Mathematics 121. Prerequisite: Mathematics 104 or equivalent. Instructor: Staff. 3 units.

201. Introduction to Algebraic Structures II. Fields and field extensions, modules over rings, further topics in groups, rings, fields, and their applications. Prerequisite: Mathematics 200, or 121 and consent of instructor. Instructor: Staff. 3 units.

203. Basic Analysis I. Topology of $R^{<^>n}$, continuous functions, uniform convergence, compactness, infinite series, theory of differentiation, and integration. Not open to students who have had Mathematics 139. Prerequisite: Mathematics 104. Instructor: Staff. 3 units.

204. Basic Analysis II. Differential and integral calculus in $R^{<^>n}$. Inverse and implicit function theorems. Further topics in multivariable analysis. Prerequisite: Mathematics 104; Mathematics 203, or 139 and consent of instructor. Instructor: Staff. 3 units.

205. Topology. Elementary topology, surfaces, covering spaces, Euler characteristic, fundamental group, homology theory, exact sequences. Prerequisite: Mathematics 104. Instructor: Staff. 3 units.

206. Differential Geometry. Geometry of curves and surfaces, the Serret-Frenet frame of a space curve, the Gauss curvature, Cadazzi-Mainardi equations, the Gauss-Bonnet formula. Prerequisite: Mathematics 104. Instructor: Staff. 3 units.

207. Topics in Mathematical Physics. Topics selected from general relativity, gravitational lensing, classical mechanics, quantum mechanics, string theory, critical phenomena and statistical mechanics, or other areas of mathematical physics. Consult on-line Course Synopsis description each semester. Instructor: Staff. 3 units.

211. Mathematical Methods in Physics and Engineering I. Heat and wave equations, initial and boundary value problems, Fourier series, Fourier transforms, potential theory. Not open to students who have had Mathematics 133 or 230. Prerequisite: Mathematics 114 or equivalent. Instructor: Staff. 3 units.

216. Applied Stochastic Processes. An introduction to stochastic processes without measure theory. Topics selected from: Markov chains in discrete and continuous time, queueing theory, branching processes, martingales, Brownian motion, stochastic calculus. Not open to students who have taken Mathematics 240. Prerequisite: Mathematics 135 or equivalent. Instructor: Staff. 3 units. C-L: Statistics and Decision Sciences 253.

217. Linear Models. 3 units. C-L: Statistics and Decision Sciences 244.

218. Introduction to Multivariate Statistics. 3 units. C-L: Statistics and Decision Sciences 245.

221. Numerical Analysis. 3 units. C-L: Computer Science 250, Statistics and Decision Sciences 273.

223. Numerical Linear Algebra. 3 units. C-L: Computer Science 254.

224. Scientific Computing I. Well-posedness of ODEs; method, order, and stability. Methods for hyperbolic, parabolic, and elliptic PDEs. Structured programming and graphical user interfaces. Programming in C++, C, and Fortran. Prerequisite: Mathematics 103, plus some familiarity with ODEs and PDEs. Instructor: Staff. 3 units.

225. Scientific Computing II. Compressible fluid flow. Shock-capturing methods for conservation laws. Incompressible fluid flow. Vortex and probabilistic methods for

high Re flow. Viscous Navier-Stokes equations and projection methods. Prerequisite: Mathematics 224. Instructor: Staff. 3 units.

226. Numerical Partial Differential Equations I. Numerical solution of hyperbolic conservation laws. Conservative difference schemes, modified equation analysis and Fourier analysis, Lax-Wendroff process. Gas dynamics and Riemann problems. Upwind schemes for hyperbolic systems. Nonlinear stability, monotonicity and entropy; TVD, MUSCL, and ENO schemes for scalar laws. Approximate Riemann solvers and schemes for hyperbolic systems. Multidimensional schemes. Adaptive mesh refinement. Prerequisite: Mathematics 224, 225, or consent of instructor. Instructor: Staff. 3 units.

227. Numerical Partial Differential Equations II. Numerical solution of parabolic and elliptic equations. Diffusion equations and stiffness, finite difference methods and operator splitting (ADI). Convection-diffusion equations. Finite element methods for elliptic equations. Conforming elements, nodal basis functions, finite element matrix assembly and numerical quadrature. Iterative linear algebra; conjugate gradients, Gauss-Seidel, incomplete factorizations and multigrid. Mixed and hybrid methods. Mortar elements. Reaction-diffusion problems, localized phenomena, and adaptive mesh refinement. Prerequisite: Mathematics 224, 225, or consent of instructor. Instructor: Staff. 3 units.

228. Mathematical Fluid Dynamics. Properties and solutions of the Euler and Navier-Stokes equations, including particle trajectories, vorticity, conserved quantities, shear, deformation and rotation in two and three dimensions, the Biot-Savart law, and singular integrals. Additional topics determined by the instructor. Prerequisite: Mathematics 133 or 211 or an equivalent course. Instructor: Staff. 3 units.

229. Mathematical Modeling. Formulation and analysis of mathematical models in science and engineering. Emphasis on case studies; may include individual or team research projects. Instructor: Staff. 3 units.

231. Ordinary Differential Equations. Existence and uniqueness theorems for nonlinear systems, well-posedness, two-point boundary value problems, phase plane diagrams, stability, dynamical systems, and strange attractors. Not open to students who have taken the former Mathematics 296. Prerequisite: Mathematics 104, 111 or 131, and 203 or 139. Instructor: Staff. 3 units.

232. Partial Differential Equations I. Fundamental solutions of linear partial differential equations, hyperbolic equations, characteristics, Cauchy-Kowalevski theorem, propagation of singularities. Not open to students who have taken the former Mathematics 297. Prerequisite: Mathematics 204 or equivalent. Instructor: Staff. 3 units.

233. Asymptotic and Perturbation Methods. Asymptotic solution of linear and nonlinear ordinary and partial differential equations. Asymptotic evaluation of integrals. Singular perturbation. Boundary layer theory. Multiple scale analysis. Prerequisite: Mathematics 114 or equivalent. Instructor: Staff. 3 units.

238. Topics in Applied Mathematics. Conceptual basis of applied mathematics, graph theory, game theory, mathematical programming, numerical analysis, or problems drawn from industry or from academic science or engineering. Prerequisite: Mathematics 103 and 104 or equivalents. Instructor: Staff. 3 units.

239. Applied Mathematics. Continuation of Mathematics 238. Prerequisite: Mathematics 103 and 104 or equivalents. Instructor: Staff. 3 units.

241. Real Analysis I. Measures; Lebesgue integral; L^p spaces; Daniell integral, differentiation theory, product measures. Not open to students who have taken the former Mathematics 281. Prerequisite: Mathematics 204 or equivalent. Instructor: Staff. 3 units.

242. Real Analysis II. Metric spaces, fixed point theorems, Baire category theorem, Banach spaces, fundamental theorems of functional analysis, Fourier transform. Not

open to students who have taken the former Mathematics 282. Prerequisite: Mathematics 241 or equivalent. Instructor: Staff. 3 units.

245. Complex Analysis. Complex calculus, conformal mapping, Riemann mapping theorem, Riemann surfaces. Not open to students who have taken Mathematics 285. Prerequisite: Mathematics 204 or equivalent. Instructor: Staff. 3 units.

250. Computation in Algebra and Geometry. Application of computing to problems in areas of algebra and geometry, such as linear algebra, algebraic geometry, differential geometry, representation theory, and number theory, use of general purpose symbolic computation packages such as Maple or Mathematica; use of special purpose packages such as Macaulay, PARI-GP, and LiE; programming in C/C++. Previous experience with programming or the various mathematical topics not required. Corequisite: Mathematics 251 or consent of instructor. Instructor: Staff. 3 units.

251. Groups, Rings, and Fields. Groups including nilpotent and solvable groups, p -groups and Sylow theorems; rings and modules including classification of modules over a PID and applications to linear algebra; fields including extensions and Galois theory. Not open to students who have taken Mathematics 260. Prerequisite: Mathematics 201 or equivalent. Instructor: Staff. 3 units.

252. Commutative Algebra. Extension and contraction of ideals, modules of fractions, primary decomposition, integral dependence, chain conditions, affine algebraic varieties, Dedekind domains, completions. Not open to students who have taken the former Mathematics 261. Prerequisite: Mathematics 251 or equivalent. Instructor: Staff. 3 units.

254. Topics in Algebra. Algebraic number theory, algebraic K -theory, homological algebra, or other topics. Prerequisite: Mathematics 251. Instructor: Staff. 3 units.

261. Algebraic Topology I. Fundamental group and covering spaces, singular and cellular homology, Eilenberg-Steenrod axioms of homology, Euler characteristic, classification of surfaces, singular and cellular cohomology. Not open to students who have taken Mathematics 271. Prerequisite: Mathematics 200 and 205 or consent of instructor. Instructor: Staff. 3 units.

262. Algebraic Topology II. Universal coefficient theorems, Künneth theorem, cup and cap products, Poincaré duality, plus topics selected from: higher homotopy groups, obstruction theory, Hurewicz and Whitehead theorems, and characteristic classes. Prerequisite: Mathematics 261 or consent of instructor. Instructor: Staff. 3 units.

263. Topics in Topology. Algebraic, geometric, or differential topology. Consent of instructor required. Instructor: Staff. 3 units.

264. Topics in Topology. Algebraic, geometric, or differential topology. Consent of instructor required. Instructor: Staff. 3 units.

267. Differential Geometry. Differentiable manifolds, fiber bundles, connections, curvature, characteristic classes, Riemannian geometry including submanifolds and variations of length integral, complex manifolds, homogeneous spaces. Not open to students who have taken Mathematics 275. Prerequisite: Mathematics 204 or equivalent. Instructor: Staff. 3 units.

268. Topics in Differential Geometry. Lie groups and related topics, Hodge theory, index theory, minimal surfaces, Yang-Mills fields, exterior differential systems, harmonic maps, symplectic geometry. Prerequisite: Mathematics 267 or consent of instructor. Instructor: Staff. 3 units.

273. Algebraic Geometry. Affine varieties, projective varieties, Riemann surfaces, algebraic curves, algebraic groups, sheaf cohomology, singularities, Hodge theory, or computational algebraic geometry. Prerequisite: Mathematics 251 or equivalent and consent of instructor. Instructor: Staff. 3 units.

277. Topics in Algebraic Geometry. Schemes, intersection theory, deformation theory, moduli, classification of varieties, variation of Hodge structure, Calabi-Yau

manifolds, or arithmetic algebraic geometry. Prerequisite: Mathematics 273 or consent of instructor. Instructor: Staff. 3 units.

278. Topics in Complex Analysis. Geometric function theory, function algebras, several complex variables, uniformization, or analytic number theory. Prerequisite: Mathematics 245 or equivalent. Instructor: Staff. 3 units.

279. Topics in Mathematical Physics. Topics selected from: critical phenomena and statistical mechanics, mathematical aspects of quantum field theory, string and superstring theories, or other areas of mathematical physics. Instructor: Staff. 3 units.

281. Partial Differential Equations II. Linear wave motion, dispersion, stationary phase, foundations of continuum mechanics, characteristics, linear hyperbolic systems, and nonlinear conservation laws. Not open to students who have taken the former Mathematics 298. Prerequisite: Mathematics 232 or equivalent. Instructor: Staff. 3 units.

282. Partial Differential Equations III. Fourier transforms, distributions, elliptic equations, singular integrals, layer potentials, Sobolev spaces, regularity of elliptic boundary value problems. Prerequisite: Mathematics 232 and 241 or equivalent. Instructor: Staff. 3 units.

283. Topics in Partial Differential Equations. Hyperbolic conservation laws, pseudo-differential operators, variational inequalities, theoretical continuum mechanics. Prerequisite: Mathematics 281 or equivalent. Instructor: Staff. 3 units.

284. Topics in Partial Differential Equations. Continuation of Mathematics 283. Prerequisite: Mathematics 281 or equivalent. Instructor: Staff. 3 units.

287. Probability. Random variables, independence, expectations, laws of large numbers, central limit theorem, martingales, Brownian motion. Not open to students who have taken Mathematics 290. Prerequisite: Mathematics 241 or equivalent. Instructor: Staff. 3 units. C-L: Statistics and Decision Sciences 207.

295. Special Topics. Instructor: Staff. 3 units.

296. Special Topics. Instructor: Staff. 3 units.

297. Special Readings. Instructor: Staff. 3 units.

298. Special Readings. Instructor: Staff. 3 units.

For Graduates

348. Current Research in Analysis. Not open to students who have taken Mathematics 388, 389. Instructor: Staff. 3 units.

358. Current Research in Algebra. Not open to students who have taken Mathematics 368-369. Instructor: Staff. 3 units.

368. Current Research in Topology. Not open to students who have taken Mathematics 378-379. Instructor: Staff. 3 units.

369. Current Research in Differential Geometry. Instructor: Staff. 3 units.

378. Current Research in Algebraic Geometry. Instructor: Staff. 3 units.

379. Current Research in Mathematical Physics. Not open to students who have taken Mathematics 387. Instructor: Staff. 3 units.

388. Current Research in Differential Equations. Instructor: Staff. 3 units.

389. Current Research in Applied Mathematics. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

212. Mathematical Methods in Physics and Engineering II

222. Numerical Methods for Partial Differential Equations

248. Topics in Analysis

249. Topics in Functional Analysis

257. Mathematical Logic

288. Topics in Probability Theory

Medical Historian Training Program

Peter English, M.D., *Director*

The Medical Historian Training Program is conducted under the auspices of the School of Medicine and the Graduate School. The M.D.-Ph.D. program requires a minimum of six years of graduate and medical study, and the M.D.-A.M. four or five years, depending on the use of summer terms. The M.D.-Ph.D. program is intended for those students who know that their major career effort will be in teaching and other scholarly activities in the history of medicine (not necessarily to the total exclusion of clinical medicine). The M.D.-A.M., on the other hand, is appropriate for those who are undecided, but who wish to acquire a firm foundation for future study. In both programs the first two years and the last year will be spent in the Medical School. All requirements for the Ph.D. and the A.M. must be completed before the final year of the M.D. program.

Application and Admission Procedures. Applicants must meet the requirements for admission to the School of Medicine and the Graduate School in the Department of History including the MCAT and GRE exams. Those candidates holding the M.D. degree will be considered for the Ph.D. and the A.M. degrees. Candidates who have completed two years of medical school will also be considered for either degree.

Applicants should complete and submit an application to the Graduate School for admission to the Department of History. Additional information may be obtained by writing to Dr. Peter English, Box 3675 Duke University Medical Center, Durham, North Carolina 27710.

Medical Scientist Training Program

Salvatore V. Pizzo, M.D., Ph.D., *Director*

The Medical Scientist Training Program, conducted under the auspices of the Graduate School and the School of Medicine, is designed for students with a strong background in science who are motivated toward a career in the medical sciences and academic medicine. It provides an opportunity to integrate graduate education in one of the sciences basic to medicine with the clinical curriculum of the School of Medicine. The program usually requires six to seven years of study and leads to both the M.D. and Ph.D. degrees. Although the special emphasis of this program is on basic medical science, the trainees, because of their education in clinical medicine, have a remarkable range of career opportunities open to them. Graduates of this program generally follow one of two broad paths. Some directly pursue careers in teaching and research in one of the basic medical sciences, while maintaining strong ties with clinical science as a result of their combined training; others enter residency programs before pursuing investigative and teaching careers in clinical medicine, carrying with them strong academic backgrounds in the basic sciences.

Eligibility. Applicants must meet the admission requirements of both the Graduate School as a candidate for the Ph.D. degree and the School of Medicine as a candidate for the M.D. degree. Most candidates apply for admission to the first year of the program, but applications are sometimes accepted from students who are enrolled in appropriate stages of their curriculum in the Graduate School or School of Medicine of Duke University. In addition to the minimum requirements for acceptance in the Graduate School and the School of Medicine, advanced course work in science and mathematics as well as prior research experience count heavily in the selection of candidates.

Financial Support. Students admitted to the first year of the program can receive a traineeship award, consisting of a stipend and full tuition allowance, provided by a grant from the National Institutes of Health. The present annual stipend is \$16,300. Current policy of the National Institutes of Health limits the duration of the traineeship to six years, but the years need not be consecutive; this permits curricula which take more than six years. For those students requiring more than six years, the department and/or preceptor of the student provides support for additional years in training.

This traineeship, created by the National Research Service Award Act of 1974 (PL 93-348) provides (as do all research training awards under this act) for certain alternate service or payback requirements in the event that a research career is not pursued. Support by the NIH under the National Research Service Award Act requires the recipient to be a citizen or resident of the United States.

The Training Program. This program has been designed to offer trainees latitude in the selection of course material. Basic requirements are two academic years composed of the first basic science year and the second clinical science year of the curriculum for medical students at Duke University. Following completion of the second year, the trainee enters the graduate program to complete the requirements for the Ph.D. degree. A final academic year of elective clinical study is necessary to complete the requirements for the M.D. degree. Both degrees are awarded at the completion of this sequence.

Additional information may be obtained by writing Professor Salvatore V. Pizzo, Medical Scientist Training Program, Department of Pathology, Box 3712 Duke University Medical Center, Durham, North Carolina 27710.

Program in Medieval and Renaissance Studies (MEDREN)

Professor Aers, *Chair*; Professor DeNeef, *Director of Graduate Studies* (127 Allen)

The Graduate Program in Medieval and Renaissance Studies is an interdisciplinary program administered by the Duke University Center for Medieval and Renaissance Studies. Some fifty faculty in ten different degree-granting departments participate in the medieval-Renaissance program. Students may earn a certificate of graduate study by completing two core course requirements in addition to a dissertation focused on a medieval or Renaissance subject. In consultation with the director of graduate studies, students in the program select courses in art, history, music, philosophy, religion, language, and literature (classical studies, English, German, and Romance languages).

200. Advanced Topics in Medieval and Renaissance Studies. Topics may focus on fine arts, history, language and literature, or philosophy and religion. Open to seniors and graduate students; other students may need consent of instructor. Instructor: Staff. 3 units.

200S. Advanced Seminar in Medieval and Renaissance Studies. Topics may focus on fine arts, history, language and literature, or philosophy and religion. These seminar courses frequently engage interdisciplinary perspectives, historiography, and interpretation of medieval and Renaissance cultures. Open to seniors and graduate students; other students may need consent of instructor. Instructor: Staff. 3 units.

202A. Christian Thought in the Middle Ages. A survey of the history of Christian theology from St. Augustine to the young Martin Luther. Also offered as a Divinity School course. Open to juniors and seniors only. Instructor: Steinmetz. 3 units.

202B. Early and Medieval Christianity. A survey of the history of Christianity from its beginnings through the fifteenth century. Also offered as a Divinity School course. Open to juniors and seniors only. Instructor: Keefe and Steinmetz. 3 units.

202C. Modern European Christianity. A survey of the history of Christianity from the Reformation to the present, with emphasis on the early modern era. Also offered as

a Divinity School course. Open to juniors and seniors only. Instructor: Heitzenrater and Steinmetz. 3 units.

203S. Sex, Gender, and Love in Medieval German Literature. 3 units. C-L: German 203S.

204. Origen. 3 units. C-L: Religion 204.

205. The English Reformation. The religious history of England from the accession of Henry VIII to the death of Elizabeth I. Extensive readings in the English reformers from Tyndale to Hooker. Also offered as a Divinity School course. Open to juniors and seniors only. Instructor: Steinmetz. 3 units.

206. The Christian Mystical Tradition in the Medieval Centuries. Reading and discussion of the writings of medieval Christian mystics (in translation). A different focus each year: for example, Women at Prayer; Fourteenth-Century Mystics; Spanish Mystics. Less well-known writers (Hadewijch, Birgitta of Sweden, Catherine of Genoa) as well as giants (Eckhart, Ruusbroec, Tauler, Suso, Teresa of Avila, Julian of Norwich, Catherine of Siena, and Bernard of Clairvaux) included. Also offered as a Divinity School course. Open to juniors and seniors only. Instructor: Keefe. 3 units.

207. Readings in Historical Theology. Also offered as a Divinity School course. Open to juniors and seniors only. Prerequisite: Medieval and Renaissance Studies 202B and 202C. Instructor: Staff. 3 units.

209. Middle English Literature: 1100 to 1500. 3 units. C-L: English 212.

210A. History of the Spanish Language. 3 units. C-L: Spanish 210.

211. Notation. 3 units. C-L: Music 211.

212. Notation. 3 units. C-L: Music 212.

213. Chaucer. 3 units. C-L: English 213.

214. Chaucer. 3 units. C-L: English 214.

216. Augustine. 3 units. C-L: Religion 219.

218S. Medieval Philosophy. 3 units. C-L: Philosophy 218S.

219S. Late Medieval and Renaissance Philosophy. 3 units. C-L: Philosophy 219S.

221A. Special Topics in the History of Europe, 1200-1700. 3 units. C-L: History 221.

221B. Renaissance Prose and Poetry: 1500 to 1660. 3 units. C-L: English 221.

221C. Medieval Latin. 3 units. C-L: Latin 221.

222A. The Humanist as Reformer: Petrarch, Machiavelli, and Erasmus. 3 units. C-L: History 222A.

222B. Florence: Renaissance City. C-L: History 222B.

222CS. Petrarch. 3 units. C-L: History 222CS.

223B. Music in the Renaissance. 3 units. C-L: Music 223B.

224. Music in the Baroque Era. 3 units. C-L: Music 224.

234A. Early Christian Asceticism. 3 units. C-L: Religion 234, Women's Studies.

234B. Heresy: Theological and Social Dimensions of Early Christian Dissent. 3 units. C-L: Religion 235.

235. Topics in the History of Monasticism. 3 units. C-L: History 236A.

236A. Luther and the Reformation in Germany. The theology of Martin Luther in the context of competing visions of reform. Also offered as a Divinity School course. Open to juniors and seniors only. Instructor: Steinmetz. 3 units.

236B. Special Topics in Early Medieval History. 3 units. C-L: History 236B.

237S. Topics in Romanesque and Gothic Art and Architecture. 3 units. C-L: Art History 236S.

238S. Europe in the High Middle Ages. 3 units. C-L: History 238S.

- 240. Medieval Narrative.** 3 units. C-L: French 240.
- 241. History of Netherlandish Art and Visual Culture in a European Context.** 3 units. C-L: Art History 241, Comparative Area Studies.
- 242. History of Netherlandish Art and Visual Culture in a European Context.** 3 units. C-L: Art History 242, Comparative Area Studies.
- 243S. Topics in Netherlandish and German Art.** 3 units. C-L: Art History 243S, Comparative Area Studies.
- 244. Classical Islamic Theology and Ethics.** 3 units. C-L: African and African American Studies 241, Religion241.
- 245. Problems in Reformation Theology.** Consent of instructor required. Also offered as a Divinity School course. Open to juniors and seniors only. Instructor: Steinmetz. 3 units.
- 246. Problems in Historical Theology.** Consent of instructor required. Also offered as a Divinity School course. Open to juniors and seniors only. Instructor: Staff. 3 units.
- 247A. Readings in Latin Theological Literature.** Critical translation and study of important theological texts in Latin from various periods of the history of the Church. Also offered as a Divinity School course. Open to juniors and seniors only. Prerequisite: reading knowledge of Latin. Instructor: Keefe. 3 units.
- 247B. Readings in Latin Theological Literature.** Continuation of Medieval and Renaissance Studies 247A. Also offered as a Divinity School course. Open to juniors and seniors only. Prerequisite: reading knowledge of Latin. Instructor: Keefe. 3 units.
- 248S. Topics in Italian Renaissance Art.** 3 units. C-L: Art History 247S.
- 250. Women in the Medieval Church.** The history of the Medieval Church told from its women figures. Attention to the life and writings of saints, heretics, abbesses, queens, mystics, recluses, virgins, bishops' wives, and reformers. Topic varies. Also offered as a Divinity School course. Open to juniors and seniors only. Instructor: Keefe. 3 units.
- 251B. Topics in Intellectual History of Europe, 1450-1650.** 3 units. C-L: History 251B.
- 254. Justice, Law, and Commerce in Islam.** 3 units. C-L: , Religion 254, African and African American Studies 254, Law 568, Comparative Area Studies.
- 260A. The Byzantine Empire.** 3 units. C-L: Classical Studies 260.
- 260B. History of the German Language.** 3 units. C-L: Linguistics, German 260.
- 267S. Britain in the Sixteenth Century.** 3 units. C-L: History 267S.
- 268S. England in the Seventeenth Century.** 3 units. C-L: History 268S.
- 272. The Early Medieval Church.** Also offered as a Divinity School course. Open to juniors and seniors only. Instructor: Keefe. 3 units.
- 273. The Early Medieval Church, Out of Africa: Christianity in North Africa before Islam.** Selected writings of Tertullian, Cyprian, and Augustine, as well as lesser known African Fathers, on topics such as the African rite of baptism, African creeds, and African church councils. Focus on major theological, liturgical, and pastoral problems in the African church in order to gain perspective on the crucial role of the African church in the development of the church in the West. Also offered as a Divinity School course. Open to juniors and seniors only. Instructor: Keefe. 3 units.
- 276. The Sacraments in the Patristic and Early Medieval Period.** A study of the celebration and interpretation of baptism or eucharist in the church orders and texts of the early church writers. Also offered as a Divinity School course. Open to juniors and seniors only. Instructor: Keefe. 3 units.

For Graduates

300. Research Colloquium in Medieval and Renaissance Studies. Credit grading only. Instructor: Staff. 3 units.

301. Medieval and Renaissance Studies. Seminar on the material bases (archival documents, legal records, court records, manuscripts, material artifacts, and the like) for the study of the Middle Ages. Topics addressed include origins and accessibility, as well as questions of method and historiography. Topics vary. Consent of instructor required. Instructor: Shatzmiller. 3 units.

COURSES CURRENTLY UNSCHEDULED

201S. Introduction to Medieval German: The Language of the German Middle Ages and Its Literature

208. History of the English Language

210B. History of the French Language

215S. German Baroque Literature

220. Shakespeare: Selected Topics

223A. Music in the Middle Ages

233S. Topics in Early Christian and Byzantine Art

261S. Topics in Italian Baroque Art

Microbiology (MICROBIO)

Professor Keene, *Chair* (414A Jones); Associate Professor Pickup, *Director of Graduate Studies* (421 Jones); Professors Bastia, Bolognesi, Cullen, Endow, Linney, and Nevins; Associate Professors Abraham, Heitman, Kreuzer, Mitchell, Vigalys, and White; Assistant Professors Garcia-Blanco, Gromeier, Kuehn, McCusker, and Wharton; Professors Emeriti Joklik, Osterhout, Wheat, and Willett; Associate Research Professors Burdett, Harrell, and Miller

The Department of Microbiology offers a broadly based graduate program leading to the Ph.D. degree. It also participates in interdepartmental programs such as the University Program in Genetics, the Program in Cell and Molecular Biology, and the Medical Scientist Training Program. The department's graduate program is designed to provide students with a strong scientific base in the principles and techniques of contemporary bacterial and animal cell biology.

The research interests of the faculty provide numerous and diverse areas for training in prokaryotic and eukaryotic molecular cell biology, molecular genetics and virology, as well as in broad multidisciplinary areas like the nature of protein nucleic acid interactions, the nature of the molecular controls of gene expression, molecular virology, and the function of oncogenes and antioncogenes.

Undergraduate preparation in the biological and physical sciences and in biochemistry is required. A brochure more fully describing the Ph.D. degree program, prerequisites for admission, and research in the department may be obtained either by writing the director of graduate studies, Box 3020, Duke University Medical Center, Durham, North Carolina 27710, or from the departmental web site at <http://abacus.mc.duke.edu>.

221. Medical Microbiology. Intensive study of common bacteria, viruses, fungi, and parasites that cause human disease. The didactic portion focuses on the nature and biological properties of microorganisms causing disease, the manner of replication, and their interaction with the entire host as well as specific organs and cells. Staff. 4 units.

252. General Virology and Viral Oncology. Molecular biology of mammalian viruses, with emphasis on mechanisms of virus replication, virus-host interactions, viral pathogenicity, and the relationship of virus infection to neoplasia. Consent of instructor required. Instructors: Keene and staff. 3 units. C-L: Immunology 252.

258. Structural Biochemistry I. 2 units. C-L: Biochemistry 258, Cell Biology 258, Cell and Molecular Biology 258, University Program in Genetics 258, Immunology 258, Molecular Biophysics 258.

259. Structural Biochemistry II. 2 units. C-L: Biochemistry 259, Cell Biology 259, University Program in Genetics 259, Immunology 259, Molecular Biophysics 259.

268. Nucleic Acids. 3 units. C-L: Biochemistry 268, Cell Biology 268, University Program in Genetics 268, Immunology 268.

282. Microbial Pathogenesis. Modern molecular genetic approaches to understanding the pathogenic bacteria and fungi. Underlying mechanisms of pathogenesis and host-parasite relationships that contribute to the infectious disease process. Instructors: Hanna and staff. 3 units.

291. Comprehensive Immunology. Required course for all students specializing in immunology. Consent of instructor required. Prerequisite: recommended, Immunology 244 or equivalent. Instructor: Krangel and staff. 3 units. C-L: Immunology 291.

331. Microbiology Colloquium. Current topics in microbiology with seminars presented by students, faculty, and outside speakers. Required course for all students specializing in microbiology. Instructor: McCusker. 1 unit.

COURSES CURRENTLY UNSCHEDULED

214. Fundamentals of Electron Microscopy

304. Molecular Membrane Biology

323. Topics in Cell and Molecular Biology

324. Topics in Molecular Genetics

325. Medical Mycology

The University Program in Molecular Biophysics (MOLBPHY)

Terrence G. Oas, *Director* (biochemistry); Professor H. Erickson, *Director of Graduate Studies* (cell biology); Professors Hammes (biochemistry); McGown (chemistry), McIntosh (cell biology), Needham (mechanical eng and materials sci) Palmer (chemistry), D. Richardson and J. Richardson (biochemistry), Shaw (chemistry), J. Simon (chemistry), S. Simon (neurobiology), Spicer (biochemistry) and Yang (Chemistry); Associate Professors Beese (biochemistry), Board (electrical and computer engineering), Hellinga (biochemistry), Hsieh (biochemistry), Oas (biochemistry), Toone (chemistry), and Van Dongen (pharmacology and cancer biology); Assistant Professors York (pharmacology and cancer biology)

The program in structural molecular biophysics at Duke centers on those research endeavors that use physical measurements to study biological macromolecules and their interactions, where the details of molecular structure are critical to understanding the biological problem in question. The focus is on understanding molecular structure/function at atomic resolution; the breadth extends to detecting molecular events and describing structural relationships in a chemically meaningful way, and relating atomic-level with higher-order structures. There is a commonality in the intellectual approaches and experimental techniques. Research problems addressed within the University Program in Molecular Biophysics include: 3-D structure determination by crystallography and NMR; molecular assemblies studied by various diffraction, spectroscopy, and microscopy techniques; protein folding; molecular modeling and design studies and their direct experimental testing; and functional studies in biochemistry, genetic mechanisms, drug interactions, membrane systems, and so on, for which the details of molecular geometry are central to interpreting the experiments.

Participating students may receive a certificate from the Molecular Biophysics Program in addition to the doctoral degree from their home department. Requirements

for the certificate ordinarily will include the core courses (Proteins and Enzymes, Physical Biochemistry I, Physical Biochemistry II, Structure of Biological Macromolecules, Membrane Biophysics and Molecular Biophysics Seminar), lab rotations with molecular biophysics faculty, presenting and attending seminars, and an appropriate thesis topic and committee. However, the curriculum can be tailored for students with special interests and backgrounds. For further information about the University Program in Molecular Biophysics, contact the program office at agw@biochem.duke.edu or at Duke University, Box 3567 DUMC, Durham, North Carolina 27710.

222. Structure of Biological Macromolecules. Computer graphics intensive study of some of the biological macromolecules whose three-dimensional structures have been determined at high resolution. Emphasis on the patterns and determinants of protein structure. Two-hour discussion session each week along with computer-based lessons and projects. Instructors: D. Richardson and J. Richardson. 3 units. C-L: Biochemistry 222.

258. Structural Biochemistry I. 2 units. C-L: Biochemistry 258, Cell Biology 258, Cell and Molecular Biology 258, University Program in Genetics 258, Immunology 258, Microbiology 258.

259. Structural Biochemistry II. 2 units. C-L: Biochemistry 259, Cell Biology 259, University Program in Genetics 259, Immunology 259, Microbiology 259.

291. Physical Biochemistry. Basic principles of physical chemistry as applied to biological systems. Topics include thermodynamics, kinetics, statistical mechanics, spectroscopy, and diffraction theory. Concepts discussed in the context of the biochemistry and behavior of biological macromolecules. Emphasis on quantitative understanding of biochemical phenomena, with extensive problem solving as an instructive tool. Prerequisite: undergraduate physical chemistry and one year of calculus. Instructor: Oas and staff. 3 units. C-L: Biochemistry 291.

292. Advanced Biophysical Chemistry. Topics include X-ray crystallography, nuclear magnetic resonance, and molecular simulations; techniques (for example, Laue techniques for following enzyme reaction intermediates, NMR methods for measuring protein dynamics); applications (for example, NMR and protein folding, analysis of structure/function relationships in a particular protein or group of proteins). Prerequisite: Biochemistry 291 or Molecular Biophysics 291. Instructor: Hellinga and staff. 3 units.

293. Membrane Biophysics. Composition of biological membranes, structure/properties of membrane lipids and proteins (receptors, pores, channels, ion transport ATPases, membrane junctions), mechanical properties of membranes and bilayers, interaction of small molecules with membranes, ionic basis of membrane and action potentials, synaptic transmission. Instructor: McIntosh and staff. 3 units. C-L: Cell Biology 293.

345. Molecular Biophysics Seminar. Required of all MBP students. Instructor: Oas. 1 unit.

346. Molecular Biophysics Seminar. Required of all MBP students. Instructor: Oas. 1 unit.

The University Program in Molecular Cancer Biology (MOLCAN)

Professor Casey (pharmacology and cancer biology and biochemistry), *Director* (C133 LSRC); Associate Professor Shenolikar (pharmacology and cancer biology), *Director of Graduate Studies* (C303 LSRC); Professors Abraham (pharmacology and cancer biology), Bennett (cell biology), Blackshear (medicine and biochemistry), Caron (cell biology), Colvin (medicine), Dawson (immunology), Dewhirst (radiation oncology),

Kaufman (medicine), Keene (microbiology), Lefkowitz (medicine and biochemistry), Linney (microbiology and pharmacology), Modrich (biochemistry), Nevins (genetics), and Slotkin (pharmacology and cancer biology); Associate Professors Garcia-Blanco (genetics), Heitman (genetics), McDonnell (pharmacology and cancer biology), Pendergast (pharmacology and cancer biology), and Wang (pharmacology and cancer biology); Assistant Professors Counter (pharmacology and cancer biology), Futreal (experimental surgery), Kornbluth (pharmacology and cancer biology), Lew (pharmacology and cancer biology), Riggins (Pathology), Yao (pharmacology and cancer biology) and York (pharmacology and cancer biology)

The University Program in Molecular Cancer Biology facilitates graduate training in basic science aspects of cancer research. Specifically, program students receive training in areas of normal cell regulation including extracellular signals, receptor-mediated signal transduction, second messengers, protein kinases and phosphatases, transcriptional regulation and cell-cycle control. Aspects of cell-cell interaction and communication and the interaction of cells with the extracellular matrix are also examined. Finally, the program explores the consequences of oncogene activation and tumor-suppressor gene inactivation on such fundamental processes in tumor cells.

The Graduate Program in Molecular Cancer Biology is an interdisciplinary program. In consultation with the director of graduate studies, students in the program select courses in cell biology, molecular biology, immunology, cancer biology, pharmacology, and developmental biology. For descriptions of the individual courses see the listings under specified departments.

200. Cancer Biology. A comprehensive course in basic and clinical aspects of cancer biology. Topics include a historical review of cancer research, properties of cultured mammalian cells, cell transformation and tumorigenesis, oncogenes and tumor-suppressor genes, cell-cycle regulation, signal transduction, molecular carcinogenesis, cancer epidemiology, and basic science aspects of clinical oncology. This course is designed primarily for medical students and fellows. Instructor: Staff. 4 units.

210. Independent Study in Molecular Cancer Biology. Consent of instructor required. Instructor: Staff. 1 unit.

300. Special Topics in Cancer Biology. Instructor: Staff. 2 units.

301. Molecular Cancer Biology Seminar. Instructor: Staff. 1 unit.

350. Advances in Cancer Research. A presentation and discussion course in which program faculty and graduate students review the recent progress in areas of cancer research being investigated at Duke University. Provides an important avenue for evaluation and feedback for graduate student research and is required each year for all students pursuing their Ph. D. degree in molecular cancer biology. Instructor: Staff. 2 units.

417. Cellular Signaling. Mechanism of action of hormones at the cellular level including hormone-receptor interactions, secondary messenger systems for hormones, mechanisms of regulation of hormone responsiveness, regulation of growth, differentiation and proliferation, mechanisms of transport and ion channels, stimulus sensing and transduction. Some lectures stress the clinical correlation of the basic course concepts. Instructors: Caron, Casey, Means, and invited lecturers. 3 units. C-L: Biochemistry 417, Cell Biology 417, Pharmacology 417.

418. Molecular Mechanisms of Oncogenesis. Lectures, oral presentations, and discussions on advanced topics and recent advances in the molecular biology of cancer. Particular emphasis on strategies to exploit this information in the design of intervention strategies to selectively block the growth of cancer cells. Prerequisite: Cell Biology 417. Instructor: Wang and staff. 2 units. C-L: Pharmacology 418.

Music (MUSIC)

Professor Todd, *Chair* (105 Mary Duke Biddle Music Building); Professor Silbiger, *Director of Graduate Studies* (067 Mary Duke Biddle Music Building); Professors Jaffe and Williams; Associate Professors Bartlet, Gilliam, Lindroth, and Lyon; Assistant Professors Brothers, Leafstedt, Meintjes, and Moreno; Professor of the Practice Parkins

The Department of Music offers graduate programs leading to the A.M. and Ph.D. degrees in composition and musicology, and the A.M. in performance practice. Applicants for admission to all degree programs will normally have a broad liberal arts background as well as demonstrable musical competence. Those applying to the composition program should submit samples of their compositions with their applications; for the musicology program, applicants should include samples of their writing on musical topics. Upon acceptance to the university, by nomination of the graduate faculty in music, musicology students may also be admitted to the Program in Medieval and Renaissance Studies (see section on Medieval and Renaissance Studies in this bulletin). For the performance practice program, the department encourages applications from advanced musicians who have demonstrated an ability to conduct research about the performance of music in historical contexts. Applicants in performance practice should submit a recording of their work in the field as well as a sample of their writing.

For the Ph.D. degree in composition seventeen courses (51 units) are required; no more than four courses (16 units) may be accepted for transfer from another institution. Two courses should be taken in other departments. Students are expected to pass a qualifying examination (usually in the second year) and a preliminary examination (after completing course work, usually in the third year); before taking the preliminary examination they are asked to submit a portfolio of compositions. Students in composition must also demonstrate knowledge of one foreign language. The dissertation requirements consist of a large-scale composition and an article of publishable quality.

For the Ph.D. in musicology seventeen courses (51 units) are required; no more than four courses (16 units) may be accepted for transfer from another institution. Three courses should be taken in other departments. Students are expected to pass a qualifying examination (usually in the second year) and a preliminary examination (after completing course work, usually in the third year); in addition they must demonstrate knowledge of two foreign languages. Within the framework of the musicology degree students may also pursue projects in ethnomusicology, music theory, or performance practice.

For the A.M. in performance practice eleven courses (33 units) are required. Students are expected to pass a qualifying examination (usually in the second year) and to give a master's recital (usually toward the end of the first year). They also must demonstrate knowledge of one foreign language.

A more detailed description of each degree program is available upon request from the director of graduate studies.

201. Introduction to Musicology. Methods of research on music and its history, including studies of musical and literary sources, iconography, performance practice, ethnomusicology, and historical analysis, with special attention to the interrelationships of these approaches. Instructor: Bartlet or Druessedow. 3 units.

203. Proseminar in Performance Practice. Critical methods in the study of historical performance practice, including the evaluation of evidence provided by musical and theoretical sources, archival and iconographic materials, instruments, and sound recordings. Current issues regarding the performance practice for music from the Middle Ages to the twentieth century. Instructor: Silbiger. 3 units.

211. Notation. First part of a two-course sequence examining the development and changing function of musical notation from c. 900 to c. 1900, including plainchant nota-

tions, black notations, white notations, the invention of printing (particularly movable type and engraving), keyboard and lute tablatures, scores. Instructors: Brothers or Silbiger. 3 units. C-L: Medieval and Renaissance Studies 211.

212. Notation. Continuation of Music 211. Instructor: Brothers or Silbiger. 3 units. C-L: Medieval and Renaissance Studies 212.

213. Theories and Notation of Contemporary Music. The diverse languages of contemporary music and their roots in the early twentieth century, with emphasis on the problems and continuity of musical language. Recent composers and their stylistic progenitors: for example, Ligeti, Bartók, and Berg; Carter, Schoenberg, Ives, and Copland; Crumb, Messiaen, and Webern; Cage, Varèse, Cowell, and Stockhausen. Instructor: Jaffe or Lindroth. 3 units.

215. Music Analysis. Historical, philosophical, and ideological issues raised by music analysis. Intensive study of harmony and voice leading in the works of major tonal composers, with emphasis on the analytic approach of Heinrich Schenker. Instructor: Moreno or Todd. 3 units.

217. Selected Topics in Analysis. An exploration of analytical approaches appropriate to a diversity of music, which may include settings of literary texts, pre-tonal music, and music in oral and vernacular traditions. Prerequisite: Music 215 or consent of instructor. Instructor: Moreno or Silbiger. 3 units.

Courses dealing with selected topics in the period concerned, at a level between simple surveys and advanced seminars:

223. Music in the Renaissance. Selected topics. Instructor: Brothers or Silbiger. 3 units. C-L: Medieval and Renaissance Studies 223B.

224. Music in the Baroque Era. Selected topics. Instructor: Silbiger. 3 units. C-L: Medieval and Renaissance Studies 224.

225. Music in the Classic Era. Selected topics. Instructor: Bartlet or Todd. 3 units.

226. Music in the Nineteenth Century. Selected topics. Instructors: Bartlet, Gilliam, or Todd. 3 units.

227. Music in the Twentieth Century. Selected topics. Instructor: Gilliam or Todd. 3 units.

228. Collegium Musicum. First part of a two-course sequence providing an opportunity to study and perform vocal and instrumental music from the Middle Ages to the early romantic period. Weekly rehearsals and one or two concerts each semester. A written project required of all participants. Consent of instructor required for all except graduate students in music. Credit contingent upon successful completion of Music 229. Instructor: Staff. 1 and 1/2 units.

228A. Collegium Musicum. Same as 228, but no project required and no credit awarded. Instructor: Staff. 0 units.

229. Collegium Musicum. Continuation of, and required for credit for, Music 228. Consent of instructor required for all except graduate students in music. Instructor: Staff. 1 and 1/2 units.

229A. Collegium Musicum. Same as 229, but no project required and no credit awarded. Prerequisite: Music 228A. Instructor: Staff. 0 units.

295S. Composition Seminar. Selected topics in composition. Instructor: Jaffe or Lindroth. 3 units.

296S. Analysis of Contemporary Music. Structures, expressive intentions, and functions since 1914. Contemporary orchestral music, American music, European music, popular media, musical tradition, and contemporary composers. Analysis of works performed in the department's Encounters Series with occasional guest composers present. Instructor: Jaffe or Lindroth. 3 units.

297. Composition. Weekly independent study sessions at an advanced level with a member of the graduate faculty in composition. Instructor: Jaffe or Lindroth. 3 units.

298. Composition. Continuation of Music 297. Weekly independent study sessions at an advanced level with a member of the graduate faculty in composition. Instructor: Jaffe or Lindroth. 3 units.

299. Composition. Continuation of Music 298. Weekly independent study sessions at an advanced level with a member of the graduate faculty in composition. Instructor: Jaffe or Lindroth. 3 units.

317S. Seminar in the History of Music. Selected topics. Instructor: Staff. 3 units.

318S. Seminar in Performance Practice. A practical seminar in which participants will be expected to perform, to introduce the work to be played or sung, and to outline its interpretative problems. A list of the music concerned will be posted in advance, and all students will participate in the study (if not necessarily in the performance) of the works announced. It is expected that the seminar will cover most periods, from Gregorian chant to twentieth-century repertoires. Consent of instructor required. Instructor: Staff. 3 units.

331. Independent Study in Performance Practice and Interpretation. The exploration of significant interpretive and performance-practice issues as they affect a specific repertory. Weekly meetings with a member of the graduate faculty. Consent of instructor and director of graduate studies required. Instructor: Staff. 3 units.

332. Independent Study in Performance Practice and Interpretation. The exploration of significant interpretive and performance-practice issues as they affect a specific repertory. Weekly meetings with a member of the graduate faculty. Consent of instructor and director of graduate studies required. Instructor: Staff. 3 units.

333. Independent Study in Performance Practice and Interpretation. The exploration of significant interpretive and performance-practice issues as they affect a specific repertory. Weekly meetings with a member of the graduate faculty. Consent of instructor and director of graduate studies required. Instructor: Staff. 3 units.

382S. Music; Studies in Ethnomusicology. A theoretical and methodological exploration of ethnomusicological approaches to the study of music and related expressive forms. Topics vary. Instructor: Meintjes. 3 units. C-L: Cultural Anthropology 382S.

390. Independent Study. With the consent of a graduate faculty member and the approval of the director of graduate studies, the student will undertake a specialized research project of his/her own choosing. Instructor: Staff. 3 units.

397. Composition. Weekly independent studies at the doctoral level with a member of the graduate faculty in composition. Instructor: Jaffe or Lindroth. 3 units.

398. Composition. Weekly independent studies at the doctoral level with a member of the graduate faculty in composition. Instructor: Jaffe or Lindroth. 3 units.

399. Composition. Weekly independent studies at the doctoral level with a member of the graduate faculty in composition. Instructor: Jaffe or Lindroth. 3 units.

COURSES CURRENTLY UNSCHEDULED

218. Advanced Counterpoint

222. Music in the Middle Ages

236. Nineteenth-Century Piano Music

341S. History of Music Theory to Rameau

351S. Studies in Musical Iconography

361S. Musical Organology

Neurobiology (NEUROBIO)

Professor Purves, *Chair* (1011 Bryan Research Building); Professor Chikaraishi, *Director of Graduate Studies* (427G Bryan Research Building); Professors Abou-Donia, Augustine, Fitzpatrick, Flanagan, W. C. Hall, W. G. Hall, Katz, McCarthy, McClay, McNamara, Nadler, Simon, Slotkin, Staddon, Strittmatter, Turner, Tyrey, and Warner; Associate Professors Benveniste, Boustany, Cant, Corless, Haglund, Lewis, Lo, Madison, Nicolelis, Nowicki, Reinhart, Schmechel, Schwartz-Bloom, Skene, Vandongen, and Wong; Assistant Professors Ehlers, Feng, George, Jarvis, Mooney, and Platt; Associate Research Professor Matthew; Assistant Research Professor Voyvodic

At a time when many questions in biology have been eloquently answered, both scientists and the public correctly perceive that the brain remains, in fundamental ways, a profound mystery. During the last century tremendous advances have been made in understanding the structure, function, chemistry, and development of the brain. Nonetheless, broad and important questions about this complex organ remain to be answered in both biology and medicine. These include how genetic instructions are linked to brain development, the basis of learning and memory, the nature of consciousness, and the etiology and proper treatment of neurological diseases such as epilepsy and a variety of diseases.

The ways that neurobiologists approach these problems, while generally reductionist, are diverse. Preeminent are the techniques of molecular biology and molecular genetics, a host of sophisticated electrophysiological methods for detecting the activity of individual nerve cells or groups of nerve cells, and a wealth of anatomical methods for seeing the structure and connections of nerve cells. Novel and increasingly noninvasive means of imaging the nervous system—by nuclear magnetic resonance, detection of positron emission, or activity related magnetic fields—also hold great promise for better understanding the brain. Despite the power of these methods, progress in neurobiology—much as progress in any science—will depend on a few important insights arising from the imagination of neuroscientists who think deeply about these issues. The purpose of the graduate program in neurobiology is to enable talented students to think about the nervous system at this level.

Neurobiology at Duke is pursued in a variety of departments and settings, all of which are possible sites for students who wish to be trained in this field. Although much of this research is carried out in the Department of Neurobiology at Duke University Medical Center, several departments on the undergraduate campus also participate in this work. There are now forty-five faculty members associated with the graduate program in neurobiology at Duke, and a large and diverse body of students and other professionals engaged in neurobiological research.

Students in the graduate program in neurobiology take a core curriculum that covers the major subfields of contemporary neurobiology, but are generally free to pursue with the help of faculty advisors a course of study tailored to their needs, backgrounds, and individual interests. The core courses in the Department of Neurobiology are 315, Molecular Neurobiology; 317, Neuronal Signaling: Ion Channels and Synapses; 321, Systems Neurobiology; and 322, Developmental Neurobiology.

For additional information, please visit our web site at <http://www.neuro.duke.edu> or send an email to nbgrad@neuro.duke.edu.

202. Basic Neurobiology. A systematic introduction to the structure and function of the mammalian nervous system designed specifically for first-year medical students. Lectures, laboratory exercises, clinical presentations, and problem-solving conferences during the month of January. Instructor: Cant and staff. 4 units.

210. Individual Study. Directed reading and research in neurobiology. Consent of director of graduate studies required. Instructor: Staff. 3 to 9 units each.

280. Student Seminar. Preparation and presentation of seminars to students and

faculty on topics of broad interest in neurobiology. Required of all first- and second-year neurobiology students. Instructor: Augustine and Katz. 1 unit.

311. Advanced Topics in Neurobiology. Journal club format covering a variety of topics in neurobiology, for example, sensory transduction, neurobiology of disease. Focus on critical reading of the literature. Consent of instructor required. Instructor: Kauer and staff. 1 unit.

312. Advanced Topics in Neurobiology. Journal club format covering a variety of topics in neurobiology, for example, sensory transduction, neurobiology of disease. Focus on critical reading of the literature. Consent of instructor required. Instructor: Kauer and staff. 1 unit.

315. Molecular Neurobiology. (Graduate Core Course.) The macromolecules responsible for the specialized functions of neurons and glia. Topics stress the biochemical, molecular, cellular, and genetic processes involved in the development and function of the mammalian nervous system. Introductory biochemistry is recommended. Consent of instructors required. Fall. Instructors: Chikaraishi, Reinhart, and Skene. 3 units.

317. Neuronal Signaling: Ion Channels and Synapses. (Graduate Core Course.) Basic principles of neural electrical signaling. Areas of emphasis will include action potential generation, ion channel structure/function relationships, modulation of channel activity, neurotransmitter secretion, transmitter receptors, and mechanisms of synaptic plasticity. Consent of Instructors required. Fall. Instructor: Augustine, Kauer, Lo, and Reinhart. 3 units. C-L: Cell Biology 317.

321. Systems Neurobiology. (Graduate Core Course.) Structure and function of the mammalian sensory and motor systems. Consent of instructor required. Spring. Instructor: Cant, Fitzpatrick, Nicolelis, and Purves. 3 units.

322. Developmental Neurobiology. (Graduate Core Course.) The development of the nervous system covering both the history and present status of the major issues in this field. Consent of instructor required. Spring. Instructor: Katz, Lo, and Mooney. 3 units.

360. Neuropharmacology: From Molecules to Behavior. Seminar-lecture course emphasizing neurotransmitter mechanisms and the mechanisms of action of drugs used to modify nervous system function. Material will be drawn from recent literature. Consent of instructor required. Instructor: Fremeau. 3 units. C-L: Pharmacology 360.

364. Neurotoxicology. Adverse effects of drugs and toxicants on the central and peripheral nervous system; target sites and pathophysiological aspects of neurotoxicity; factors affecting neurotoxicity, screening and assessment of neurotoxicity in humans; experimental methodology for detection and screening of chemicals for neurotoxicity. Instructor: Abou-Donia and staff. 3 units. C-L: Pharmacology 364.

372. Research in Neurobiology. Guided independent study and research experience in neurobiology. Nature of topic to be decided by individual arrangement with faculty advisor. Prerequisite: consent of faculty advisor. Staff. 1-16 units.

COURSES CURRENTLY UNSCHEDULED

219. Molecular and Cellular Bases of Differentiation

Center for Nonlinear and Complex Systems (NCS)

Professor Behringer (physics), *Director*; Professors Beale (mathematics), Dowell (mechanical engineering), Haff (earth and ocean sciences), Nijhout (biology), Palmer (physics), Schaeffer (mathematics), Trangenstein (mathematics), and Venakides; Associate Professors Bertozzi (mathematics), Greenside (physics), Layton (mathematics), Lewis (neurobiology), Teitworth (physics), and Virgin (mechanical engineering); Assistant Professors Gauthier (physics), Howle (mechanical engineering), Katul (envi-

ronment), Krassowska (biomedical engineering), Krystal (medicine), Lozier (environment), McShea (biology), Socolar (physics), Wang (electrical and computer engineering), and Wilson (biology)

The Center for Nonlinear and Complex Systems (CNCS) at Duke University is a well-established interdisciplinary program that links researchers in diverse scientific, mathematical, engineering and medical fields who have a common interest in all aspects of nonlinear dynamical phenomena. The activities of the CNCS include graduate and undergraduate training, and the fostering of interdisciplinary research. The center offers a certificate program for graduate students, provides a range of relevant courses, supports a regular seminar series and organizes scientific meetings. It helps foster links among researchers and students at Duke as well as on national and world scales.

The CNCS graduate certificate program was created to respond to the need for a broad, interdisciplinary, and transferrable set of skills. Certain basic concepts and techniques relevant to dynamical systems are now widely used in a many different disciplines. This program is intended to guide students toward this broad view by requiring the completion of a survey course, participation in seminars, and course work.

The CNCS was officially established in the early '90s for the purpose of bringing together faculty at Duke whose research relies on the rapidly developing fields of nonlinear dynamics and complex systems. Anyone in the Duke community with interests in nonlinear dynamics and/or complex systems may choose to be affiliated with the CNCS. At present, members of the center include faculty, post-docs and students from the Departments of Biology, Biomedical Engineering, Cell Biology, Computer Science, Electrical Engineering, Earth and Ocean Sciences, Mathematics, Mechanical Engineering and Material Science, Physics, Neurobiology, Psychiatry.

Requirements for a certificate in the Program in Nonlinear and Complex Systems
To obtain a certificate, a student must:

- Complete the overview course Topics in Nonlinear and Complex Systems—this includes a requirement that students attend the CNCS seminars. More broadly, students are expected to attend the CNCS seminars regularly during the period of their thesis work.
- Complete at least four courses from an approved list—the current version follows.
- Complete a thesis on a topic within the domain covered by the CNCS, with at least two faculty from the center on the thesis committee.

201. Survey of Nonlinear and Complex Systems. Survey lectures by Duke experts active in CNCS research; regular attendance in the CNCS seminar series; and a weekly meeting to discuss the lectures and seminars. May be repeated once. Prerequisite: Physics 213. Instructor: Behringer and Greenside. 2 units. C-L: Physics 201.

Approved Courses for the Graduate Certificate Program in Nonlinear and Complex Systems

Biology

268. Ecological Theory and Data
291. Mathematical Biology
292. Population Ecology
293. Simulating Ecological and Evolutionary Systems
303. Principles of Ecological Modeling
304. Plant Growth Modeling

Biomedical Engineering

201. Electrophysiology
204. Measurement and Control of Cardiac Electrical Events
207. Transport Phenomena in Biological Systems
212. Theoretical Electrocardiology

- 213. Nonlinear Dynamics in Electrophysiology
- 216. Transport Phenomena in Cells and Organs
- 229. Tissue Mechanics
- 231. Intermediate Biomechanics
- 239. Cell Transport Mechanisms
- 244. Mathematical Models of Physiological Systems
- 246. Computational Methods in Biomedical Engineering
- 250. Cardiovascular Mechanics
- 331. Viscoelasticity

Civil Engineering

- 201. Advanced Mechanics of Solids
- 303. Plasticity
- 207. Transport Phenomena in Biological Systems
- 210. Intermediate Dynamics
- 225. Dynamic Engineering Hydrology
- 237. Advanced Soil Mechanics
- 245. Pollutant Transport Systems
- 252. Buckling of Engineering Structures
- 255. Nonlinear Finite Element Analysis
- 263. Multivariable Control
- 283. Structural Dynamics

Computer Science

- 240. Computational Complexity
- 250. Numerical Analysis
- 252. Numerical Methods for Partial Differential Equations
- 264. Nonlinear Dynamics
- 270. Artificial Intelligence
- 271. Numerical Artificial Intelligence
- 350. Topics in Numerical Mathematics
- 364. Advanced Topics in Nonlinear and Complex Systems

Earth and Ocean Sciences

- 203. Physical Oceanography
- 207. Analysis of Coastal Engineering Models
- 221. Hydrogeology
- 222. New Perspectives and Methods in the Earth Sciences
- 223. Computational Methods in Hydrologic Sciences
- 230. Advanced Structural Geology
- 250. Applied Mathematics for the Environmental and Earth Sciences
- 252. Geophysics and Crustal Dynamics

Electrical Engineering

- 241. Linear Systems: Theory and Control
- 243. Pattern Classification and Recognition
- 255. Mathematical Modeling for Systems Analysis I
- 258. Artificial Neural Networks
- 263. Multivariable Control
- 281. Random Signals and Noise
- 282. Digital Signal Processing
- 285. Signal Detection and Extraction Theory
- 288. Image and Array Signal Processing
- 289. Adaptive Filters
- 299. Nonlinear Control Systems (Advanced Topics)

Mathematics

- 216. Applied Stochastic Processes
- 221, 222. Numerical Analysis
- 224. Scientific Computing I
- 225. Scientific Computing II
- 226. Topics in Numerical Analysis
- 228. Mathematical Fluid Dynamics
- 231. Ordinary Differential Equations
- 232. Partial Differential Equations I

- 233. Asymptotic and Perturbation Methods
- 239. Mathematical Modeling
- 281,282. Partial Differential Equations II, III

Mechanical Engineering and Materials Science

- 202. Engineering Thermodynamics
- 207. Transport Phenomena in Biological Systems
- 209. Soft Wet Materials and Interfaces
- 210. Intermediate Dynamics
- 216. Mechanical Metallurgy
- 217. Fracture of Engineering Materials
- 221. Compressible Fluid Flow
- 225. Mechanics of Viscous Fluids
- 226. Intermediate Fluid Mechanics
- 227. Advanced Fluid Mechanics
- 229. Computational Fluid Dynamics and Heat Transfer
- 230. Modern Control and Dynamical Systems
- 231. Adaptive Structures
- 232. Optimal Control
- 235. Advanced Mechanical Vibrations
- 237. Aerodynamics
- 238. Advanced Aerodynamics
- 239. Unsteady Aerodynamics
- 252. Buckling of Engineering Structures
- 280. Convective Heat Transfer
- 290. Physical Oceanography
- 325. Aeroelasticity
- 331. Nonlinear Control Systems
- 335. Nonlinear Mechanical Vibration

Physics

- 213. Introductory Nonlinear Dynamics
- 230. Mathematical Methods in Physics
- 271. Quantum Optics
- 281. Classical Mechanics
- 303. Statistical Mechanics
- 304. Advanced Topics in Statistical Mechanics
- 313. Advanced Nonlinear Dynamics
- 318. Fundamentals of Electromagnetism
- 319. Advanced Electrodynamics

School of the Environment

- 216. Applied Population Ecology
- 290. Physical Oceanography
- 356. Environmental Fluid Mechanics

Pathology (PATHOL)

Professor Pizzo, *Chair* (301B Davison); Associate Professor Abraham, *Director of Graduate Studies* (255 Jones); Professors D. Bigner, S. Bigner, Klintworth, Proia, Reimer, and Shelburne; Associate Professors Greenberg, Hoffman, Kane and Telen; Assistant Professors Dewhirst, Friedman, Hale, Jirtle, Kraus, Kurtzberg, Lewis, Marks, Riggins, and Zalutsky; Associate Research Professor Wikstrand

The Ph.D. program in the Department of Pathology is designed to train students for research and teaching careers in molecular medicine. Coursework aims to provide a clear understanding of disease processes, while focusing on modern molecular approaches to understanding and treating human disease. Research in the department covers the broad areas of inflammation, tumor biology, and vascular biology in a multidisciplinary fashion, involving both basic scientists and clinician researchers. Further information can be obtained from the director of graduate studies or from the departmental web site at <http://pathology.mc.duke.edu>.

225. Introduction to Systemic Histology. Organ system approach to microscopic identification of a variety of cell types and tissues in histologic sections. Emphasis on the histology of normal organs. Microscope required; rental microscopes available. First half of spring semester. Consent of instructor required. Instructors: Hale and staff. 2 units.

250. General Pathology. This is the medical school core course in pathology. Lectures deal with broad concepts of disease and underlying molecular mechanisms. Consent of instructor required. Instructor: Staff. 4 units.

251. Laboratory Course in General Pathology. Fundamentals of pathology are presented by correlating gross and microscopic material to illustrate the structural changes in disease. Laboratories are broken into small groups of students and are held under the guidance of staff pathologists. Instructor: Staff. 2 units.

258. Cellular and Subcellular Pathology. The course consists of lectures and seminars on the alterations of cellular structure and associated functions that accompany cell injury. Instructors: Shelburne and staff. 2 units.

275. Fundamentals of Electron Microscopy and Biological Microanalysis. Emphasis will be placed on preparative procedures including freezing techniques and on the application of electron microscopy to ultrastructural pathology. Scanning electron microscopy, X-ray microanalysis, and scanning ion microscopy will be discussed in addition to conventional transmission electron microscopy. Limited laboratory experience included. Consent of instructor required. Instructors: Ingram, Lefurgey, Roggli, and Shelburne. 3 units.

325. Cardiovascular Pathology. Study of cardiovascular disease processes, reviewing anatomic, embryologic, and physiologic features, and utilizing case material and gross specimens. Consideration of principles of electrocardiography. Consent of instructor required. Instructors: Reimer and staff. 3 units.

353. Advanced Neuropathology. Current problems and research methods related to diseases which affect the nervous system. Consent of instructor required. Instructor: Staff. 3 units.

355. Graduate Seminar in Pathology. Discussions outlining the scope of modern pathology. This will include reports of original research by members of staff and visitors. Instructor: Abraham. 1 unit.

357. Research in Pathology. Independent research projects in various fields of pathology. Hours and credit to be arranged. Instructor: Graduate faculty. Variable credit.

361. Autopsy Pathology. A detailed consideration of the morphologic, physiologic, and biochemical manifestations of disease. Includes gross dissection, histologic examinations, processing, analyzing of all autopsy findings under tutorial supervision. Instructors: Lewis and staff. 3 to 6 units. Variable credit.

362. Autopsy Pathology. A detailed consideration of the morphologic, physiologic, and biochemical manifestations of disease. Includes gross dissection, histologic examinations, processing, analyzing of all autopsy findings under tutorial supervision. 6 credits each course. Instructors: Lewis and staff. 3 to 6 units. Variable credit.

364. Systemic Pathology. This is the medical school and graduate course in the detailed pathology of major organ systems. The course consists of lectures and seminars presenting the latest scientific concepts of disease. Instructors: Bradford and staff. 6 units.

367. Special Topics in Pathology. Special problems in pathology will be studied with a member of the senior staff; the subject matter will be individually arranged. Consent of instructor required. Hours and credit to be arranged. Instructors: Pizzo and staff. 1 to 4 units. Variable credit.

369. Ophthalmic Pathology. Lectures, seminars, and laboratory sessions. Review of the normal anatomy and embryology of the eye as a basis for the study of the various ocular disease processes. The more common diseases of the eye will be considered in detail. Problems in ophthalmic pathology discussed together with methods of solving them. Instructor: Klintworth. 3 units.

370. Developmental Pathology and Teratology. A systematic study of disease processes involving the prenatal, natal, and postnatal period. Emphasis on developmental anatomy and teratogenesis. The format includes seminars and clinicopathologic correlations derived from gross and microscopic material. Prerequisites: Pathology 250 and anatomy and histology. Instructor: Bradford. 3 units.

374. Pulmonary Pathology and Postmortem Pathophysiology. Emphasis will be on pulmonary pathology and pathophysiology of infectious, metabolic, environmental, and neoplastic diseases, and certain diseases of unknown etiology (e. g., sarcoid, alveolar proteinosis). Ventilatory experiments will be done on excised human lungs. Instructors: Roggli and staff. 3 units.

377. Pathology of the Kidney. A comprehensive study of pathological, immunological, and clinical features of the glomerulonephritis, and pyelonephritis, as well as of metabolic, congenital, and neoplastic renal disorders. Lectures will be supplemented with gross and microscopic specimens, demonstrations, and special library studies. Instructor: Howell. 3 units.

380. Diagnostic Immunology. Diagnostic and laboratory procedures used in evaluating immunologic diseases: especially autoimmune, infectious, immunodeficiency, immunoproliferative, and hypersensitivity disorders. Emphasis on the theoretical and practical aspects of testing procedures and their proper interpretation. Consent of instructor required. Instructors: R. Buckley, Howell, and Zwadyk. 2 units.

382. General Pathology for Toxicologists. General principles of pathology using examples from human and experimental toxicological disease. Prerequisites: courses in biochemistry, physiology, and histology (histology may be taken concurrently). Instructor: Staff. 3 units.

385. Molecular Aspects of Disease. Background, investigative methods, and recent advances in understanding the molecular basis of selected diseases. In-depth focus on selected diseases whose defects are known at genetic or molecular levels. Prerequisites: introductory cell biology and biochemistry courses. Instructors: Hale and staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

219. Molecular and Cellular Bases of Differentiation

360. Cytochemistry

381. Cancer Biology

Pharmacology (PHARM)

Professor Means, *Chair* (C238 LSRC); Professor Abraham, *Director of Graduate Studies* (C333B LSRC); Professors Abou-Donia, Casey, Colvin, Ellinwood, Kuhn, McDonnell, McNamara, Mills, Nadler, Schanberg, Slotkin and Stiles; Associate Professors Hellinga, Heitman, Levin, Pendergast, Schwartz-Bloom, Schwinn, Shenolikar, VanDongen, Wang, and Whorton; Assistant Professors Collins, Counter, Kornbluth, Kwatra, Lew, Yao, and York; Professors Emeriti Kirshner, Lack, Ottolenghi, and Wilder; Medical Research Professor Wilson

Pharmacology offers a graduate program which leads to the Ph.D. degree. Training is available in the following specific areas of pharmacology: neuropharmacology; toxicology; developmental, cardiovascular, behavioral, and endocrine pharmacology; regulation of cell growth and differentiation (cancer pharmacology); cellular signaling and receptor structure and function. Because pharmacology is an interdisciplinary

science, the department considers applicants with strong undergraduate backgrounds in biological, chemical, and neural sciences. There is no foreign language requirement, and students normally complete all required coursework, including laboratory rotations, in the first year so they can move quickly into sustained independent research.

For Seniors and Graduates

200. Medical Pharmacology. This basic course in pharmacology for medical and graduate students describes the action of drugs in relation to biochemical and physiological processes and the rationale for their clinical use. Additional topics include pharmacokinetics, drugs of abuse, and commonly encountered toxins. Nine lectures and one small-group, case-based discussion per week for eight weeks, April-June. Instructors: Nadler and staff. 4 units.

210. Individual Study and Research. Directed reading and research in pharmacology. Consent of director of graduate studies required. Instructor: Staff. 3 to 9 units each.

211. Individual Study and Research. Directed reading and research in pharmacology. Consent of director of graduate studies required. 3 to 9 units each. Instructor: Staff. 3 to 9 units. Variable credit.

233. Essentials of Pharmacology and Toxicology. Drug absorption, distribution, excretion, and metabolism. Structure and activity relationships; drug and hormone receptors and target cell responses. Consent of instructor required. Prerequisite: introductory biology; Chemistry 151L; Mathematics 31 and 32. Instructor: Slotkin and staff. 4 units.

233A. Essentials of Pharmacology for Biologists. Drug disposition, drug metabolism, drug receptor interactions. Prerequisite: introductory biology, Chemistry 151L; Mathematics 31 and 32. Instructor: Slotkin. 2 units.

234. Interdisciplinary Approach to Pharmacology. Several model systems (cardiovascular, reproductive, neural, and cell cycle) will be used to explore the molecular, biochemical, and physiologic basis of drug action. Instructor: Whorton and staff. 4 units.

254. Mammalian Toxicology. Principles of toxicology as related to humans. Emphasis on the molecular basis for toxicity of chemical and physical agents. Subjects include metabolism and oxikinetis, toxicologic evaluation, toxic agents, target organs, toxic effects, environmental toxicity, management of poisoning, epidemiology, risk assessment, and regulatory toxicology. Prerequisite: introductory biology, and Chemistry 151L, or consent of instructor. Instructor: Abou-Donia and staff. 4 units.

280. Student Seminar in Pharmacology. Preparation and presentation of seminars to students and faculty on topics of broad interest to pharmacology. Required of all pharmacology graduate students. Instructor: Whorton. 2 units.

For Graduates

314. Integrated Case Studies in Toxicology. 1 unit. C-L: Environment 314.

315. Focused Topics in Toxicology. 1 unit. C-L: Environment 315.

331. Laboratory Methods in Pharmacology. Tutorial laboratory training in various fields of pharmacology including neuropharmacology, cardiovascular pharmacology, biochemical pharmacology, and biophysical pharmacology. Consent of instructor required. Instructor: Staff. 3 to 6 units.

333. Statistics for Basic Biomedical Scientists. The use and importance of statistical methods in laboratory science, with an emphasis on the nuts and bolts of experimental design, hypothesis testing, and statistical inference. Central tendency and dispersion, Gaussian and non-Gaussian distributions, parametric and nonparametric tests, uni- and multivariate designs, ANOVA and regression procedures. Student presentations in addition to formal lectures. Instructor: Slotkin. 2 units.

347. Seminar in Toxicology. A weekly research seminar throughout the year is required of participants in the Toxicology Program. Students, faculty, and invited speakers present their findings. Instructor: Levin. 1 unit.

348. Seminar in Toxicology. A weekly research seminar throughout the year is required of participants in the Toxicology Program. Students, faculty, and invited speakers present their findings. Instructor: Levin. 1 unit.

360. Neuropharmacology: From Molecules to Behavior. Seminar-lecture course emphasizing neurotransmitter mechanisms and the mechanisms of action of drugs used to modify nervous system function. Material will be drawn from recent literature. Consent of instructor required. Instructor: Fremeau. 3 units. C-L: Neurobiology 360.

364. Neurotoxicology. Adverse effects of drugs and toxicants on the central and peripheral nervous system; target sites and pathophysiological aspects of neurotoxicity; factors affecting neurotoxicity, screening and assessment of neurotoxicity in humans; experimental methodology for detection and screening of chemicals for neurotoxicity. Instructor: Abou-Donia and staff. 3 units. C-L: Neurobiology 364.

372. Research in Pharmacology. Laboratory investigation in various areas of pharmacology. Credit to be arranged. Instructor: Staff. 1 to 4 units. Variable credit.

417. Cellular Signaling. Mechanism of action of hormones at the cellular level including hormone-receptor interactions, secondary messenger systems for hormones, mechanisms of regulation of hormone responsiveness, regulation of growth, differentiation and proliferation, mechanisms of transport and ion channels, stimulus sensing and transduction. Some lectures stress the clinical correlation of the basic course concepts. Instructor: Caron, Casey, Means, and invited lecturers. 3 units. C-L: Biochemistry 417, Cell Biology 417, Molecular Cancer Biology 417.

418. Molecular Mechanisms of Oncogenesis. Lectures, oral presentations, and discussions on advanced topics and recent advances in the molecular biology of cancer. Particular emphasis on strategies to exploit this information in the design of intervention strategies to selectively block the growth of cancer cells. Prerequisite: Cell Biology 417. Instructor: Wang and staff. 2 units. C-L: Molecular Cancer Biology 418.

423. Neurobiological Basis of Behavior. Survey of neuroanatomical, neurophysiological, neurochemical, and neuropharmacological evidence of central nervous system function as it relates to normal and abnormal behavior. Clinical description, measurement of function, as well as the biological substrates of affective disorders and psychoses will be emphasized. Scientific bases of current therapeutic procedures, especially psychopharmacological, will be examined. Prerequisite: familiarity with basic neuroanatomy, neurophysiology, and neuropharmacology is assumed. Instructors: Ellinwood and staff. 4 units.

COURSES CURRENTLY UNSCHEDULED

219. Tutorial in Pharmacology

Philosophy (PHIL)

Professor Brandon, *Chair* (201 West Duke); Professor Flanagan, *Director of Graduate Studies*; Professors Gillispie (political science), Golding, Mahoney, and Sanford; Associate Professors Ferejohn, Schmaltz, Stone (law), Sugarman (medicine); Assistant Professors Güzeldere; Visiting Professor Wiredu; Associate Professor of the Practice Kiss (political science); Adjunct Associate Professor Ward; Professors Emeriti Peach and Welsh; Senior Research Scholar Dretske

The Department of Philosophy offers graduate work leading to the A.M. and Ph.D. degrees. Tutorial work complements formal instruction. Students may, after taking a balanced program, specialize in any of the following fields: the history of philosophy, logic, philosophy of science, epistemology, metaphysics, philosophy of mind,

philosophical analysis, ethics, aesthetics, political philosophy, philosophy of law, philosophy of medicine, and philosophy of religion.

Individual programs of study are developed for each student. Prior to being admitted to candidacy for the Ph.D. degree, the student must successfully complete seventeen courses distributed among five subject areas and pass a qualifying exam in the history of philosophy and a preliminary examination in the special area of dissertation research. In satisfying these requirements, students are expected to demonstrate both factual knowledge and critical understanding. Work in a minor or related field, not necessarily confined to any one department, is encouraged but not required. A minor normally includes 6 units for the A.M. or the Ph.D. degree and may include more as a student's program requires or permits.

A reading knowledge of at least one foreign language, ancient or modern, is required for the Ph.D. degree. More than one language may be required where this is judged appropriate to the research demanded by the candidate's dissertation.

The Philosophy Department considers for financial aid only students seeking the Ph.D. degree. Almost all philosophy graduate students at Duke are either in the Ph.D. program or in a joint-degree program, such as the J.D./M.A. program. In exceptional cases, the department may admit someone to a master's program. A terminal degree of Master of Arts may also be earned by a Ph.D. student who decides not to continue with doctoral studies and who meets the requirements of the Graduate School for the A.M. Such a student must pass an oral master's examination, which may be the defense of a master's thesis or an alternative academic exercise approved by the department. In addition, a J.D./M.A. degree is offered by the department in cooperation with the Duke Law School. J.D./M.A. students must apply for admission to the Law School, and they must combine relevant course work in philosophy with full-time work toward a law degree.

For further information about the Ph.D. or master's program in philosophy, please write to: Graduate Program, Department of Philosophy, Box 90743, 201 West Duke Building, Duke University, Durham, North Carolina 27708, or contact our web site at <http://www.duke.edu/philosophy/>. To inquire about the J.D./M.A. program, applicants should contact the Law School directly, at the following address: Associate Dean of Student Affairs, Duke Law School, Box 90376, Duke University, Durham, North Carolina 27708.

For Seniors and Graduates

203S. Contemporary Ethical Theories. The nature and justification of basic ethical concepts in the light of the chief ethical theories of twentieth-century British and American philosophers. Consent of instructor required. Instructor: Flanagan or Golding. 3 units. C-L: Political Science 289S, Women's Studies.

206S. Responsibility. The relationship between responsibility in the law and moral blameworthiness; excuses and defenses; the roles of such concepts as act, intention, motive, ignorance, and causation. Instructor: Golding. 3 units.

208S. Political Values. Analysis of the systematic justification of political principles and the political values in the administration of law. Instructor: Golding. 3 units.

211S. Plato. 3 units. C-L: Classical Studies 211S.

217S. Aristotle. 3 units. C-L: Classical Studies 217S.

218S. Medieval Philosophy. Study of Augustine against background of late ancient Roman philosophy, and Thomas Aquinas and others against background of medieval Muslim philosophy, in particular Avicenna and Averroes, and Neoplatonism. Instructor: Mahoney. 3 units. C-L: Medieval and Renaissance Studies 218S.

219S. Late Medieval and Renaissance Philosophy. Readings in Scotus, Ockham, and others. Discussions regarding the critical turn in fourteenth-century philosophy,

rival theories of knowledge, the 'Great Chain of Being'. Instructor: Mahoney. 3 units. C-L: Medieval and Renaissance Studies 219S.

220. The Presocratic Philosophers. Instructor: 3 units. C-L: Greek 220.

225S. British Empiricism. A critical study of the writings of Locke, Berkeley, or Hume with special emphasis on problems in the theory of knowledge. Instructor: Schmaltz. 3 units.

227S. Continental Rationalism. A critical study of the writings of Descartes, Spinoza, or Leibniz with special emphasis on problems in the theory of knowledge and metaphysics. Instructor: Schmaltz. 3 units.

228S. Recent and Contemporary Philosophy. A critical study of some contemporary movements, with special emphasis on analytic philosophers. Instructor: Staff. 3 units.

231S. Kant's *Critique of Pure Reason*. Instructor: Staff. 3 units.

232S. Recent Continental Philosophy. Selected topics. Instructor: Staff. 3 units.

233S. Methodology of the Empirical Sciences. Recent philosophical discussion of the concept of a scientific explanation, the nature of laws, theory and observation, probability and induction, and other topics. Consent of instructor required. Instructor: Brandon. 3 units.

234S. Problems in the Philosophy of Biology. Selected topics, with emphasis on evolutionary biology: the structure of evolutionary theory, adaptation, teleological or teleonomic explanations in biology, reductionism and organicism, the units of selection, and sociobiology. Consent of instructor required. Instructor: Brandon. 3 units. C-L: Biology 234S.

237S. Nietzsche's Political Philosophy (C-N). 3 units. C-L: Political Science 226S, German 276S.

240S. Philosophical Psychology. A study of recent work on the nature of the self and the nature and function of consciousness. Work from philosophy, psychology, cognitive neuroscience, and evolutionary biology will be discussed. Instructor: Flanagan or Güzeldere. 3 units.

251S. Epistemology. Selected topics in the theory of knowledge; for example, conditions of knowledge, skepticism and certainty, perception, memory, knowledge of other minds, and knowledge of necessary truths. Instructor: Sanford. 3 units.

252S. Metaphysics. Selected topics: substance, qualities and universals, identity, space, time, causation, and determinism. Instructor: Sanford. 3 units.

253S. Philosophy of Mind. Analysis of concepts such as thought and belief; issues such as mind-body relations, thought and action, the nature of persons and personal identity. Instructor: Flanagan, Güzeldere, or Sanford. 3 units.

255S. Topics in Philosophy of Mind. One or more topics such as mental causation, animal minds, artificial intelligence, and foundations of cognitive science. Includes relevant literature from fields outside philosophy (for example, psychology, neuroscience, ethology, computer science, cognitive science). Instructor: Güzeldere. 3 units.

273S. Heidegger. 3 units. C-L: Political Science 273S.

289S. Environmental Ethics. 3 units. C-L: Environment 282S.

291S. Special Fields of Philosophy. Instructor: Staff. 3 units.

292S. Special Fields of Philosophy. Instructor: Staff. 3 units.

For Graduates

300. Problems in the Theory of Value and Judgment. An advanced seminar dealing with classic problems relating to the concept of value and evaluative behavior (e. g., standards, judgments, canon-formation, taste), as illuminated by contemporary work in

critical theory, anthropology, economics, sociology, etc. Instructor: B. H. Smith. 3 units. C-L: English 386, Literature 300.

311. Philosophy and Medicine. The scope of medicine as a philosophical problem, the concept of health, and investigation of ethical issues arising in medical contexts. Consent of instructor required. Instructor: Golding. 3 units.

COURSES CURRENTLY UNSCHEDULED

202S. Aesthetics: The Philosophy of Art

204S. Philosophy of Law

205S. Philosophy of History

210. Logic for Computer Science

235S. Nineteenth-Century German Philosophy

236S. Hegel's Political Philosophy

250S. Topics in Formal Philosophy

254S. Topics in Philosophy of Religion

331. Seminar in Special Fields of Philosophy

332. Seminar in Special Fields of Philosophy

Physics (PHYSICS)

Professor Behringer, *Chair* (108 Physics); Professor Weller, *Director of Graduate Studies*; Professors Baranger, Edwards, Evans, Han, Mueller, Palmer, Thomas, Tornow, and Walter; Associate Professors Gauthier, Greenside, Howell, Litvinenko, Oh, Socolar, Springer, and Teitsworth; Assistant Professors Chandrasekharan, DeBraekeleer, Kotwal, Matveev, and Plesser; Professors Emeriti Bilpuch, Fairbank, Lewis, Meyer, Roberson, Robinson, and Walker; Associate Research Professor Phillips; Adjunct Professors Ciftan, Everitt, Guenther, Rogosa, Stroschio, and Skatrud; Visiting Professor Matinyan; Visiting Assistant Professor Brown; Senior Lecturing Fellows Johnson, McNairy, and Putnam

The Department of Physics offers graduate work for students wishing to earn the A.M., M.S., or Ph.D. degree. In addition to a balanced program of basic graduate courses, the department offers specialized courses and seminars in several fields in which research is being done by faculty and staff. With the help of faculty advisors, students select a course program to fit their individual backgrounds and goals, often including work in a related field. Students are encouraged to begin research work early in their careers, normally not later than the end of the second year of study, when most students complete their formal coursework. Active areas of research include experimental studies in condensed matter, high energy, nuclear and photon-laser physics, as well as theoretical work in condensed matter and nuclear and particle physics. In addition, the Physics Department is a major part of the university-wide Center for Nonlinear and Complex Systems.

For Seniors and Graduates

185. Modern Optics I. Optical processes including the propagation of light, coherence, interference, and diffraction. Consideration of the optical properties of solids with applications of these concepts to lasers and modern optical devices. Lecture and laboratory projects. Instructor: Guenther. 2 units.

201. Survey of Nonlinear and Complex Systems. 3 units. C-L: Nonlinear and Complex Systems 201.

205. Introduction to Nuclear Physics. Phenomenological aspects of nuclear physics, interaction of gamma radiation and charged particles with matter, nuclear detectors, particle accelerators, radioactivity, basic properties of nuclei, nuclear systematics, direct

and resonance reactions, photonuclear reactions, description of the strong N-N force, nuclear models, the Standard Model, symmetries. Instructor: Weller. 3 units.

211. Fundamentals of Quantum Mechanics. Experimental foundation, wave-particle duality, the Schroedinger equation and the meaning of the wave function, analytical and numerical solution of one-dimensional problems, formulation in terms of states and operators, angular momentum and spin, applications to the harmonic oscillator and hydrogen atom. Prerequisite: Mathematics 111 and Physics 143L. Instructor: Greenside, Springer, or Plesser. 3 units.

212. Applications of Quantum Mechanics. Further development of quantum mechanics with applications. Topics include: perturbation methods (time-independent and time-dependent), path integrals, scattering theory, local density theory, elements of relativistic quantum mechanics, and miscellaneous examples drawn from atomic, condensed matter, particle, and nuclear physics. Prerequisite: Physics 211. Instructor: Greenside, Springer, or Plesser. 3 units.

213. Nonlinear Dynamics. Introduction to the study of temporal patterns in non-equilibrium systems. Theoretical, computational, and experimental insights used to explain phase space, bifurcations, stability theory, universality, attractors, fractals, chaos, and time-series analysis. Each student carries out an individual research project on a topic in nonlinear dynamics and gives a formal presentation of the results. Prerequisite: Computer Science 6, Mathematics 111, and Physics 51L, 52L. Instructor: Behringer or Greenside. 3 units. C-L: Computer Science 264.

217S. Advanced Physics Laboratory and Seminar. Experiments involving the fields of electricity, magnetism, heat, optics, and modern physics. Written and oral presentations of results. Instructor: Teitsworth. 3 units.

220. Electronics. Basic elements of modern electronics including AC circuits, transfer functions, solid-state circuits, transistor circuits, operational amplifier applications, digital circuits, and computer interfaces. Instructor: Staff. 3 units.

222S. General Relativity. Review of special relativity; ideas of general relativity; mathematics of curved space-time; formation of a geometric theory of gravity; Einstein field equation applied to problems such as the cosmological red-shift and blackholes. Prerequisite: Physics 181 and Mathematics 111 or equivalents. Instructor: Staff. 3 units.

230. Mathematical Methods in Physics. Includes topics in complex analysis, residue calculus, infinite series, integration, special functions, Fourier series and transforms, delta functions, and ordinary differential equations; and use of MATHEMATICA for graphical, symbolic, and numerical computation. Prerequisite: Mathematics 111. Instructor: Palmer. 3 units.

271. Quantum Optics. The linear and nonlinear interaction of electromagnetic radiation and matter. Topics include simple theory of lasers, second-harmonic generation, photon echoes, bistability, Raman scattering, Brillouin scattering, phase conjugation, two-photon lasers, and cooling and trapping of atoms. Prerequisite: Physics 212 and 231. Instructor: Thomas. 3 units.

281. Classical Mechanics. Newtonian, Lagrangian, and Hamiltonian methods for classical systems; symmetry and conservation laws; rigid body motion; normal modes and forced oscillations; small nonlinear oscillations; canonical transformations; Hamiltonian chaos. Instructor: Kotwal. 3 units.

291S. Physics at the Cutting Edge. Introduction, for graduates and advanced undergraduates, to several research topics at the core of recent advances in physics. Reading and analysis of primary literature and instruction in writing research papers. Prerequisite: Physics 181, 182, and 211, or equivalents. Instructor: Baranger. 3 units.

For Graduates

303. Introduction to Statistical Mechanics. Fundamentals of kinetic theory, thermodynamics, and statistical mechanics with applications to physics and chemistry. Prerequisite: Physics 215. Instructor: Staff. 3 units.

304. Advanced Topics in Statistical Mechanics. * This course will vary from year to year. Possible topics include Fermi liquids, systems of bosons, many-body theory, non-equilibrium statistical mechanics. Prerequisite: Physics 303 and 316. Instructor: Palmer. 3 units.

307. Introduction to Condensed Matter Physics. Microscopic structure of solids, liquids, liquid crystals, polymers, and spin systems; elastic scattering and long-range order; topological defects; electronic structure of crystals (metals and semiconductors); phonons and inelastic scattering; magnetism; superconductivity. Prerequisite: Physics 215, 231, 303. Instructor: Staff. 3 units.

308. Introduction to High-Energy Physics. An overview of elementary particles and forces studied by experiments carried out at the frontier of high-energy physics. Discussion of basic symmetry principles and conservation laws of nature and review of their experimental tests. Development of the quark model of hadrons and comparisons with observed particle spectra. Review of the Standard Model by comparing predictions to current experimental measurements. Instructor: Staff. 3 units.

310. Advanced Solid-State Physics. Advanced energy band theory; Fermi liquid theory; many-body Green functions and diagrammatic techniques; interacting electron gas; superconductivity; applications. Prerequisite: Physics 307 or equivalent. Instructor: Teitworth. 3 units.

311. Introductory Quantum Mechanics. Wave mechanics in one dimension, matrix mechanics, quantum mechanics in three dimensions, identical particles, time-independent perturbation theory, the variational approach, time-dependent quantum mechanics. Instructor: Thomas. 3 units.

313. Advanced Topics in Nonlinear and Complex Systems. Survey of current research topics that may include: advanced signal analysis (wavelets, Karhunen-Loeve decomposition, multifractals), bifurcation theory (amplitude and phase equations, symmetry breaking), spatio-temporal chaos, granular flows, broken ergodicity, complexity theory of dynamical systems, and adaptive systems (genetic algorithms, neural networks, artificial life). Emphasis on quantitative comparisons between theory, simulations, and experiments. Not open to students who have taken Computer Science 313. Prerequisite: Computer Science 264 or Physics 213; recommended: Physics 230, 231, and 303 or equivalents. Instructor: Behringer or Greenside. 3 units. C-L: Computer Science 364.

314. Introduction to Fluid Mechanics. Fundamentals of fluid dynamics. Ideal fluids, viscous fluids, turbulence, boundary layers, heat conduction, relativistic fluids. Prerequisite: Physics 230 and 231. Instructor: Rischke. 3 units.

315. Quantum Mechanics I. Review of fundamental principles, Dirac notation, operators, eigenvalues and eigenfunctions, nonquantum models, multi-electron atoms, perturbation theory, selection rules, time dependent quantum mechanics, two-level atoms and lasers, Heisenberg equations, path integral approach, symmetry, rotation and angular momentum, tensor operators, Wigner-Eckart theorem, angular momentum recoupling, evaluation of matrix elements. Instructor: Thomas. 3 units.

316. Quantum Mechanics II. Quantum physics of systems of many identical particles, symmetrization, anti-symmetrization, scattering theory, Born approximation, WKB approximation, partial wave expansion, optical theorem, quantization of continuous systems, one-dimensional string, electromagnetic field, spontaneous emission, second quantization. Prerequisite: Physics 315. Instructor: Chandrasekharan. 3 units.

318. Fundamentals of Electromagnetism. Electrostatics, Laplace's equation, multipole expansion, dielectrics, magnetostatics, magnetization, Maxwell equations, gauge transformations, electromagnetic waves, Fresnel equations, and waveguides. Prerequisite: Physics 182 or equivalent and 230. Instructor: Teitsworth. 3 units.

319. Advanced Electrodynamics. Lienard-Wiechart potentials, scattering theory, radiation theory, MHD and plasmas. Prerequisite: Physics 231. Instructor: Litvinenko. 3 units.

321. Introduction to Accelerator Physics. Aspects of modern accelerator physics; operation of a variety of accelerators from electron microscopes to large ring machines; phenomena responsible for stability and instability of particle beams. Prerequisite: Physics 231, 281, or equivalents. Instructor: Litvinenko. 3 units.

332. Advanced Quantum Optics. Advanced theory of light-matter interactions. Density matrix and semiclassical Bloch-Maxwell equations, three level laser and nonlinear spectroscopic methods. Super radiance in extended media. Electromagnetic field quantization and radiative damping, master equation approach. Noise and fluctuations, first and second order coherence for classical and quantum fields. Dressed state picture of laser cooling. Prerequisite: Physics 316 and 317. Instructor: Thomas. 3 units.

341. Quantum Field Theory. Path integral quantization, generating functional for Green functions, quantization of gauge fields, perturbative formulations, spontaneous symmetry breaking, Goldstone theorem, Higgs-Kibble mechanism, operator product expansion, renormalization group, anomalies, semiclassical methods, solitons and instantons. Prerequisite: Physics 317. Instructor: Plesser. 3 units.

343. Advanced Quantum Field Theory. Study of a variety of topics in quantum field theory selected from nonabelian gauge theory, anomalies, instantons, supersymmetry, topological defects, large-N techniques, spontaneous symmetry breaking, effective potentials, and finite temperature methods. Prerequisite: Physics 341. Instructor: Plesser. 3 units.

344. Advanced Quantum Field Theory IV. Fourth semester of a four-semester course. See Physics 341 for full description. Prerequisite: Physics 317, 341, 343. Instructor: Staff. 3 units.

346. Topics in Theoretical Physics. Topics vary; check Physics Department website. Prerequisite: Physics 317. Instructor: Staff. 3 units.

351. Physics Research Seminar. Series of weekly presentations on research projects under investigation in the department. Credit/no credit grading only. Instructor: Staff. 0 units.

352. Seminar Techniques. Discussion of ways of presenting seminars and participating in follow-on question periods. Each student is required to present at least one seminar on an appropriate research topic. Instructor: Meyer. 1 unit.

356S. Physics Journal Seminar. For advanced graduates to research and report on topics at the core of recent advances in physics. Prerequisite: Physics 351 and 352. Instructor: Staff. 3 units.

361. Physics of Free-Electron Lasers. Seminar course on the basic physical mechanisms and effects responsible for emission and amplification of radiation by electron beams moving through transverse fields. Prerequisite: Physics 316 and 319. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

235. Computational Methods in Physics

261. Laser Physics

334. Atomic Physics and Spectroscopy

335. Molecular Spectroscopy

342. Theory of Elementary Particles.

345. Advanced High Energy Physics

Political Science (POLSCI)

Professor Munger, *Chair* (214-B Perkins); Professor Brehm, *Director of Graduate Studies* (307 Perkins); Professors Aldrich, Ascher, Fish, Gillespie, Grieco, Holsti, Horowitz, Hough, N. Keohane, R. Keohane, Kitschelt, Kornberg, Lange, MacIntyre, Mickiewicz, Paletz, Price, and Spragens; Associate Professors Coles, Eldridge, Feaver, Grant, Hamilton, Mayer, McKean, Niou, and Shi; Assistant Professors De Marchi, Gelpi, Goemans, Gronke, Morgenstern, Orr, Pickus, Shi, and Wilkinson; Associate Professor of the Practice Kiss; Assistant Professor of the Practice Curtis; Professors Emeriti Ball, Barber, Braibanti, Cleaveland, Hall, and Leach; Associate Professor Emeritus Johns; Adjunct Professor Kessler

The Department of Political Science offers graduate work leading to the A.M. and Ph.D. degrees. Before being admitted to candidacy for the Ph.D. degree, an applicant must have qualified for the A.M. degree. Instruction is designed to prepare the student primarily for teaching and research and for government service. Before undertaking graduate study in political science, a student is ordinarily expected to have completed at least 12 semester hours of course work in political science. Instruction is currently offered in the following fields: American government and politics, comparative government and politics, political theory, international relations, and political methodology.

The candidate for the degree of Doctor of Philosophy in political science must take at least fifteen courses in all, including twelve in the department, and demonstrate competence in at least two general fields of the discipline as well as in inter-field theme concentration. The candidate must also fulfill a statistics and/or foreign language requirement.

The terminal degree of Master of Arts, for those who do not intend to continue with doctoral studies, is awarded following successful completion of: (1) eight one-semester courses of 3 units each, at least half of which must be in political science; (2) two other courses of 3 units each or 6 units of ungraded research; and (3) either the A.M. thesis or two seminar-length research papers done for Duke courses with a grade of G+ or above (the student will be required to pass an oral exam with either of these options). In addition, candidates for the A.M. degree must demonstrate competence in one foreign language or in statistics.

Further details on the graduate program in political science, the departmental facilities, the staff, and available financial aid may be obtained from the Director of Graduate Studies, Department of Political Science.

201S. Problems in International Security (D). The impact of democratic political structures on state foreign policy behavior. Emphasis on the influence of democratic norms and principles on the use of force. Theoretical debates on the influence of democracy and the use of force, with attention to the methodological and statistical difficulties of both measuring democracy and estimating its impact on international politics. Prerequisite: a course in international relations or American foreign policy. Instructor: Staff. 3 units.

203S. Issues in Politics and the Media in the United States (A). The impact of the media of communication and new technologies on American political behavior, government, politics, issues and controversies. Development of critical interpretive skills and arguments as students write research papers assessing the media's political influence and effects. Instructor: Paletz. 3 units.

205S. The Political Economy of Environmental Resources (B). The rational choice tradition (public goods, collective action, game theory, property rights, new institution-

alism) as applied to environmental problems, resource exploitation, environmental justice, and the design of an environmentally sound society. Instructor: McKean. 3 units.

206S. Political Participation: Comparative Perspectives (B). The study of political participation through development of an understanding of relevant research methods. The effects of political culture on political participation. Popular participation and mobilization systems in liberal democracies and developing countries. Instructor: Shi. 3 units.

207S. American Constitutional Interpretation (A). Critical analysis of U. S. Supreme Court interpretations of selected provisions of the Constitution relating to national powers, federalism, individual liberty and equality. Attention to constitutional theory and judicial reasoning. Research component involves writing "Supreme Court opinions" on hypothetical facts that raise constitutional questions. Prerequisite: Political Science 127 or 177 or 178 and consent of instructor. Instructor: Fish. 3 units.

210S. Politics and Markets in Modern Capitalism (D). Exploration, through a critical interpretation of classic works and contemporary analyses, of the relationship between representative democracy and markets in modern capitalist society, with special attention to the impact of the world political economy on democracy and capitalism. Instructor: R. Keohane. 3 units.

211S. Current Problems and Issues in Japanese Politics (B). Sources of strength and weakness in the Japanese economy, the rise of new issues and strains in postindustrial society, changes in the party system and decision-making process, the possible transfer of power, the challenge of Japan's new world role. Instructor: McKean. 3 units.

212S. Politics and Markets (D). Seminar on classics of political economy, exploring the relationship between economic markets and politics as treated in the works of Adam Smith, Marx, Polanyi, Schumpeter, Lindblom, and Hirsch, as well as contemporary works on globalization and its effects on domestic politics. Open only to seniors and graduate students. Instructor: R. Keohane. 3 units.

213S. Theories of International Political Economy (D). Basic theoretical and empirical skills needed to analyze complex socio-economic phenomena. Various political, social, and economic problems in various industrial and developing areas of the world. Particular attention placed on Latin America, which has experimented with a variety of approaches to development. Instructor: Grieco. 3 units.

215S. Democratic Institutions (B). How constitution makers choose basic rules of the democratic game, such as the relations between legislatures and executives, the role of parties, electoral system, prerogatives of constitutional courts, and other important elements of democratic institutional design; the impact of such arrangements on various groups within the state, and the overall performance of democracies; durability of arrangements, the structuring of power relations among parties, and whether democratic institutions affect economic and social policy outcomes. Instructor: Kitschelt. 3 units.

218. Political Thought in the United States (C-N). American political thought and practice through the Civil War period. A critical analysis of the writing of our founders and their European antecedents. Focus on the philosophical and political debates and the underlying ethical and political issues found in the debates over the Constitution, slavery, and the Union. Instructor: Gillespie or Grant. 3 units.

219S. Film and Politics (A). Selected film genres and films as they illuminate political behavior. Ethical issues and controversies raised by the making and contents of films. Inducts students into the ways research is conducted in the study of films and the generation and presentation of knowledge in the discipline. Instructor: Paletz. 3 units.

220S. Problems in International Politics (D). The development and critical analysis of various models in political science and economics that focus on the relationship between international economics and international security. Various models of the impact of political-military dynamics on international economic relationships, and the

impact of international economics on the likelihood of war and peace among nations. Attention to the interplay between economics and security in a key region of the world—East Asia. Prerequisite: one course in international relations, foreign policy, or diplomatic history. Instructor: Staff. 3 units.

222. Introduction to Statistical Analysis (C-E). Basic applications of statistical theory to political questions: research design, hypothesis tests, computer data analysis. Consent of instructor required for undergraduates. Instructor: Brehm or Gronke. 3 units.

223. Ancient Political Philosophy. Intensive analysis of the political philosophy of Plato, Aristotle, and other ancient theorists. Research paper required. Instructor: Gillespie or Grant. 3 units. C-L: Classical Studies 203.

224S. Modern Political Theory (C-N). A historical survey and philosophical analysis of political theory from the beginning of the seventeenth to the middle of the nineteenth century. The rise of liberalism, the Age of Enlightenment, the romantic and conservative reaction, idealism, and utilitarianism. Instructor: Grant or Spragens. 3 units.

225. Topics in Comparative Government and Politics: Western Europe (B). The development of mass democracy and the welfare state and its impact on various groups within particular nations; political and electoral participation and mobilization; social movements and political change; center-periphery conflicts; government and bureaucratic institutions and their relationships to society; the modern welfare state and political economy. Instructor: Kitschelt or Lange. 3 units.

226S. Nietzsche's Political Philosophy (C-N). Study of the thinker who has, in different incarnations, been characterized as the prophet of nihilism, the destroyer of values, the father of fascism, and the spiritual source of postmodernism. An examination of his philosophy as a whole in order to come to terms with its significance for his thinking about politics. Instructor: Gillespie. 3 units. C-L: German 276S.

227S. Issues in International Communications (B). Research seminar analyzing selected political issues in international communications. Examines the impact of international communication technologies on United States and foreign governments and politics. The resulting ethical implications of globalization and semi-monopolization. Instructor: Paletz. 3 units.

228S. Nineteenth- and Twentieth-Century Political Philosophy (C-N). The relationships among freedom, morality, aesthetics, and politics as interpreted by various major figures in modern political philosophy, including, Kant, Hegel, Marx, Nietzsche, Fichte, Heidegger, Foucault, and Derrida. Focus on normative arguments and presuppositions, as well as various approaches to interpretation of philosophical texts. Instructor: Coles or Gillespie. 3 units.

229S. Contemporary Theory of Liberal Democracy (C-N). Instructor: Spragens. 3 units.

230S. Introduction to Positive Political Theory (C-E). Introduction to formal models in political science and a field of research that is at various times called political economy, positive political theory, formal theory, and public choice. Focus on three basic models that form the foundation of the field: individual choice, game theory, and social choice. Instructor: Aldrich or Niou. 3 units.

231S. Crisis, Choice, and Change in Advanced Democratic States (B). Contributions of Marx, Weber, and Durkheim toward analysis of modern democracies. Examination of selected contemporary studies using these three perspectives to highlight processes of change and crisis. Unsettling effects of markets upon political systems, consequences of bureaucratic regulation, and transformation of sources of solidarity and integration in modern politics. Instructor: Kitschelt. 3 units.

232. Political Economy: Theory and Applications (C-E). Selected topics. Instructor: Lange. 3 units.

233. Intermediate Statistical Methods (C-E). Applications of regression models of politics emphasizing the effect of assumptions behind Generalized Least Squares regression. Prerequisite: Political Science 222; Consent of instructor required for undergraduates. Instructor: Munger. 3 units.

234S. Political Economy of Development: Theories of Change in the Third World. Alternative approaches to political economy and social change in the Third World. Instructor: Staff. 3 units. C-L: Cultural Anthropology 234S, Sociology 234S.

237S. Understanding and Managing Global Capital Markets Crises (D). A critical evaluation of theories and models from both economics and political science exploring global capital market crises, their causes and dynamics. Positive (descriptive/analytical) as well as normative (prescriptive) elements; exploration of alternative hypothesis aiming to explain why these crises occur. Instructor: Grieco. 3 units.

238S. Development of United States Courts in the Mid-Atlantic South (A). The impact of international, international policing and domestic wars relating to national security on the United States courts of the Fourth Circuit (Maryland, Virginia, West Virginia, North and South Carolina), and the role played by these courts in the Mid-Atlantic South from the American Founding into the Cold War Era. The American Constitution, laws and treaties of the United States, and principles of admiralty and international law which figure in assigned published and unpublished judicial decisions of the region's United States district and old circuit courts and of the post-1891 Fourth Circuit Court of Appeals. Research paper required. Instructor: Fish. 3 units. C-L: History 255AS.

247. Politics and Philosophy of Self and Other (C-N). Epistemological, ontological, ethical, and political dimensions of relations between self and other. Theorists may include Husserl, Merleau-Ponty, Levinas, Derrida, Adorno, Gadamer, Sartre, Foucault, and Bakhtin. Instructor: Coles. 3 units.

248. International Politics and International Law (D). Relationship between international law and politics, with attention to how politics affects law and how law channels and structures politics. emphasis on changes in sovereignty as a result of globalization and shifts in norms. Instructors: Byers and Keohane. 3 units.

253S. Comparative Government and the Study of Latin America (B). Current literature on major themes of Latin American politics. Instructor: Morgenstern. 3 units.

256S. Theory and Practice of National Security (D). In-depth look at the theoretical and empirical literature explaining how states seek to guarantee their national security. Topics include: grand strategy, nuclear deterrence and war fighting, coercive diplomacy, military intervention, decisions for war, and civil-military relations. Special attention paid to U. S. national security during and after the Cold War. Instructor: Feaver. 3 units.

267S. Policy-Making in International Organizations (D). 3 units. C-L: Public Policy Studies 267S.

268S. The Regulatory Process (A). 3 units. C-L: Public Policy Studies 269S.

271S. International Environmental Regimes (B). Law, politics, and institutional design of international regimes created among nations to cope with environmental problems. Includes study of particular conventions and treaties (for example, acid rain, ozone, carbon reduction, biodiversity, Antarctica, regional seas, ocean dumping), and the environmental implications of international trade rules and regimes (for example, GATT). Instructor: McKean. 3 units. C-L: Public Policy Studies 258S.

272. China and the World (D). The formulation and development of Chinese foreign relations and foreign policy since 1949. The rationales of policy as well as organizational, cultural, and perceptual factors that influence Chinese foreign policy formulation. Instructor: Shi. 3 units.

273S. Heidegger. An examination of the philosophy of Martin Heidegger from its phenomenological beginnings to its postmodernist conclusions with particular atten-

tion to its meaning for questions of identity, history, nihilism, technology, and politics. Instructor: Gillespie. 3 units. C-L: Philosophy 273S.

274S. Seminar in Urban Politics and Urban Public Policy (A). A probing of topical issues in both their theoretical antecedents and their contemporary manifestations. The intellectual debates and scholarly treatments surrounding issues of power in the city, urban redevelopment policy, urban poverty, and race in the city. Instructor: Orr. 3 units. C-L: Public Policy Studies 275S.

275. The American Party System (A). The role of political parties and the party system in the origin and perpetuation of democratic politics. Critical evaluation of different theories and models of the origins, structures and activities of American political parties and their contribution to the maintenance of a democratic society. Students will encounter an extensive array of evidence, including statistical estimation and formal modeling, for use in the development of their own original research or in critical evaluation of research findings. Instructor: Staff. 3 units.

276S. Media in Post-Communist Societies (B). 3 units. C-L: Public Policy Studies 243S.

277. Comparative Party Politics (B). The concepts, models, and theories employed in the study of political parties in various competitive democracies. Focus on advanced industrial democracies where there is a rich empirically oriented literature on this topic. The resurgence of democracy in developing areas and the role of party competition and democracies in these regions of the world. Instructor: Lange. 3 units.

278S. Black Political Participation. Topical issues concerning the political participation of African Americans, primarily on the national level. Black voter turnout, the electoral choice, the role of African Americans in the Democratic and Republican parties, black interest group politics, black political opinion, and black political socialization. Instructor: Orr. 3 units. African and African American Studies 278S.

282S. Canada. 3 units. C-L: Canadian Studies 282S, Cultural Anthropology 282S, History 282S, Sociology 282S.

284S. Public Policy Process in Developing Countries (B). 3 units. C-L: Public Policy Studies 284S.

286. Theory and Practice of International Security (D). Analysis and criticism of the recent theoretical, empirical, statistical, and case study literature on international security. This course highlights and examines potentially promising areas of current and future research. No prerequisite, but Political Science 93 recommended. Instructor: Goemans. 3 units.

288. War and the National State. Transformation of warfare by selected socio-economic and technological revolutions and its impact on international relations, 1800-1945. No prerequisite, but Political Science 93 recommended. Instructor: Goemans. 3 units. C-L: History 255B.

289S. Contemporary Ethical Theories. 3 units. C-L: Philosophy 203S, Women's Studies.

291. Research Methods in Japanese. 3 units. C-L: Japanese 291, Cultural Anthropology 290, History 292, Sociology 291.

299. Advanced Topics in Government and Politics. Topics vary from semester to semester.

- A. American Government and Politics
 - B. Comparative Government and Politics
 - C. Political Theory
 - D. International Relations.
- Instructor: Staff. 3 units.

For Graduates

303. Seminar on Statistics. Application of advanced statistical methods to political science research problems. Primary focus on multiple regression procedures. Emphasis on assumptions, interpretation of results, and use of the computer. Consent of instructor required. Instructor: Staff. 3 units.

304. Classics in American Politics (A). Introduction to fundamental research and theoretic statements in American politics. Instructor: Aldrich, Brehm, or Paletz. 3 units.

305. Seminar in United States Foreign Policy. Decision making in American foreign policy. The sources, substance, and consequences of United States policy will be examined. The emphasis is on the period since 1945. Instructor: Holsti. 3 units.

306. Public Opinion (A). Intensive study of the causes and consequences of public attitudes toward politics, with special attention given to recent research in the field. Instructor: Brehm or Gronke. 3 units.

307. Formal Modeling in Political Science. Introduction to formal analysis of recent work in political science. Focus on a number of important theorems and their proofs drawn from such areas as bargaining, deterrence, public goods, collective choice, electoral politics, and new institutionalism. Students will in the process be expected to begin work on formal proofs of their own. Prerequisite: one course in game theory. Instructor: Niou. 3 units.

308. Individual Research. Students will conduct research designed to evaluate hypotheses of their choice. Reports on the research must be presented in appropriate professional style. Instructor: Staff. 3 units.

309. Seminar in International Relations. Critical survey of theories and research in international relations and foreign policy. Emphasis will be placed on the interrelation between theory and research. Instructor: Holsti. 3 units.

310. Scope and Methods in Political Science. Designed to explore philosophical assumptions in political science, theory, and matters of evidence and judgment, the course is meant to be an introduction to variations in research design, empirical methods, and the execution of research. Instructor: Staff. 3 units.

312. Electoral Behavior (A). Survey of major themes and controversies in electoral behavior research. Aggregate and individual level analyses of elections; historical and contemporary trends in voting behavior. Instructor: Aldrich or Gronke. 3 units.

313. Seminar in Political Communications. A field survey with emphasis on politics and media in the United States. Instructor: Paletz. 3 units.

314. Graduate Seminar on International Institutions. The role of international institutions in world politics. Implications for international relations theory, analytical insights from economics and American politics; research topics and issues. Instructor: Keohane. 3 units.

315. Noncooperative Game Theory. 3 units. C-L: Economics 315, Statistics and Decision Sciences 386.

317. The New Institutionalism in Political Science. Survey of recent developments in information economics, theory of the firm, the property rights paradigm, and contract theory. Emphasis on using these techniques to answer classic questions in political science. Instructor: McKean. 3 units.

319. Ethics and Policy-Making. 3 units. C-L: Public Policy Studies 316.

320. Political Psychology. Examination of the human political situation through the study of actual problems and solutions at the level of: (1) the individual, (2) political discourse among government officials, (3) public discourse in the media. Instructor: Staff. 3 units.

321. Seminar in Political Theory. Prerequisite: 6 units in political science elected from 223, 224, 229, 231, or their equivalents. Instructor: Staff. 3 units.

322. Topics in Early Modern Political Thought. Selected readings from political thinkers ranging from Machiavelli to Mill. Instructor: Grant or Spragens. 3 units.

324. Seminar in Comparative Politics (A). A field survey with emphasis on the politics of developing areas. Note: it is generally expected that political science graduate students taking comparative politics as a preliminary field will take both this course and Political Science 325. Instructor: Staff. 3 units.

325. Seminar in Comparative Politics (B). A field survey with emphasis on the politics of advanced industrial democracies. Note: it is generally expected that political science graduate students taking comparative politics as a preliminary field will take both this course and Political Science 324. Instructor: Staff. 3 units.

326. Research Seminar in Comparative Government and Politics. Seminar in major issues in comparative politics and intensive individual student research projects. Instructor: Staff. 3 units.

327. Comparative Political Behavior. This seminar critically examines research on variations in elite and mass behavior as well as the conditions affecting that behavior in a variety of Western countries. Instructor: Kornberg. 3 units.

330. Qualitative Research Design. Systematic consideration of major problems in qualitative research; how they can be understood with the same logic of social science that applies to quantitative work; and how political scientists can do systematic social science even when only a few independent observations can be made. Instructor: R. Keohane. 3 units.

332. Seminar on Political Economy: Micro Level. Survey of recent work in political science and economics on the organization of institutions: political, sociological, and economic. Focus upon the ways in which rational choice theory is applied to areas outside of economics. Instructor: Staff. 3 units.

333. Seminar in Political Economy: Macro Level. Survey and analysis of recent work in political science, economics and sociology on the relationships between states and markets. Special emphasis on the ways states influence market outcomes and the ways the organization of power in markets influences state behavior, especially in democratic systems. Instructor: Lange. 3 units.

340. Seminar in American Politics and Institutions. Survey, analysis, and critique of the literature. Instructor: Aldrich, Brehm, Gronke, or Paletz. 3 units.

341. Legislative Politics. Survey of current research on the legislative branch of government. Topics include: elections, committee systems, oversight, party organizations, and others. Instructor: Staff. 3 units.

351. Comparative Law and Politics: Ethnic Group Relations (B). Various approaches to the reduction of conflict in deeply divided societies, primarily in Asia and Africa, with secondary attention to Western countries. The nature of ethnic identity, the sources of group conflict, and the forms and patterns it takes. Methods of analyzing social science materials and utilizing them for the design of polities, laws, and institutions. Consent of instructor required. Instructor: Horowitz. 3 units.

381. Research Seminar in Latin American Government and Politics. Prerequisite: Political Science 253 or equivalent. Instructor: Staff. 3 units.

390. Research Seminar in International Relations. Prerequisite: Political Science 226, Political Science 309 or equivalent. Instructor: Holsti. 3 units.

397. Selected Topics in Government and Politics. Topics vary from semester to semester. Instructor: Staff. 2 units.

398. Selected Topics in Government and Politics. Topics vary from semester to semester. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

- 202. American Foreign Economic Policy (D)**
- 204S. Ethics in Political Life (C-N)**
- 216S. Evolution of European Marxism (C-N)**
- 217. Comparative and Historical Methods (B)**
- 236S. Hegel's Political Philosophy**
- 243S. Political Applications of Game Theory (C-E)**
- 244S. The Politics of the European Community (D)**
- 249. The Politics of Health Care (A)**
- 250S. International Security after the Cold War (D)**
- 252S. The Nation-State and the International System (D)**
- 257S. Making American Defense Policy (D)**
- 265S. The Process of International Negotiation (D)**
- 279S. Political Protest and Collective Mobilization (B)**
- 281. American Political Thought Since the Gilded Age (C-N)**
- 287. Revolution, Reform, and Democratization (B)**
- 360. Seminar in Government and Politics in the Soviet Union**

RELATED COURSE WORK IN THE SCHOOL OF LAW

It is possible to receive graduate credit for course work completed in the Duke University School of Law, under regulations referred to in this bulletin under the section on academic regulations.

Psychology (PSY)

Professors Asher and W. G. Hall, *Co-Directors of Graduate Studies*; Professors Costanzo, Dodge, Eckerman, C. Erickson, R. Erickson, Hamilton, Holland, Lockhead, Mangun, Putallaz, Roth (*Chair*: Social and Health Sciences), Rubin, Staddon, and M. Wallach; Associate Professors Day, Mazuka, Meck, Needham, Schmajuk, and C.L. Williams (*Chair*: Experimental); Associate Research Professors Cerutti and Woldorff; Assistant Professors Hill, LaBar, Serra, and Swaab; Research Professors Crovitz and L. Wallach; Assistant Research Professor Brannon; Professors Emeriti Alexander, Borstelmann, Carson, Coie, Diamond, Kimble, Kremen, Lakin, H. Schiffman, and Wing. Faculty with secondary appointments in Psychology, primary appointments in other departments: Professors Bettman, Blumenthal, Brodie, Dodge, Flanagan, Gallagher, George, W. C. Hall, Keefe, McCarthy, Madden, Palmer, Payne, Quinn, S. Schiffman, Sheppard, Siegler, Spenner, Surwit, Thompson, Vidmar, and R. B. Williams; Associate Professors Curry, Fairbank, Kuhn, Linville, Logue, March, Nowicki, Robins, Swartzwelder, Wells, and Welsh; Assistant Professors Gustafson and Marsh; Assistant Clinical Professors Bonner and Lynch; Research Professor Madden; Adjunct Professor Gottlieb; Research Associate Edwards; Associate Research Professor Gold; Adjunct Associate Professors Rabiner and Reese; Adjunct Assistant Professors McNeilly and Stocking

The department offers graduate work leading to the Ph.D. degree. Graduate work is organized around four areas of concentration: (1) cognitive and sensory sciences with emphases on memory, language, autobiographical memory, perception, psychophysics, sensory coding, development, and aging; (2) psychobiology and behavioral neuroscience with emphases on cognitive neuroscience, mechanisms of behavior, learning, neural networks, ingestion, sex differences, time perception and sensory systems; (3) developmental psychology, focusing on social and cognitive development, developmental psychopathology, psychobiology, and the cognitive,

perceptual, social, and language development of infants, adolescents, and adults; and (4) clinical psychology with concentrations in personality and psychopathology, developmental psychopathology, and health psychology, and which meets the accreditation criteria of the American Psychological Association. Research and training are highly collaborative with Duke's Schools of Medicine, particularly the departments of Biological Anthropology, Neurobiology, Neurology, Pharmacology, and Psychiatry; the schools of Business, Law, and Engineering; and the Arts and Sciences departments of Biology, Computer Science, Cultural Anthropology, Physics, and Sociology. State-of-the-art facilities include Brain Imaging and Analysis Center, Carolina Consortium on Human Development, Center for Child and Family Policy, Center for Cognitive Neuroscience, Center for the Study of Aging and Human Development, John Umstead Hospital, Talent Identification Program, and Women's Studies Program. Applicants must take the general portion of the Graduate Record Examination. There is no foreign language requirement. An undergraduate major in psychology is usual but is not required. Our goal is to produce skilled scientists and scholars who are ready for careers in academic, research, clinical, or industrial settings. To achieve this, students work closely with mentors and secondary advisors in individualized training programs. In the first year, students take a year-long proseminar plus selected courses, have research experience in one or more laboratories, and select an advisory committee to help tailor their program. In the second year, students write a paper that reflects mastery of a delineated field of inquiry, as well as taking any needed courses. Coursework decreases progressively such that research and some teaching are the essential activities by the third year. The Ph.D. is typically completed within five years.

For Seniors and Graduates

202S. Autobiographical Memory (C). A review and critical analysis of the literature, theory, and empirical study of autobiographical memory with incognitive psychology. Emphasis on the reasoning, research designs, and methods used in examining autobiographical memory. Consent of the instructor required. Instructor: Rubin. 3 units.

205S. Children's Peer Relations (D). Examination of the empirical literature with emphasis on the functions that peers serve for children, the developmental course of these relationships, the clinical ramifications and possible explanations for inadequate peer relations (including an examination of the family's role), and interventions used to improve children's relationships with their peers. Regular opportunities to analyze, critique, and synthesize primary research literature. Consent of instructor required. Instructor: Asher or Putallaz. 3 units.

206S. Pediatric Psychology (D, P). The conceptual and methodological bases for the field. Emphasis on the reasoning, research designs, and methods implemented at the interface of behavioral and biomedical issues concerning health care for children. Case material illustrating how developmental, biological, and psychosocial processes act together in child health and illness. Focus on adjustment and coping with illness and treatments related to cystic fibrosis, sickle cell disease, cancer, diabetes, and seizure disorders. Consent of instructor required. Instructor: Staff. 3 units.

211S. Neural Development and Comparative Cognition (B, C). Current research on neural development of cognitive processing in several sensory systems (for example, auditory, visual, and olfactory systems), and in several species (for example, aplysia, song birds, rats, cats, monkeys, and humans) with regard to how attention and memory processes develop. Both the normal ontogeny of cognitive ability and differentiation that is altered during an early sensitive period of development. Prerequisite: three courses in biological psychology for undergraduates and consent of instructor. Instructor: C. Williams. 3 units.

212S. Human Memory (C). Classical and modern literature, data, and theories relating to mechanisms of information processing, storage, and retrieval. Emphasis on the reasoning, research designs and methods by which human memory is studied. Evaluation of experiments and interpretation of data. Research proposal required. Consent of instructor required. Instructor: Hasher, Rubin, or Serra. 3 units.

214S. Development of Social Interaction (D, P). Major concepts and methods pertaining to early social development, emphasizing human social behavior and a developmental psychobiological approach. Consent of instructor required. Instructor: Eckerman. 3 units.

217S. Advanced Social Psychology (P). Theoretical and empirical approaches to understanding socially significant human behavior and experience. Review of classic and contemporary research literatures, with an emphasis on applied issues. Prerequisite: Psychology 99 and 147S, and consent of instructor. Instructor: Costanzo or Fischer. 3 units.

218S. Personality, Stress, and Disease (P). The interaction between person and social environment as a contributor to development of physical disease. Both epidemiological and laboratory-based research considered. Prerequisite: Psychology 98 or 109A for undergraduates and consent of instructor. Instructor: R. B. Williams. 3 units.

220S. Psycholinguistics (C). Evaluation of empirical research in various areas of psycholinguistics, in particular whether or not the hypotheses, methodology and analyses are appropriate and whether or not the data gathered warrant the conclusions drawn. Emphasis on cross-linguistic approaches to psycholinguistics. Systematic comparison of languages from different cultures through selected readings. Topics include neurolinguistics, linguistic versus pictorial representation, individual differences, oral versus written expression, language and personality, and the language-thought interaction. Prerequisite: Psychology 134 for undergraduates and consent of instructor. Instructor: Day or Mazuka. 3 units.

223S. Animal Learning and Cognition: A Neural Network Approach (B, C). Several connectionist theories of animal learning and cognition. Neural network theories of classical conditioning; the concepts of models of the environment, prediction of future events, reliable and salient predictors, redundancy reduction, competition for limited capacity short-term memory, mismatch between predicted and observed events, stimulus configuration, inference generation, modulation of attention by novelty, and timing. Neural networks of operant conditioning; the concepts of goal-seeking mechanisms, response-selection mechanisms, and cognitive mapping. How neural network models permit simultaneous development of psychological theories and models of the brain. Prerequisite: Mathematics 31, 32 for undergraduates and consent of instructor. Instructor: Schmajuk. 3 units.

224S. Timing and Time Perception (B, C). Selected topics dealing with the psychobiological bases of internal clocks used to time in the-seconds-to-minutes range. Impact of neural pacemaker systems on cognitive processes involved in divided attention, temporal memory, and the determination of the quantal unit of time and/or consciousness. Emphasis on the development and critical evaluation of quantitative theories of interval timing using mathematical, physiological, and/or deductive/inductive models of reasoning and experimentation. Research project, data analysis, and preparation of a scientific report required. Consent of instructor required. Instructor: Meck. 3 units.

227S. Behavioral Physiology: Basic Systems (P). Organ systems review of physiology, emphasizing the role of the central nervous system and behavior in physiological function. Emphasis on the research designs, methods, and reasoning by which the physiology of behavior is understood. Prerequisite: Psychology 91 or 159S for undergraduates and consent of instructor. Instructor: Surwit. 3 units.

230S. Social Behavior of Animals (B, D, P). An examination of the developmental, ecological, and physiological aspects of territorial, sexual, parental, and aggressive

behavior of animals, from invertebrates to primates. Emphasis on the research designs, methods and reasoning for understanding the social organizations and interactive patterns of animals. Instructor: C. Erickson. 3 units.

232S. Advanced Seminar in Perception (C). Discussions of selected, current topics, including illusions and psychophysics, concerning how context affects what we know about the world and its objects. Consent of instructor required. Instructor: Lockhead. 3 units.

233S. Nature and Nurture in Animal and Human Development (B, D, P). The nature-nurture dichotomy and reasons it is invalid; applications of the arguments and evidence to such student selected topics as personality, intelligence, behavior genetics, social behavior, infant behavior, criminality, mental disorder, homosexuality, sociobiology. Emphasis on the research designs, methods and reasoning by which inferences can be made about genetic and experiential contributions to development. Prerequisite: Psychology 91 and consent of instructor. Instructor: Gottlieb. 3 units.

234S. Advanced Personality (P). Selected topics of current interest concerning empirical research on personality. Strategies for the definition of research questions and the evaluation of research progress. Consent of instructor required. Instructor: M. Wallach. 3 units.

238S. Everyday Cognition (C). Selected cognitive concepts (for example, encoding, retrieval, representation, information load) and their application to everyday situations. Cognition in the classroom, courtroom, hospital, grocery store, and laboratory, as well as on the job, athletic field, construction site, dance floor, and computer. For each situation: successful vs. mediocre performance, cognitive processes involved, task analysis, potential problems, experimental tests, and implications for both cognitive theory and everyday life. Class sessions include presentations by the. Instructor, students, and individuals from the everyday world. Prerequisites: for undergraduates: Psychology 92 or related course work and consent of instructor. Instructor: Day. 3 units.

249S. Anthropology and Psychology. 3 units. C-L: Cultural Anthropology 249S.

258S. Social Behavior and Personality (P). A broad examination of current theory and research on the interpersonal, personological, and social cognitive influences on social behavior and social interaction. Emphasis on contemporary thought on issues such as the nature of social influence, the function and construction of the self, relationship formation and maintenance, aggression and altruism, personality-based mediators and moderators of social behavior, and the application of social psychological theory and research to the study of clinical, social legal, and educational issues. Methodological approaches to the study of social phenomena including experimental, quasi-experimental, narrative, observational, and correlational models. Prerequisite: Psychology 99 or 116 and 185A or 185B and Statistics 110, Psychology 117 or equivalent and consent of instructor for undergraduates. Instructor: Costanzo. 3 units.

261S. Advanced Learning Theory (C). Selected topics in the data and theory of basic processes of learning, memory, and motivation in animals and humans. Emphasis on the nature of theory construction and evaluation, and the relation of current perspectives to older ones. Consent of instructor required. Instructor: Holland. 3 units.

264S. Gender, Hormones, and Health (P). Hormone effects on behavior in animals and humans with topics including pubertal, menstrual-cycle, sex-related, and gender-related effects on mood, behavior, cognition, and health. Emphasis on the research designs, methods and reasoning by which hormonal effects are understood. How gender biases have shaped scientific inquiry and how new knowledge about the psychology of gender influences ethical, sociological, and public debates. Cross-cultural, race-ethnicity and socioeconomic issues affecting gender and health. Consent of instructor required. Instructor: Hamilton. 3 units.

268S. Brain and Language (B, C). Focus on cognitive processes and brain mechanisms involved in language comprehension and production. Psycholinguistic models and how these models may be implemented in the brain. Consent of instructor required. Instructor: Swaab. 3 units.

270S. A-R, U-Z. Selected Problems. New courses not yet in the bulletin are designated as 170S or 270S depending on level. Since all faculty offer these courses, their contents vary accordingly. Different courses indicated by the letter. Consent of instructor required. Instructor: Staff. 3 units.

273. Statistics I (G). Foundations of probability and statistical inference. Introduction to the general linear model via multiple regression. Emphasis on application via statistical computing with SAS. Prerequisite: Psychology 117 or Statistics 110 for undergraduates and consent of instructor. Instructor: Compton. 3 units.

274. Statistics II (G). Basic and advanced ANOVA models via the GLM. Broad-based overview of multivariate models, including MANOVA, canonical correlation, discriminant analysis, and factor analytic models. Emphasis on application and use of computer packages. Prerequisite: Psychology 117 or Statistics 110 and Psychology 273 for undergraduates and consent of instructor. Instructor: Compton. 3 units.

For Graduates

301. Group Psychotherapy and Group Influence Processes. Theories of group interventions and group techniques. Instructor: Lakin. 3 units.

302. Personality Theory. An advanced course in the representative theories of human functioning, from Freud to contemporary approaches. Instructor: Staff. 3 units.

303S. Family Theory and Family Therapy. An examination and analysis of theories of family functioning and models of family therapy. Survey of empirical literature on family process assessment with child and adolescent psychopathology and marital function and dysfunctions, and on parent training and family therapy models that arise out of theory and research. Methods include didactic presentations and group discussions of readings. Case material supplements discussions. Consent of instructor required. Instructor: Wells. 3 units.

304. Personality and Psychopathology, I and II. Semester one considers perspectives and fundamental principles in the study of personality. Semester two is devoted to the implications of these principles for psychopathology and behavior disorders and for the classification of abnormal behavior. Instructor: Carson. 3 units.

305. Personality and Psychopathology, I and II. Semester one considers perspectives and fundamental principles in the study of personality. Semester two is devoted to the implications of these principles for psychopathology and behavior disorders and for the classification of abnormal behavior. Instructor: Carson. 3 units.

307. Models of Intervention and Prevention. Concepts of prevention and mental health promotion; community psychology and social systems; epidemiology and prediction of disorder; intervention strategies; evaluation of prevention trials; and ethical and cultural issues. Specific approaches to psychotherapy and psychoeducational therapy will be discussed in relation to the prevention-intervention continuum. Instructor: Robins. 3 units.

311. Introduction to Psychology: Social and Health Sciences. Provides brief coverage of the history of psychology in general, and clinical psychology in particular. Acquaints students with research and clinical work of faculty, and introduces them to elementary questions of ethics in human research, treatment, and prevention. Instructor: Surwit. 0 units.

312. Introduction to Psychology: Social and Health Sciences. Provides brief coverage of the history of psychology in general, and clinical psychology in particular. Acquaints students with research and clinical work of faculty, and introduces them to

elementary questions of ethics in human research, treatment, and prevention. Instructor: Surwit. 0 units.

315. Seminar in Consumer Behavior. 3 units. C-L: Business Administration 562.

316. Behavioral Decision Theory. 3 units. C-L: Business Administration 525, Statistics and Decision Sciences 231.

318. Research Design. Examines the foundations of psychological and scientific inquiry. Emphasis on applications that are likely to be countered by the research psychologist. Consent of instructor required. Instructor: Moore. 3 units.

320. Multivariate Statistics. Introduction to multivariate statistical modeling using the general linear model and matrix algebra. Fundamentals of matrix algebra. Topics include multivariate analysis of variance, multivariate regression, discriminant function analysis, canonical correlation, exploratory factor analysis, confirmatory factor analysis, an introduction to structural equation modeling, and various approaches to longitudinal data analysis. Emphasis on underlying statistical theory and real data applications using the SAS statistical computing system and other more specialized software applications. Instructor: Staff. 3 units.

321. Life-Span Development. Analysis of development across the life span including the origins and course of cognitive and emotional development as well as the components of personality and social development. Applications to models of both normative and pathological development. Instructor: Asher. 3 units.

322. Advanced Cognitive Development. Advanced level introduction to critical issues in the study of cognitive development from birth to adolescence. Emphasis on Piagetian and information processing approaches to explaining development, and on recent research that informs these explanations. Instructor: Needham. 3 units.

323. Seminar in Community Psychology. An examination of the organization and functioning of community systems and an exploration of factors involved in system changes through psychologically based intervention strategies. On-line experiences with school system consultation will provide a primary basis for study. Instructor: Costanzo or staff. 3 units.

324. Seminar in Community Psychology. An examination of the organization and functioning of community systems and an exploration of factors involved in system changes through psychologically based intervention strategies. On-line experiences with school system consultation will provide a primary basis for study. Instructor: Costanzo or staff. 3 units.

329S. Evolution, Development, and Behavior. Behavior is affected by and has an effect upon evolution, developmental, and physiological processes. Current concepts and controversies in biopsychology. Instructor: Staff. 3 units.

330S. Learning, Memory, and Cognition. Current concepts and controversies in the way people and other animals perceive, think, and remember. Instructor: Staff. 3 units.

332. Developmental Psychopathology. Consideration of major psychopathological disorders in childhood and adolescence, theories, and research on etiology and prediction of disorder. Instructor: Staff. 3 units.

333. Cognition and Teaching. An examination of key phenomena and concepts in cognitive psychology (especially in areas of perception, attention, memory, comprehension, mental representation, and problem solving) and their implications for the teaching-learning process at the college level. Instructor: Day. 3 units.

335. Personality Assessment. Assessment of persons through a variety of methods, including clinical and semistructured interviews. Introduction to self-report and projective testing, and to observational rating methods. Laboratory experiences in clinical setting. Instructor: Curry. 3 units.

339. Ethics for Psychotherapists. A course for graduate students in the clinical program. Instructor: Blumenthal. 3 units.

343. Clinical Practicum. Intensive experience and supervision in clinical intervention processes. Student training in psychotherapy strategies and techniques and in clinical consultation skills is conducted in clinical settings. Instructor: Staff. 0 to 6 units.

344. Clinical Practicum. Intensive experience and supervision in clinical intervention processes. Student training in psychotherapy strategies and techniques and in clinical consultation skills is conducted in clinical settings. Instructor: Staff. 0 to 6 units.

346. Seminar in Ethics. For graduate students in the clinical program. Credit grading only. Instructor: Staff. 0 units.

348. Psychotherapy with Children and Families. Major theoretical approaches to clinical intervention with children and adolescents, either individually or in the family system context. Instructor: Staff. 3 units.

349. Practicum in Psychological Research. Instructor: Staff. 3 units.

350. Practicum in Psychological Research. Instructor: Staff. 3 units.

352. Child Assessment. Interview methods; intelligence and achievement testing; personality and developmental batteries; peer, teacher, and parental instruments; and observational techniques. Instructor: Fitzgerald and Putallaz. 3 units.

353. Research Practicum in Prevention. Students will be involved in a short-term research apprenticeship to a faculty member other than their mentor for hands-on experience with research efforts pertinent to the prevention of illness. Instructor: Staff. 3 units.

355. Research Practicum. Students will be involved in a research apprenticeship to a faculty member for hands-on experience with research efforts. Instructor: Staff. 3 units.

356. Research Practicum. Students will be involved in a research apprenticeship to a faculty member for hands-on experience with research efforts. Instructor: Staff. 3 units.

357S. Cognitive Neuroscience Colloquia. Examines current topics in cognitive neuroscience. Journal article discussions and invited lectures by distinguished faculty in the field. Students lead individual sessions and evaluate research findings. Topics vary each semester. Consent of instructor required. Instructor: LaBar, Mangun, or Swaab. 1 unit.

358S. Cognitive Neuroscience I. Introduction to topics in cognitive neuroscience, including neural systems mediating sensory, motor, and higher-level perceptual processes. Discussion and evaluation of theories, methodological advances, controversies, and ethical principles. Students learn to write NSF or NIH-style grant proposal. Consent of instructor required. Instructor: LaBar, Mangun, or Swaab. 3 units.

359S. Cognitive Neuroscience II. Introduction to the cognitive neuroscience of higher-level mental functions, including language, memory, emotion, and consciousness. Highlights current theories, methodological advances, and controversies. Students evaluate and synthesize findings across a variety of research techniques. Consent of instructor required. Prerequisite: Psychology 358S is required only for graduate students in the cognitive neuroscience track. Instructor: LaBar, Mangun, or Swaab. 3 units.

360S. Cognitive Neuroscience Colloquia II. Examines current topics in cognitive neuroscience. Journal article discussions and invited lectures by distinguished faculty in the field. Students lead individual sessions and evaluate research findings. Topics vary each semester. Consent of instructor required. Instructor: LaBar, Mangun, or Swaab. 1 unit.

396. Graded Research. Instructor: Staff. 1 to 3 units.

399. Special Readings in Psychology. Consent of instructor required. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

209S. The Cognitive Psychology of Oral Traditions (C)

225S. Ingestion: Behavior and Neurobiology (B)

262S. Minority Mental Health: Issues in Theory, Treatment, and Research (P)

284S. Feminist Theory and Methods in the Social Sciences (P)

288S. Advanced Topics in Social Science and Law (P)

310. Seminar in Perception

Public Policy Studies (PUBPOL)

Professor Jentleson, *Chair* (124 Sanford Institute Building); Professor Ladd, *Director of Graduate Studies* (214A Sanford Institute Building); Professors Ascher, Behn, Clotfelter, Cook, Dodge, Fleishman (law), Healy (environment), Hough (political science), Keyssar (history), Kuniholm, Ladd, Magat (business), Mickiewicz, Pearsall (engineering), Price (political science), Schroeder (law), and Sloan (economics); Associate Professors Conrad, Hamilton, Mayer, and Moore (business); Assistant Professors Korstad, Pickus, and Stangl (statistics); Assistant Research Professors Conover, Taylor, and Whetten-Goldstein; Professors of the Practice Brown, Harris, Jones, Lethem, Raspberry, Stubbing, and Tift; Adjunct Professor Yaggy; Visiting Professors Felsman and Lapp; Senior Research Scientist Vaupel; Lecturer Payne; Visiting Lecturers Ahearne, Coble, Kaufman, Lin, and Slawson

The Master of Public Policy (M.P.P.) degree requires two academic years, a summer internship, and a master's "memo" to be researched and written on a problem of current policy concern. The first year is devoted to core courses in policy analysis, quantitative methods, economics, political analysis, and ethics. The summer internship is with a federal, state, or local agency of government, a not-for-profit organization, or business. The second-year curriculum includes course work in public management, electives in substantive policy areas, and the master's "memo" (the equivalent of a master's thesis) on a problem of current policy concern for an actual client. In the first year, the fall semester core courses include: Microeconomics and Public Policy-Making (PPS 310), Politics of the Policy Process (PPS 314), Statistics and Data Analysis for Policymakers (PPS 222), Ethics and Policy-Making (PPS 316), and Policy Analysis I (PPS 304), plus at least one elective. In the spring, first-year students take Quantitative Evaluation Methods (PPS 231), Microeconomics: Policy Applications (PPS 232), and Policy Analysis II (PPS 304), plus at least one elective.

Students who are concurrently enrolled in a Ph.D. program or a professional degree program (M.D., J.D., M.B.A., M.E.M., etc.), or who have already obtained such a degree, can apply for a compressed version of the M.P.P. program. Such students complete the full first-year curriculum, the summer internship, and the master's "memo" and are excused from most second-year requirements. As a result, the M.P.P. can be completed in one additional year. Students usually apply for a joint-degree program simultaneously with their applications to the graduate departments or professional schools, or during their first or second year of advanced study. More information concerning the M.P.P. programs can be obtained by writing the Director of Graduate Studies or the Graduate Program Coordinator at the Sanford Institute of Public Policy, Box 90243, Duke University, Durham, NC 27708-0243 or e-mail mpp@pps.duke.edu. The Sanford Institute's web page address is <http://www.pubpol.duke.edu>.

Related Programs

In addition to the M.P.P., the Sanford Institute offers the Program in International Development Policy (PIDP) through its Center for International Development Research. This program provides from one semester to two years of training in policy analysis

and problems related to sustainable development. Professionals with several years' experience as practitioners or applied researchers in a development-related field are eligible to apply to the program. Participants in the program—known as PIDP fellows—pursue either a certificate or A.M. in International Development Policy while at Duke. See also the description elsewhere on the activities of the Center for International Development Research. Further information may be obtained by writing the Center for International Development Research, Box 90237, Duke University, Durham, North Carolina 27708-0237, or email cidr@pps.duke.edu.

216S. Economics of Education. 3 units. C-L: Economics 216S.

218. Macroeconomic Policy. Survey of macroeconomic theory and analysis of policies designed to reduce unemployment, stimulate economic growth, and stabilize prices. Conventional monetary and fiscal instruments, employment policies, and new policies designed to combat inflation. Instructor: Lapp. 3 units. C-L: Economics 218.

221S. Media and Democracy. Examines the relationship between mass media and democracy in the United States, other developed democracies, and societies in transition. Seeks to explain how the media cover politics and public policy, examining the nature of media institutions, the economics of news production and consumption, and the strategic interplay of politicians, journalists, editors, and other actors who influence the content of news. Instructor: Mickiewicz. 3 units.

222. Statistics and Data Analysis for Policymakers. 3 units. C-L: Statistics and Decision Sciences 210A.

235S. Setting the National Agenda for the Twenty-First Century. Focus on the proper role of the federal government in the future. Includes individual student research, culminating in a major research paper and oral presentation, on one of the four main roles of the government: taxes, entitlements, defense, and domestic programs. Instructor: Stubbing. 3 units.

238. Public Budgeting and Financial Management. Fund accounting for government; techniques of financial analysis, including break-even analysis, cost accounting, cash-flow analysis, and capital budgeting; and governmental budgeting, including the budgetary process and reforms, and the budget crunch in the public sector. Instructor: Stubbing. 3 units.

239. Nonprofit Leadership and Management. The impact of nonprofit organizations on public policy making; management and leadership skills for nonprofit organizations; laws affecting nonprofit organizations. Instructor: Staff. 3 units.

242S. Chinese Economy in Transition. 3 units. C-L: Economics 242S.

243S. Media in Post-Communist Societies (B). Comparative analysis of role and impact of media in formerly Communist societies of Europe. Discussion of television and electoral process, dilemmas of newspaper sector, issues of privatization, new technology, and editorial autonomy. Develops understanding of relevant Soviet-era history and contemporary context of problems and prospects across a number of different countries, with special attention to Russia. Research paper. Instructor: Mickiewicz. 3 units. C-L: Political Science 276S.

255S. Health Policy Analysis. Group analysis of a current health-policy problem. Project involves background research, data acquisition, analysis, writing, and presentation of a substantial policy report. Designed for candidates seeking the undergraduate certificate in health policy. Consent of instructor required. Instructor: Conover or Taylor. 3 units.

258S. International Environmental Regimes (B). 3 units. C-L: Political Science 271S.

259S. State and Local Public Finance. Analysis of state and local revenue sources, intergovernmental fiscal relations, budgets and expenditures, fiscal aspects of economic

development, and the municipal bond market. Policy topics include financing schools and transportation systems, tax policy, and current fiscal issues. Prerequisite: Public Policy Studies 217 or equivalent. Instructor: Ladd. 3 units. C-L: Economics 259S.

260S. Science and Technology Policy. Review of major political, international, and technical factors which led to the current world leadership of the United States in research and development. Examination of trends in federal and industry funding. Reasons for the federal government funding research, ways federal funds should be allocated, relationships among industry, government, and academia. Several current policy issues selected for in-depth analysis. Instructor: Ahearne. 3 units.

261. Evaluation of Public Expenditures. Basic development of cost benefit analysis from alternative points of view, for example, equity debt, and economy as a whole. Techniques include: construction of cash flows, alternative investment rules, inflation adjustments, optimal timing and duration of projects, private and social pricing. Adjustments for economic distortions, foreign exchange adjustments, risk and income distribution examined in the context of present value rules. Examples and cases from both developed and developing countries. Instructor: Conrad. 3 units. C-L: Economics 261, Environment 272.

262S. Seminar in Applied Project Evaluation. Initiate, develop, and perform a project evaluation. Range of topics include measuring the social cost of deforestation, the B1 Bomber, a child nutrition program, the local arts program. Prerequisite: Economics 285 or Public Policy Studies 261. Instructor: Conrad. 3 units. C-L: Economics 262S.

263S. Public Health Issues: Prevention and Management. Focus on prevention of diseases and health problems; funding, policy, and management decision making. Overview of public health interventions and outcomes in United States, Europe, and less industrialized nations. Emphasis on understanding the social construction of race and ethnicity and the impact of socioeconomic variables such as race, ethnicity, gender, income and education on health. Public health perspective applied to such topics as: HIV/AIDS; teen pregnancy; cocaine use during pregnancy; infant mortality and low birth weight; violence; major causes of mortality in less industrialized countries; and role of public health in state and national health reform. Instructor: Whetten-Goldstein. 3 units.

264. Advanced Topics in Public Policy. Selected topics. Instructor: Staff. 3 units.

264S. Advanced Topics in Public Policy. Selected topics. Seminar version of Public Policy Studies 264. Instructor: Staff. 3 units.

267S. Policy-Making in International Organizations (D). The behavior of international organizations in the fields of development, environment, and security, including their relationships with the governments of member countries and non-governmental organizations within these countries. Required research paper focusing on how these organizations can be established or adapted to face changing challenges in the three substantive fields. Instructor: Ascher. 3 units. C-L: Political Science 267S.

269S. The Regulatory Process (A). Study of theories in economics, political science, and law to examine the structure, conduct, and performance of U. S. regulatory agencies. Emphasis on why decisions are delegated to agencies, the degree to which regulators behave strategically, and the impact of regulatory actions on society. Focus on political and economic roots of scientific and technological debates in regulatory policy. Required research paper on origins and effectiveness of a particular regulation. Instructor: Hamilton. 3 units. C-L: Political Science 268S.

270S. History of Poverty in the United States. 3 units. C-L: History 211S.

271S. Schools and Social Policy. Overview and selected current policy issues related to K-12 education. Includes small-group research projects that require data analysis, literature searches, and interviews with education policy makers. Instructor: Ladd. 3 units.

272. Resource and Environmental Economics. C-L: Environment 270, Economics 270.

274. Resource and Environmental Policy. Development of a policy analysis framework for studying resource and environmental policy. Political institutions, interest group theory, public choice theory, role of economics in policy analysis, ethics and values. Application to current and historical United States policy issues. Instructor: Staff. 3 units. C-L: Environment 274.

275S. Seminar in Urban Politics and Urban Public Policy (A). 3 units. C-L: Political Science 274S.

280S. Philanthropy, Voluntarism, and Not-for-Profit Management (Seminar). An examination of the role and functioning of the not-for-profit sector in relation to both the public sector and the private for-profit sector in dealing with significant social problems. Instructor: Fleishman. 3 units.

284S. Public Policy Process in Developing Countries (B). How the distinctive characteristics of developing and transitional countries affect the patterns of public policymaking, especially in the areas of economic, environmental, and cultural policy. Examining cases from Latin America, formerly socialist countries, Africa, and Asia, through readings and student research papers, to illuminate both the commonalities and differences in how the policy process faces problems ranging from conservation to multilingualism. Instructor: Ascher. 3 units. C-L: Political Science 284S.

285. Land Use Principles and Policy. 3 units. C-L: Environment 285.

290S. Glasgow Seminar in Public Policy. Analysis of the British political system and important public policy problems in Britain including: privatization, Britain and the European community, and economic and social policy. (Taught in Scotland.) Prerequisite: Public Policy Studies 55D, two of the core courses (PPS 110, 112, 114, or 116), and consent of director of undergraduate studies. Instructor: Staff. 3 units.

303. Policy Analysis I. Introduction to policy analysis and advising. Emphasis on written and oral communication skills, the substance of public policies, and the role of policy analysts. Open to public policy studies M. P. P. students only. Instructor: Staff. 3 units.

304. Policy Analysis II. The role and influence of policy analysis. The examination of specific public policy cases and recommendations for action. Emphasis on written and oral communications skills. Open to public policy studies M. P. P. students only. Instructor: Staff. 3 units.

306S. Special Topics in Public Policy. Selected topics. Prerequisite: graduate level. Instructor: Staff. 1-3 units. Variable credit.

307. Policy Analysis III: Research Tutorial in Public Policy. Emphasis on individual or group projects. Preparation for Master's Memo. Open to public policy studies M. P. P. students only. Prerequisite: for 308: Public Policy Studies 307 or consent of instructor. Instructor: Staff. Variable credit.

308. Policy Analysis III: Research Tutorial in Public Policy. Emphasis on individual or group projects. Preparation for Master's Memo. Open to public policy studies M. P. P. students only. Prerequisite: for 308: Public Policy Studies 307 or consent of instructor. Instructor: Staff. 3 units.

310. Microeconomics and Public Policy-Making. Consumption and production theory, welfare economics, theories of collective choice, market structures and regulation, and nonmarket decision making. Not open to students who have taken Public Policy Studies 110. Graduate status only. Instructor: Clotfelter or Ladd. 3 units.

311. Microeconomics: Policy Applications. Cost benefit analysis of public programs. Public utility regulation, pollution regulation, hospital rate setting, regulation of product safety. Quantitative methods and microeconomic theory for analysis of both normative and positive aspects of economic policy. Graduate status only. Prerequisites:

Economics 149 or Public Policy Studies 110 or 217 and familiarity with regression analysis or concurrent enrollment in Public Policy Studies 231. Instructor: Conrad, Ladd, or Moore. 3 units. C-L: Economics 306.

313. Quantitative Evaluation Methods. Problems in quantifying policy target variables such as unemployment, crime, and poverty. Experimental and nonexperimental methods for evaluating the effect of public programs, including topics in experimental design, regression analysis, and simulation. Graduate status only. Prerequisite: Public Policy Studies 222 or equivalent. Instructor: Cook or Stangl. 3 units.

314. The Politics of the Policy Process. The formulation of public policies, substantive policies in a variety of contexts from local government to international affairs; the role of legislatures, interest groups, chief executives, and the bureaucracy in defining alternatives and in shaping policy from agenda formulation to implementation. Graduate status only. Instructor: Ascher or Mayer. 3 units.

315. Public Management I. Operations management, information and performance, personnel management, public sector marketing. Instructor: Behn. 3 units.

316. Ethics and Policy-Making. Normative concepts in politics, liberty, justice, and the public interest: historical and philosophical roots, relationship to one another and to American political tradition, and implications for domestic and international problems. Not open to students who have taken Public Policy Studies 116. Graduate status only. Instructor: Pickus. 3 units. C-L: Political Science 319.

325S. A-I. Program in International Development Policy Sector Seminar. Topics in policy issues and institutional structures of sectoral policy-making in less developed countries. Open only to Fellows of the Program in International Development Policy, or by consent of instructor.

- A. Urban and Rural Development in Developing Countries
- B. Natural Resources and Environmental Policy-making
- C. Urban Environmental Issues in Developing Countries
- D. Restructuring the Energy Sector in Developing Countries
- E. Privatization and the Role of the State in Development
- F. Designing Human Resource Development Programs
- G. Institutional Design for Managing the Environment
- H. Managing the Project Cycle for Sustainable Development
- I. Communities and Sustainable Development in Latin America.

Instructor: Staff. 1 to 4 units. Variable credit.

326S. A-I. Program in International Development Policy Sector Seminar. Topics in policy issues and institutional structures of sectoral policy-making in less developed countries. Open only to Fellows of the Program in International Development Policy, or by Consent of instructor.

- A. Urban and Rural Development in Developing Countries
- B. Natural Resources and Environmental Policy-making
- C. Urban Environmental Issues in Developing Countries
- D. Restructuring the Energy Sector in Developing Countries
- E. Privatization and the Role of the State in Development
- F. Designing Human Resource Development Programs
- G. Institutional Design for Managing the Environment
- H. Managing the Project Cycle for Sustainable Development
- I. Communities and Sustainable Development in Latin America.

1 to 4 units. Variable credit.

327S. A-I. Program in International Development Policy Issue Seminar. Topics in policy issues and institutional structures of sectoral policy-making in less developed countries. Consent of instructor required.

- A. Appropriate Technology and Technology Transfer
- B. Economic Analysis of Nonrenewable Resources
- C. State Reform and Social Sector Policy in Developing Countries
- D. Technology Transfer and Foreign Aid to Developing Countries
- E. Structural Adjustment and Poverty
- F. Economic Analysis of Development
- G. Project Evaluation and Development Policy
- H. Economic Foundations of Development Policy
- I. International Trade and Finance Policy.

Instructor: Staff. 1 to 4 units. Variable credit.

328S. International Development Policy Issue Seminar. Topics in policy issues and institutional structures of sectoral policy-making in less developed countries. Consent of instructor required.

- A. Appropriate Technology and Technology Transfer
- B. Economic Analysis of Nonrenewable Resources
- C. State Reform and Social Sector Policy in Developing Countries
- D. Technology Transfer and Foreign Aid to Developing Countries
- E. Structural Adjustment and Poverty
- F. Economic Analysis of Development
- G. Project Evaluation and Development Policy
- H. Economic Foundations of Development Policy
- I. International Trade and Finance Policy.

Instructor: Staff. 1 to 4 units. Variable credit.

386. Independent Research Topics in International Development Policy. Selected topics. Consent of instructor required. Instructor: Staff. 3 units.

387. Master's Project in International Development Policy. Emphasis on individual projects. Open to PIDP students only. Consent of instructor required. Instructor: Staff. 1 to 4 units. Variable credit.

399. Special Readings in Public Policy Studies. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

251S. Regulation of Vice and Substance Abuse

253. The Politics of Health Care (A)

257. United States Policy in the Middle East

265S. The Process of International Negotiation (D)

286S. Economic Policy-Making in Developing Countries

Religion (RELIGION)

Professor Lawrence, *Chair* (123A Gray); Professor Steinmetz, *Director of Graduate Studies* (209A Divinity School); Professors Bland, Carroll, Clark, Crenshaw, Hauerwas, Hays, Heitzenrater, Hillerbrand, Jones, Kort, Lischer, C. Meyers, E. Meyers, Richey, E. Sanders, D. M. Smith, Surin, Van Rompay and Wainwright; Associate Professors Berger, Fulkerson, Huetter, Keefe, Peters, Turner, and Wacker; Assistant Professors Battle, Hall, Hart, Jennings, Joyce, LaRocca-Pitts, Nickerson and Prasad

The Graduate Program in Religion offers graduate work in two programs leading to the A.M. and Ph.D. degrees. In Program I, students may concentrate their studies in

one of three academic supervisory groups (ASGs): ASG 1 (Biblical Studies, Ancient Judaism, and Ancient Christianity); ASG 2 (Historical Studies in Religion) (ASG 2 supervises the doctoral studies of students working in the history of Judaism, Christianity [excluding the late ancient period], Islam, and Asian Religions); and ASG 3 (Theological, Cultural, and Critical Studies).

Applicants should make clear the subdiscipline (or at least the general area) in which they wish to concentrate, e.g., medieval Islam, early Judaism, contemporary Christian ethics, critical theory. In addition, students may apply to Program II, which permits more interdisciplinary work and more courses outside the graduate program in religion.

Students will be expected to take courses which will contribute to an adequate understanding of their chosen fields of specialization and will be required to take two written preliminary examinations within their field of concentration. In addition to course work in their major field, students will take such other courses in cognate fields as will contribute to the enrichment of their major studies and will be required to take one written preliminary examination in a single cognate area within the program. A minor requirement may be fulfilled in the program or by work in a cognate department, such as Women's Studies, English, History, Literature, Philosophy, Political Science, or Sociology, and will constitute the outside minor and material for a fourth written preliminary examination. There is, in addition, an oral examination conducted by the student's committee immediately subsequent to the written examinations. A foreign language requirement of two languages must be met before taking the doctoral preliminary examination.

The program of doctoral studies presumes a foundation in the academic study of religion. Students applying for graduate work in religion directly from an undergraduate program should have had a strong undergraduate major in religion. For more information, visit the Department of Religion's web site at <http://www.duke.edu/religion/> or send email to gtrotter@duke.edu.

For Seniors and Graduates

203. Studies in American Methodism. Research seminar devoted to selected topics in the Wesleyan and Methodist traditions in America. Instructor: Richey. 3 units.

204. Origen. The systematic and apologetic writings of an important Alexandrian thinker and exegete of the third century. Instructor: Clark. 3 units. C-L: Medieval and Renaissance Studies 204.

206. The Christian Mystical Tradition in the Medieval Centuries. Reading and discussion of the writings of medieval Christian mystics (in translation). Each year will offer a special focus, such as: women at prayer; fourteenth-century mystics; and Spanish mystics. Less well-known writers as well as giants will be included. Instructor: Keefe. 3 units.

207. Hebrew Prose Narrative. Focus on the grammar, syntax, and prose style of classical Hebrew composition; a comparative reading of modern and precritical Jewish and Christian commentary. Readings spanning the spectrum from the early Hebrew prose of Genesis and I and II Samuel to the late compositions of Chronicles and Ezra-Nehemiah. One year of classical Hebrew required. Instructor: Crenshaw or LaRocca-Pitts. 3 units.

208. Classical Hebrew Poetry: An Introduction. The problem of defining and understanding what is "poetic" in classical Hebrew. Theories of Hebrew poetry from Lowth to Kugel and O'Connor illustrated with readings from Psalms, Isaiah, Job, and Jeremiah. One year of classical Hebrew required. Instructor: Crenshaw or LaRocca-Pitts. 3 units.

212. Theories of Religion. Late nineteenth- and twentieth-century theories, interpretations, and approaches to the study of religion. Instructor: Cornell or Hart. 3 units.

214. Feminist Theology. Examination of feminist theologians and religionists, their critical perspective on the Christian tradition and constructive proposals out of the resources of "female experience." Instructor: Fulkerson. 3 units.

215. Biblical Interpretation in Early Christianity. How early Christian writers of the second–mid-fifth centuries made meaning of the Scriptures in their own, postbiblical environments. Focus on the new historical, religious, and theological situations that required new readings of scriptural texts, the role of heresy and the ascetic movement in the development of biblical interpretation and canon development, and special problems that arose around these issues. Instructor: Clark. 3 units.

216. Syriac. The script and grammar, with readings from the Syriac New Testament and other early Christian documents. Prerequisite: some knowledge of Hebrew and Aramaic. Instructor: Staff. 3 units.

217. Islam and Islamic Art in India. To engage and enjoy the intellectual and social history and the religious, literary, and aesthetic legacy of the several Muslim communities of South Asia. Focus on the major creative saints/scholars/leaders of institutional Sufism. Includes a gallery field trip. Instructor: Lawrence. 3 units. C-L: Art History 217.

219. Augustine. The religion of the Bishop of Hippo in late antiquity. Instructor: Clark. 3 units. C-L: Medieval and Renaissance Studies 216.

220. Rabbinic Hebrew. Interpretive study of late Hebrew, with readings from the Mishnah and Jewish liturgy. Instructor: E. Meyers or staff. 3 units.

222. John among the Gospels. A consideration of the character, content, and purpose of the Gospel of John in relation to the synoptic and apocryphal gospels. Prerequisite: one year of Hellenistic Greek. Instructor: M. Smith. 3 units.

223. A-G. Exegesis of the Hebrew Old Testament.

- A. Pentateuch
- B. Historical Books
- C. Major Prophets
- D. Minor Prophets
- E. Writings
- F. Proverbs
- G. Genesis

Instructor: Staff. 3 units.

224B. Comparative Semitic II. An introduction to the morphology and syntax of classical Arabic and the Semitic languages of Palestine-Syria, together with a consideration of their relationships to Hebrew. Instructor: Staff. 3 units.

225. Living Issues in New Testament Theology. Critical examination of major problems and issues in New Testament interpretation and theology. Instructor: Staff. 3 units.

226. A-F. Exegesis of the Greek New Testament I.

- A. Matthew
- B. Romans
- C. Mark
- E. The Gospel and Epistles of John
- F. I and II Corinthians

Instructor: Staff. 3 units.

227. A-E. Exegesis of the Greek New Testament II.

- A. Luke
- B. Galatians
- C. The Pastoral Epistles

D. Epistles of Peter and James

E. Acts.

Instructor: Staff. 3 units.

227F. Exegesis of the Greek New Testament II: The Synoptic Gospels. Concentration on the "classical" methods of studying the synoptic gospels: source criticism, form criticism, and redaction criticism. Students expected to become proficient in using the Greek synopsis. Prerequisite: two years of Greek or the equivalent. Instructor: Sanders. 3 units.

230. Sainthood in Comparative Perspective. Examination of the ethical and religious dimensions of sainthood, saint cults, and sacred biography from a multidisciplinary and comparative perspective. Instructor: Cornell. 3 units.

231S. Seminar in Religion and Contemporary Thought. Analytical reading and discussion of such critical cultural analysis as is found in the works of Polanyi, Arendt, Trilling, and others, with appraisal of the relevance of theological inquiry. Instructor: Staff. 3 units.

232S. Religion and Literary Studies. Theories concerning the relation of religion to literary forms, particularly narrative. Instructor: Kort. 3 units.

233. Modern Fiction and Religious Belief. A study of kinds of religious meaning or significance in representative American, British, and continental fiction of the first half of the twentieth century. Instructor: Kort. 3 units.

234. Early Christian Asceticism. The development of asceticism and monasticism in the first six centuries of Christianity. Instructor: Clark. 3 units. C-L: Medieval and Renaissance Studies 234A, Women's Studies.

235. Heresy: Theological and Social Dimensions of Early Christian Dissent. Instructor: Clark. 3 units. C-L: Medieval and Renaissance Studies 234B.

236. Luther and the Reformation in Germany. The theology of Martin Luther in the context of competing visions of reform. Instructor: Steinmetz. 3 units.

239. Introduction to Middle Egyptian I. Grammar and readings in hieroglyphic texts relating to the Old Testament. Instructor: Staff. 3 units.

240. Introduction to Middle Egyptian II. Readings in Middle Egyptian and introduction to New Egyptian grammar. Prerequisite: Religion 239. Instructor: Staff. 3 units.

241. Classical Islamic Theology and Ethics. Islamic theology and ethical philosophy: topics include the nature of God, free will and predestination, Aristotelian and Neoplatonic influences on Islamic thought, the construction of orthodoxy, ethical rationalism and voluntarism, and Islamic moral philosophy. Instructor: Cornell. 3 units. C-L: African and African American Studies 241, Medieval and Renaissance Studies 244.

244. Archaeology of Palestine in Hellenistic-Roman Times. The study of material and epigraphic remains as they relate to Judaism in Hellenistic-Roman times, with special emphasis on Jewish art. Instructor: E. Meyers. 3 units.

245. Special Topics in Religion. Subject varies from semester to semester. Instructor: Staff. 3 units.

246. Problems in Historical Theology. Consent of instructor required. Instructor: Staff. 3 units.

247. Readings in Latin Ecclesiastical Literature. Readings in Latin of pastoral, theological, and church-disciplinary literature from the late patristic and medieval period. Prerequisite: knowledge of Latin. Instructor: Keefe. 3 units.

250. Women in the Medieval Church. The history of the medieval Church told from its women figures: the life and writings of saints, heretics, abbesses, queens, mystics, recluses, virgins, bishops' wives, and reformers. Instructor: Keefe. 3 units.

251. Goodness and Personhood. Concepts of "the good" are inextricably linked to the way in which personhood is understood. This seminar treats texts both ancient and

recent that address such issues as the relationship between the finitude of human life and its meaningfulness, the metaphors of the "inner" life and "centeredness," the differences and affinities between reason and desire, and the significance of the notions of presence and transcendence. Authors include the writers of the Song of Songs and Job, Plato, Augustine of Hippo, Iris Murdoch, and Martha Nussbaum. Instructor: Staff. 3 units.

252. Feminist Theology from the Third World. An introduction to feminist theolog-ies as they have emerged from the (so-called) Third World in the last two decades in the context of three particular ecclesial developments of the twentieth century: the emer-gence of a global Christian women's network through the Ecumenical Movement, feminist theology in the first world, and liberation theologies in the Third World. Instructor: Berger. 3 units.

254. Justice, Law, and Commerce in Islam. History and schools of Islamic jurispru-dence; Islamic legal reasoning; approaches to ethics and procedural justice, the ethical regulation of commerce, including a detailed study of pertinent issues in Islamic law. Instructor: Cornell. 3 units. C-L: African and African American Studies 254, Medieval and Renaissance Studies 254.

256. John Wesley in Controversial and Ecumenical Theology. A study of John Wesley and his theology: his engagements with other confessional traditions, and his views on such matters as church, ministry, sacraments, and authority. Relation to con-temporary theology, especially "Faith and Order." Instructor: Wainwright. 3 units.

257. New Testament Ethics. The distinctive patterns of ethical teaching in the vari-ous New Testament writings and consideration of the various ways in which the New Testament might inform contemporary ethical reflection. Representative uses of the New Testament in theological ethics (for example, Niebuhr, Barth, Yoder, Hauerwas, Schussler Fiorenza, Gutierrez) and selected topics (for example, violence, divorce, anti-Judaism, abortion, wealth, and poverty). Instructor: Hays. 3 units.

258. Coptic. Introduction to the Sahidic dialect with selected readings from Chris-tian and Gnostic texts. Prerequisite: one year of Greek or consent of instructor. Instructor: Staff. 3 units.

260. Life and Times of the Wesleys. A seminar on John and Charles Wesley and their colleagues in relation to English culture and religion in the eighteenth century. Instructor: Heitzenrater. 3 units.

262. Special Topics in Gender and Religion. Study of gender and sexualities; emphasis on cultural and social constructions of womanhood, masculinity, and sexual identities in the American context. Instructor: Joyce. 3 units.

265S. American Pragmatism: Religion, Metaphysics, Morals. Study of American pragmatism from Charles S. Peirce to Richard Rorty. The differences—phenomenolog-ical, radical empiricist, naturalist, idealist, and instrumentalist—that both connect and divide pragmatists. Instructor: Hart. 3 units.

266. Ethics and Health Care. Instructor: H. Smith. 3 units.

267. American Religious Thought. Examination of selected classic studies of American religious thought. Instructor: Joyce, Richey, or Wacker. 3 units.

270. Evangelical Traditions in America. A study of some of the major themes in the development of transdenominational evangelicalism and fundamentalism in America from the eighteenth century to the present. A reading seminar involving analyses and discussions of literature (mostly secondary works) important for understanding Amer-ican evangelicalism as a distinct movement. Instructor: Wacker. 3 units.

272. A-B. The Early Medieval Church.

A. Selected Readings in Early Medieval Religious Studies

B. Social History of the Church in Europe Prerequisite: knowledge of Latin

Instructor: Keefe. 3 units.

276. The Sacraments in the Patristic and Early Medieval Period. A study of the celebration and interpretation of baptism or eucharist in the church orders and texts of the early church writers. Instructor: Keefe. 3 units.

284. The Religion and History of Islam. Investigation of the historical study of Islam: historiography as a discipline, the historical study of Islam in the Western world, Muslim views of Islamic history. Required critical essays and major research paper. Instructor: Cornell or Lawrence. 3 units.

287. Popular Religion. An interdisciplinary, theory- and method-oriented approach to popular religion and the roles it plays in contemporary and past societies. Instructor: Nickerson. 3 units. C-L: History 287A.

293. Religious Issues in American History. A reading seminar devoted to selected topics, problems, and issues in American religion. Instructor: Joyce, Richey, or Wacker. 3 units.

For Graduates

302. Theology of John Wesley. Critical examination of selected texts of John Wesley with attention to their social and cultural contexts. Instructor: Heitzenrater. 3 units.

303. The Old Testament in the New: New Testament Writers as Interpreters of Scriptures. This doctoral seminar examines the ways in which New Testament authors read and interpreted Scripture. Working knowledge of Greek and Hebrew required. Instructor: Hays. 3 units.

304. Aramaic. A study of the Aramaic portions of the Old Testament and selected passages from the Elephantine and Qumran texts. Instructor: E. Meyers or staff. 3 units.

305. The Septuagint. A study of the modern critical use of the Greek Old Testament. Prerequisite: knowledge of Greek and Hebrew. Instructor: Peters. 3 units.

309. Hermeneutics. Consideration of the nature of understanding and of several interpretive methods—such as phenomenological, existential, historical, literary, structural—along with their application to New Testament texts, primarily the parables of Jesus. Instructor: Staff. 3 units.

310. Readings in Judaica. Selected studies in Jewish material culture and problems in Jewish religious and intellectual history. Instructor: Bland, E. Meyers, and staff. 3 units.

311. Pharisaic Judaism in the First Century. A reading course in first-century Pharisaic Judaism. Instructor: Sanders. 3 units.

315A. Problems in the Study of Paul. Justification and the law in light of the chronology of the letters. A series of advanced seminars that combine study of a theological issue with an analysis of a nontheological problem (literary, historical, social). Prerequisite: at least one Greek exegesis course in the Pauline letters. Instructor: Sanders. 3 units.

320. Origins of Orthodoxy 380-750 C. E. Introduction to the development of eastern Christian theology during period between pro-Nicene theologies to the death of John of Damascus. Instructor: Ayres. 3 units.

324. Readings in the History of Religion. An examination of the theories, methods, and purposes of the study of non-Western religions within the Western tradition. Instructor: Staff. 3 units.

326. Philosophical Theology II. Continuation of Philosophical Theology I. Instructor: Hauerwas. 3 units.

329. Readings in Theology and Language. Sample treatments of religious language in linguistic analysis, hermeneutical theory, literary criticism, liturgical practice, and fundamental theology. Instructor: Wainwright. 3 units.

333. The Doctrine of the Trinity. Biblical bases, patristic developments, contemporary statements and connections. Instructor: Wainwright. 3 units.

337. Theology of St. Thomas Aquinas. Intensive reading of the *Summa Theologica* and biblical commentaries. Instructor: Steinmetz. 3 units.

338. Calvin and the Reformed Tradition. The theological development of John Calvin. A comprehensive examination of his mature position with constant reference to the theology of other reformers. Instructor: Steinmetz. 3 units.

339. The Radical Reformation. Protestant movements of dissent in the sixteenth century. Special attention will be devoted to Müntzer, Carlstadt, Hubmaier, Schwenckfeld, Denck, Marpeck, Socinus, and Menno Simons. Instructor: Steinmetz. 3 units.

340. Seminar in the New Testament. Research and discussion on a selected problem in the biblical field. Spring only. Instructor: Staff. 3 units.

341. Seminar in the New Testament. Research and discussion on a selected problem in the biblical field. Spring only. Instructor: Staff. 3 units.

345. Catholic Moral Theology: Its History and Contemporary Issues. The development of Catholic social and moral theory from a historical and analytical perspective. Study of the Catholic social encyclicals as well as the casuistical tradition. Reading of works by Rahner, Haering, Fuchs, Schuller, McCormick, and Curran. Instructor: Hauerwas. 3 units.

348. Seminar in Theological Ethics. Philosophical paradigms and the nature of the Christian life. Instructor: Hauerwas. 3 units.

349. Interpretations of American Religion. An opportunity for advanced students in North American religious studies to deepen their understanding of some of the major questions in the field. Examination of how religious history is actually written—with special attention to the imaginative and moral motivations that enter into that process. Instructor: Wacker. 3 units.

350. Old Testament Seminar. Research and discussion on selected problems in the Old Testament and related fields. Fall only. Instructor: Staff. 3 units.

351. Old Testament Seminar. Research and discussion on selected problems in the Old Testament and related fields. Fall only. Instructor: Staff. 3 units.

352. Seminar in Christian Theology. Research and discussion of a selected problem in the systematic field. Instructor: Staff. 3 units.

354. Contemporary American Religion. A seminar dealing with trends in American religion in the twentieth century; critical assessment of primary paradigms for interpreting American religious change, and examination of major characteristics and issues facing American religion. Instructor: Carroll. 3 units.

355. Islam and Its World. An introduction to the Qur'an, theological doctrines, Islamic law and its interpretations, the Islamic state, the religious "establishment," Sufism, and the sectarian differences between Sunni and Shi'ite Islam as it is practiced in Cairo. Instructor: Cornell. 3 units.

356. History and Culture of Islamic Cairo. Focus on the evolution of Islamic Cairo, also emphasizing the basis of Islam's wealth, its agriculture, industry, and trade. Instructor: Cornell. 3 units. C-L: History 356.

360. Special Problems in Religion and Culture. Intensive investigation of the relations of religion and modernity, using seminal contemporary texts. Topics announced each semester. Consent of instructor required. Instructor: Staff. 3 units.

362. Readings in Old Testament and Semitic Studies. Selected studies in the Hebrew Bible and the languages and literatures of the ancient Near East. Instructor: Staff. 3 units.

363. Readings in New Testament and Christian Origins. Selected studies on a theme in modern New Testament scholarship. Instructor: Staff. 3 units.

364. Readings in History of Christianity. Selected issues in the social, material, and intellectual history of Christianity. Instructor: Staff. 3 units.

365. Readings in Christian Theology and Ethics. An examination of selected topics of historical and contemporary interest in these fields. Instructor: Staff. 3 units.

366. Readings in History of Religions. Selected studies in cross-cultural and inter-tribal material, together with assessment of the problems they pose for the study of religion. Instructor: Staff. 3 units.

367. Readings in Religion and Culture. Analysis and discussion of theories and of individual research projects. Instructor: Staff. 3 units.

381. Destinations. Consideration of architectures of play, escape, and healing. History and physical form of sites from antiquity to the present (for example, the Roman and Byzantine spa at Hieropolis, the pilgrimage shrine at Lourdes; DisneyWorld) studied through primary sources and theoretical texts. Instructor: Wharton. 3 units. C-L: Art History 381.

383. Moral Theology in the Twentieth Century. Critical and comparative examination of ethical theory as exhibited in the work of selected contemporary theologians. Instructor: H. Smith. 3 units.

389. Christian Ethics and Contemporary Culture. A study of the interaction between Christian thought and current social theory. Instructor: Staff. 3 units.

391. Special Readings in Religion. Readings vary from semester to semester. Consent of instructor required. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

200. Person and Work of Christ

201. Studies in Intertestamental Literature

205. War and the Christian Tradition

209. Old Testament Theology

211. Authority in Theology

213. Christian Ethics in America

218. Religions of East Asia

221. Readings in Hebrew Biblical Commentaries

224A. Comparative Semitic I

229S. Old Church Slavonic

237. History of the Ancient Near East

242. Life after Death in Semitic Thought

243. Archaeology of Palestine in Biblical Times

249. The Lord's Prayer

253. Feminist Theory and the Study of Christianity

255. Christians in Religious Dialogue

259. Icon Theology

261. Islam in the African-American Experience

263. Third World Theology

264. The Sociology of the Black Church

268. Revelation and Authority in the Church

271. Christologies of the Early Church

274A. Philosophies, Sciences, and Theologies of the European Enlightenment: Descartes to Kant

274B. Philosophies, Sciences, and Theologies after the European Enlightenment: Schleiermacher to Troeltsch

275S. Topics in Early Christian and Byzantine Art

- 277. Judaism in the Greco-Roman World
- 279. Understandings of the Resurrection in Contemporary Thought
- 280. The History of the History of Religions
- 283. Islam and Modernism
- 286. The Second Vatican Council (1962-1965)
- 288. Buddhist Thought and Practice
- 289. Theology and Contemporary Secular Understanding of Human Nature
- 290. Current Problems in Christian Social Ethics
- 291. Historical Forms of Protestant Ethics
- 292. Happiness, Virtue, and Friendship
- 294. Christianity and American Society
- 295. Religion in the American South
- 296. Community, Faith, and Violence
- 297. Philosophical and Theological Discourses on Modernity
- 298. Christian Encounters with Other Religions
- 299. The Christian Understanding of Human Nature and Destiny
- 300. Systematic Theology
- 301. Seminar in Contemporary Christian Ethics
- 304A. Targumic Aramaic
- 312. Pauline Theology
- 314. Judaism and Christianity in the New Testament
- 316S. History of Religions
- 319. The Gospel According to Saint Matthew in Recent Research
- 321. The Theology of Paul: Structure and Coherence
- 322. Nineteenth-Century European Theology
- 325. Philosophical Theology I
- 327. Philosophical Method in Religious Studies
- 328. Twentieth-Century European Theology
- 330. Contemporary Christologies
- 331. Eschatology
- 332. System in Theology
- 334. Theology and Reform in the Later Middle Ages
- 335. The English Church in the Eighteenth Century
- 342. American Religious Biography
- 343. Readings in Ancient Near Eastern Wisdom Literature
- 344. Zwingli and the Origins of Reformed Theology
- 346. Practical Reason and Personal Identity: Explorations in Narrative
- 347. Hebrew Narrative Art
- 353. Seminar on Text Criticism
- 373. Elementary Akkadian
- 374. Elementary Akkadian
- 380. Existentialist Thought
- 386. Christianity in Dialogue with Other Faiths
- 387. Ethical Method 388. Ethics and Medicine
- 397. Readings in North American Religious History
- 398. Colloquium on the Teaching of Religion

Romance Studies

Professor Bell, *Chair* (205 Languages); Associate Professor Longino, *Director of Graduate Studies* (219C Languages); Professors Caserta, Garci-Gómez, Jameson, Kaplan, Mignolo, Moi, Orr, Pérez Firmat, Stewart, Tetel, and Thomas; Associate Professors Finucci, Greer, Moreiras, Sieburth, Solterer, and Vilarós; Assistant Professors Dainotto, Fischer, Hardt, Higgins, Jonassaint, Nouzeilles and Viego; Research Associate Professor Keineg; Associate Professor of the Practice and Director of Language Programs Tufts; Assistant Professor of the Practice de la Fuente, and Damasceno; Research Professor Dorfman;

The Department of Romance Studies offers graduate work leading to the Ph.D. in French/Francophone Studies and Spanish/Latin American Studies; it also offers a new Ph.D. track in Romance Studies, including Italian and Luso-Brazilian. Related work is required in any one or two of a number of other subject areas. A reading knowledge of one foreign language that is outside the major language is required. (For those following the Romance Studies track, proficiency in two or more languages is required.) In order to undertake graduate study in any of the Romance programs, the entering student should have credit for at least 18 semester hours (or equivalent) above the intermediate level in the major language.

FRENCH STUDIES (FRENCH)

For Seniors and Graduates

200S. Seminar in French Literature. Cross-cultural analysis of literary and cultural topics focusing on specific objects of inquiry. May be repeated. Instructor: Staff. 3 units.

212. Structure of French. Modern French phonology, morphology and syntax. Pragmatic interpretation of the current modes of use, including language levels, situationism, and interrelations. Readings in current linguistic theory. Instructor: Thomas. 3 units.

223. Semiotics for Literature. Theoretical writings in general semiotics by Frege, Peirce, Saussure, Mukarovsky, and Morris and their applications for textual analysis of French literary works by representative contemporary critics such as Eco, Riffaterre, Corti, and Greimas. Taught in English. Instructor: Thomas. 3 units. C-L: Literature 280.

240. Medieval Narrative. The literatures and cultures of premodern France. Introduction to vernacular languages. Topics include literacy, orality, the experience of allegory, fictionality, the uses of the past. Major writers include Chrétien de Troyes, troubadours and trouvères, Guillaume de Machaut, Christine de Pizan, Alain Chartier. Instructor: Solterer. 3 units. C-L: Medieval and Renaissance Studies 240.

247. Early Modern Studies. Pursuits of knowledge and the shaping of the individual. Literature of travel, science, sexuality, meditation, worldliness, theater, politics by well known and lesser known authors of seventeenth-century France, with commentary by contemporary critics and theorists (Foucault, Bourdieu, Said). Genres may include fables, letters, memoirs, sermons, treatises, novels, plays. Topics may vary, but will focus on problems of identity, methodology, gender, spirituality, sociability, and state-making. Instructor: Longino. 3 units.

251. Topics in French Literature of the Eighteenth Century. Close study of a particular author, genre, or interpretive category of Enlightenment literature. Instructor: Stewart. 3 units.

256. Modern Literature and History. The interaction of history and literature in a particular period, for example: the occupation of France, the French Revolution. Problems of interpretation, historical memory, social identity, and narrative. Instructor: Kaplan, Orr, or staff. 3 units. C-L: History 256.

For Graduates

300. Graduate Reading Course. An intensive course in French to develop rapidly the ability to read French in several fields. Graduate students only. Instructor: Staff. 0 units.

315. Medieval Theater and Modernist Theatricality. A comparative study of the theatrical culture of premodern France and *mises en scène* from 1910-1945. Medieval works will range from mystery, miracle, and carnival plays to legal trials and ordeals. Modernist works will include d'Annunzio, Artaud, Cocteau, Giraudoux, and Claudel. Instructor: Solterer. 3 units.

325. Topics in Renaissance Prose. Rabelais, Marguerite de Navarre, Montaigne, and others. Instructor: Tetel. 3 units.

326. Topics in Renaissance Poetry. Instructor: Tetel. 3 units.

347. Topics in Seventeenth-Century French Literature. Includes genres, authors, movements, and works. Instructor: Longino. 3 units.

348. The Enduring Classic. Studies of the influence of the French classics over time and their function in the formation of French collective identity. Instructor: Longino. 3 units.

349. The Epistolary Genre. Fundamental questions of referentiality, materiality, and communication in writing. The first half is theoretical; the second explores issues raised through a selection of readings across time. Attention to gender and genre considerations. Instructor: Longino. 3 units.

351. Literature of the Eighteenth Century. Problems of literary history, critical reading, and interpretation, focused on varying topics. Instructor: Stewart. 3 units.

352. Literature of the Eighteenth Century. Problems of literary history, critical reading, and interpretation, focused on varying topics. Instructor: Stewart. 3 units.

355. Romantic Literature and French Culture and Politics. A study of French literature in the context of postrevolutionary society and culture. Readings might include nineteenth-century poetry (Hugo, Desbordes-Valmore), theater (Musset), political or philosophical prose, and historical discourse as well as contemporary critical and historical analyses of the period. Instructor: Orr. 3 units.

356. Topics in Nineteenth-Century French Literature. Includes genres, authors, movements, and works. Instructor: Bell, Jameson, Orr, or Thomas. 3 units.

366. Topics in Twentieth-Century French Literature. Includes genres, authors, movements, and works. Instructor: Kaplan, Moi, or Thomas. 3 units.

367. Contemporary French Novel. A chronological and theoretical approach to the major writers and movements since 1970. Selections from Duras, LeClézio, Sallenave, Modiano, Sollers, Tournier, Oulipo, Yourcenar, and others. Instructor: Kaplan, Orr, or Thomas. 3 units.

368. Structuralism. An introduction to contemporary French philosophy with a focus on the notions of identity and difference, the human origin of truth and the question of enunciation. The work of Claude Lévi-Strauss or Michel Foucault will be considered as a paradigm. Additional readings might include chapters from Georges Canguilhem, Vincent Descombes, Jean Hyppolite, Alexandre Kojève, Maurice Merleau-Ponty, and Elliott Valenstein. Instructor: Mudimbe. 3 units.

369. Culture and History in Twentieth-Century France. An interdisciplinary study of one relatively short historical period (the 1950s, the 1960s, the *entre-deux guerres*, etc.). The intellectual and cultural life of a period in its broader social, political, and historical context. Instructor: Moi. 3 units.

370. Topics in French and Francophone Literature. Concentration on twentieth-century literature. Historical and theoretical approach. Varying topics include the

migrant subject or transnational writer, and the status of fiction in a totalitarian space. Readings include literary and nonliterary texts; Québécois writers such as Roy, Aquin, Miron, Brossard; Caribbean writers such as Chauvet, Delfau, and Roche. Instructor: Jonassaint or Keineg. 3 units.

371. Topics in Migration, Literature, Transnational Writers, and Postnational Literature. A study of contemporary productions of immigrant writers in Canada and France, exploring questions of migration, literature, transnational writers, and postnational literature. Readings might include literary and nonliterary texts by, among others: Beckett, Ben Jelloun, Beyala, Bouraoui, Charles, Huston, Kristeva, Robin, Sebbar, and Zumthor. Instructor: Jonassaint. 3 units.

381. Special Topics Tutorial. Directed reading and research in areas unrepresented by regular course offerings. Instructor: Staff. 3 units.

391. French Seminar. Topics to be announced. Instructor: Graduate faculty. 3 units.

392. French Seminar. Topics to be announced. Instructor: Graduate faculty. 3 units.

COURSES CURRENTLY UNSCHEDULED

211. History of the French Language

257. Problems of Identity in the Nineteenth-Century Novel

258. The Narrative of Social Crisis

261. French Symbolism

264. Contemporary French Poetry

265. French Literature of the Early Twentieth Century

266. French Literature of the Mid-Twentieth Century

267. Writers, Artists, and Intellectuals in Twentieth-Century France

281. Paradigms of Modern Thought

290S. Studies in a Contemporary Figure

ITALIAN STUDIES (ITALIAN)

For Seniors and Graduates

240. Seminar in Medieval and Renaissance Studies. The study and interpretation of medieval and Renaissance culture. Instructor: Finucci. 3 units.

283. Italian Novel of the Novecento. Representative novelists from Svevo to the most recent writers. Instructor: Caserta. 3 units.

285. Dante. The *Purgatorio* and the *Paradiso* in the light of Dante's cultural world. Special attention will be given to the poetic significances of the *Commedia*. Readings in Italian. Prerequisite: Italian 284 or equivalent. Instructor: Caserta. 3 units.

381. Special Topics Tutorial. Directed reading and research in areas unrepresented by regular course offerings. Instructor: Staff. 3 units.

PORTUGUESE STUDIES (PORTUGUE)

For Seniors and Graduates

200S. Seminar in Luso-Brazilian Literature and Culture. A literary, cross-cultural critique focusing on specific topics to be announced. Prerequisite: 100-level Portuguese course or consent of instructor. Instructor: Damasceno. 3 units.

202S. Topics in Lusophone Literature and Culture. Exploration of topics of cultural formation in the Portuguese-speaking world that emphasize autochthonous cultural theory. Examples include: Brazilian popular culture, Literatures of Resistance, Lusophone Africa and Independence, Portugal Post-Salazar. A graduate-level course open to juniors and seniors. Level of Portuguese required varies with semester topic;

students should consult instructor. Prerequisite: 100-level Portuguese course or consent of instructor. Instructors: Damasceno and staff. 3 units.

244S. Brazilian Cultural Theory and Literature. Designed to present cultural debates in a way that fosters comparison with cultural and literary issues concurrent in Spanish America and Europe. Offers graduate students in Latin America and Comparative fields a strong introduction to Brazil. Readings include theories of cultural identity, manifestos of cultural movements, literary selections, films, and theatre. Taught in Portuguese with readings in Portuguese (Spanish and/or English translations available), students may participate in Portuguese, Spanish, or English. Recommended for graduate students or upper-level undergraduates with a background in cultural theory. Prerequisite: 100-level Portuguese course or consent of instructor. Instructor: Damasceno. 3 units.

248S. Transatlantic Cultures: Narratives of Discovery, Empire, Decolonization, and Europeanization. Explores, through literature, film, and theoretical readings, basic themes of Portuguese culture. Focuses on narratives of discovery, empire, decolonization, the admixture of cultures, and concerns of contemporary Portugal within the European Union. Questions of Portuguese identity during the epoch of discovery and expansion; the Portuguese presence in Asia, Africa, and Brazil; the role of postcolonial Portugal and Lusophone culture within the European context. Taught in Portuguese, translations of readings available. Prerequisite: 100-level Portuguese course or consent of instructor. Instructors: Damasceno and staff. 3 units.

SPANISH (SPANISH)

For Seniors and Graduates

200S. Seminar in Spanish Literature. Topics to be announced. Instructor: Staff. 3 units.

210. History of the Spanish Language. Formation and development. Internal forces and external contributions. Instructor: Garci-Gómez. 3 units. C-L: Medieval and Renaissance Studies 210A.

212S. Topics in Spanish Linguistics. In-depth analysis of one area of Spanish linguistics. Topics may include Spanish phonology, Spanish syntax, discourse analysis, applied linguistics, or Spanish pragmatics. Small research projects with a hands-on approach required. Consent of instructor required. Instructor: de la Fuente. 3 units.

244. Topics in Twentieth-Century Latin-American Fiction. Study of various critical problems in the narrative of the area. Focus on one or more major issues, such as the representation of violence, magical realism. *indigenismo.novela de la tierra*. Prerequisite: Spanish 106. Instructor: Moreiras. 3 units.

248. Studies in Spanish-American Literature. Concentration on single authors, genres, movements, or themes. Instructor: Staff. 3 units.

251S. Spanish Film. Cultural critique of Spanish film history. Topics range from the study of the production of a Spanish national identity within a changing global context to the study of a particular movement (for example, Nuevo cine de mujeres), period (for example, Civil War), or author (for example, Luis Buñuel or Pedro Almodóvar), to a critical survey of Spanish film from the 1920s to the present. Instructor: Vilarós. 1 unit.

255. Topics in Early Modern Spanish Literature and Culture. Focus on one or more areas, including the Other Cervantes (including study of the Persiles); mysticism and orthodoxy (e. g., the role and suppression of Judaic and Islamic traditions in the emergence of mysticism in Spain and the rigorous imposition of orthodoxy; the socio-political role of visionaries); the picaresque (a critical study of the influence of economic, religious and social change in shaping the emergence and evolution of a literary genre); witchcraft (study of concepts of gender and of cultural difference in the definition of witchcraft; the effects of social change in its production); the disciplinary role of the Inquisition. Instructor: Greer. 3 units.

260. Paradigms of Modern Thoughts. Exploration of modern thought in Latin America. Theories in the social sciences relevant for the humanities (for example, dependency theory, internal colonialism, subaltern studies) will be compared with cultural theories mainly expressed in essays and literature in general and with philosophical thinking grounded in Latin American colonial and postcolonial histories. Instructor: Mignolo or staff. 3 units.

280. The Cultures of Immigration in Spain. A study of the cultural processes generated by two significant migratory movements in Spain: one in Catalonia in the 1960s and early 1970s, composed mostly of impoverished peasants coming from southern Spain; and the more recent global wave composed of Latin American, African, and Filipino immigrants to the affluent industrial areas. The study will use literary and cinematic texts, and testimonial narratives. Instructor: Vilarós. 3 units.

For Graduates

306S. Teaching Spanish as a Foreign Language. Study of language learning and teaching from theoretical and practical points of view. Examines principles and practices of teaching a second or foreign language with concentration on recent interactive and communicative models of foreign language instruction. Goals include introducing principles of second language acquisition and learning; critically reading relevant literature in the area(s); and contributing to foreign language teacher education through reflective and critical thinking. Readings and discussions supplemented by classroom observation and evaluation. Small action-research project expected. Graduate students only. Instructor: de la Fuente. 3 units.

341. Indigenous Chronicles of the Colonial Period. Exploration of the relationships between languages, writing, memories, and political practices by focusing on indigenous writers such as Guaman Poman de Ayala, Alvarado Tezozomoc, Pachacuti Yamki, Alva Ixtlilxochitl. Spanish and Portuguese writers will also be included as well as anonymous texts (for example, Huarochiri Manuscripts, Popol Vuh, and Mesoamerican Codices). Instructor: Mignolo. 3 units.

344. Philosophy, Cultural History, and Literature in Latin America. Special topics. Instructor: Mignolo. 3 units.

345. Contested Spaces: Writing in Nineteenth-Century Latin America. Questioning teleological constructions of "Literature," "national literature," and the like, this course studies literacy, nonfictional, and pictorial representational practices in nineteenth-century Spanish America and Brazil in their institutional and political setting. Instructor: Fischer. 3 units.

346. Modern Spanish-American Fiction. Twentieth-century novels and short stories by Borges, Carpentier, Cortázar, Gallegos, García Márquez, Quiroga, and others. Instructor: Pérez-Firmat. 3 units.

351. Narrative Forms of Early Modern Spain. Specific topics may focus on one or more forms, including novels of chivalry; sentimental, Moorish, or pastoral novels; hagiography and the mystics; the novella form, picaresque fictions, and the Heliodoran romance. Attention given to such questions as the interaction of literary traditions and social institutions, the philosophical defense of fiction and kinds of censorship, women writers and the representation of women. Instructor: Greer. 3 units.

353. Cervantes. The life and works of Cervantes, with emphasis on the Quijote, the Novelas ejemplares and Persiles y Segismunda. Instructor: Greer. 3 units.

354. Drama of Renaissance and Early Modern Spain. Study of the nature, development, and cultural function of drama in sixteenth- and seventeenth-century Spain through representative plays—canonical and noncanonical—of the period. Specific topics may include: early drama and its cultural locations; forms and theories of tragedy and comedy; women and subjectivity in Golden Age drama; critical perspectives on the

comedia; historical and religious drama and protonational self-definition; or performance and the place of the stage as a cultural institution. Instructor: Greer. 3 units.

358. Spanish Lyric Poetry before 1700. Study of selected poetry of the Middle Ages, Renaissance, and baroque, with attention to such questions as the interaction of elite and popular culture in the evolution of poetic forms, the languages of love and faith, and the political uses of poetry. Instructor: Greer. 3 units.

360. Cross-cultural (Mis)Understanding: Europe and the New World, 1480-1800. Survey form or in-depth analysis of specific topics: the interrelations between Europe and the New World from the Renaissance to the Enlightenment, and from the last decades of the Inca and Aztec Empires to the wars of independence. The "clash of civilizations" and its implications for the cultural history of the early modern period and for the colonial expansion of the west. Instructor: Mignolo. 3 units.

365. Thinking Independence: From Tupac Amaru to 1898. Study of the cultural problems surrounding the Latin American wars of independence, and the pre- and post-independence periods. May focus on foundational fictions, political writings, the so-called Romantic period. Instructor: Moreiras. 3 units.

366. Nineteenth-Century Prose Fiction. Readings by novelists such as Valera, Galdós, Alas, and Pardo Bazán in the light of current critical theory. Instructor: Sieburth. 3 units.

370. Spanish Texts of the Post-Dictatorship: 1975 to Present. An analysis of some artistic and popular productions that came to light in Spain after Franco's death in 1975. Focus on literary and cinematic texts and other cultural productions such as music and comics. Instructor: Vilarós. 3 units.

371. Cultural History and Theory. Seminar covering various topics in Latin American cultural history and theoretical production such as: (a) colonial legacies and postcolonial theories; (b) the construction of identities and the critique of cultural colonialism; (c) contemporary critical production in Latin America, from dependency theory to transnationalism and postmodernity. May be repeated for credit. Instructor: Mignolo or Moreiras. 3 units.

375. Hispanic Literature, Mass Culture, and Theory. A study of Hispanic texts thematizing the effects of mass cultural fictions (serial novels, radio songs, movies) on those who consume them. Fictional works will be juxtaposed with theories on the effects of mass culture and its relationship to canonical literature. Authors of fictional texts include Cervantes, Galdós, Martí, Borges, Marsé, Puig, and Martín-Gaité. Instructor: Sieburth. 3 units.

381. Special Topics Tutorial. Directed reading and research in areas unrepresented by regular course offerings. Instructor: Staff. 3 units.

391. Hispanic Seminar. Each semester one of the following topics will be selected for intensive treatment: the Spanish language in America, studies in medieval literature, studies in the literature of the Golden Age, studies in Latin American literature, studies in the Spanish Renaissance and baroque, studies in Spanish poetry, studies in nineteenth-century Spanish literature, and studies in twentieth-century literature. Instructor: Staff. 3 units.

392. Hispanic Seminar. Each semester one of the following topics will be selected for intensive treatment: the Spanish language in America, studies in medieval literature, studies in the literature of the Golden Age, studies in Latin American literature, studies in the Spanish Renaissance and baroque, studies in Spanish poetry, studies in nineteenth-century Spanish literature, and studies in twentieth-century literature. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

245. Latin-American Poetry

246. Textual Politics in Nineteenth-Century Spanish-American Literature

- 250. Latin-American Film
- 262. The Romantic Movement
- 275. Modern Spanish Poetry
- 276. Modern Spanish Drama
- 277. Modern Spanish Novel

ROMANCE STUDIES (ROMST)

200S. Seminar in Romance Studies. Topics to be announced. Instructor: Staff. 3 units.

210S. Topics in Linguistics. Instructor: Staff. 3 units.

250S. Issues in Second Language Acquisition. Advanced applied linguistics course examining different areas of interests in the field of second language acquisition (SLA). Overview of main research areas in the field. Topics include: Language Testing, Action Research in SLA, Communicative Language Teaching, the role of classroom instruction in SLA, or the relationship between SLA research and foreign language learning. Students expected to become conversant with the research literature in the area and the different methodologies used in SLA research, carry out a classroom-based quantitative and/or qualitative research project, and produce a research paper that might be submitted to relevant conferences. Topics vary each year. Consent of instructor required. Instructor: de la Fuente. 3 units.

306. Theories and Techniques of Teaching Foreign Languages. A survey of approaches to foreign language teaching, an introduction to the theoretical notions underlying current trends, and a language-specific practicum. Instructor: Tufts. 3 units.

310. Critical Frameworks. An introduction to critical theory through a series of interconnected readings organized around a major theoretical approach or issue. Topics may vary. Instructor: Staff. 3 units.

320. Topics in Romance Studies. A cycle of seminars that explores a theoretical problem cross-culturally through two or more Romance traditions: French and Francophone, Italian, Portuguese and Luso-Brazilian, Spanish and Latin American. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

283S. Seminar in North American Studies

Slavic, Eurasian, and East European Studies

Edna Andrews, Ph.D., *Director*

Since its establishment in 1991, the Center for Slavic, Eurasian, and East European Studies has brought together faculty and students from different departments and schools within Duke University who share a common interest in this region. The center sponsors a variety of visiting speakers, workshops, conferences, and other programs to promote research and the dissemination of knowledge about the former Soviet Union and Central and Eastern Europe.

The center offers a certificate in Slavic, Eurasian, and East European studies to students enrolled in the Duke Graduate School, the Nicholas School of the Environment, the Law School, the Fuqua School of Business, or the Medical School. The certificate program requires that participating Duke graduate students pursue coursework related to this region in language, literature, economics, history, political science, public policy, law, or business. A student receiving the certificate will have completed significant cross-disciplinary coursework in this area and demonstrated a mastery of at least one related Slavic language.

The center also offers a certificate in Slavic, Eurasian, and East European studies with a concentration in Russian and East European legal studies. This certificate, inaugurated in 1996, is the first of its kind offered by an American university.

Students seeking either certificate must complete five courses drawn from three different disciplines. Two of the five courses must be from a single discipline, excluding the student's major department. A sixth course of a topical nature will be offered as an interdisciplinary seminar on a yearly basis and will require a major research paper of all certificate candidates. In order to receive either certificate, students will be expected to demonstrate language proficiency in a Slavic or Eastern European language at the intermediate level. Oral and written testing will be required to demonstrate the required level of proficiency.

The center also awards a limited number of foreign language and area studies fellowships for graduate students.

For further information about the center and its programs, please contact the center director, Professor Edna Andrews, 301 Languages Building, Box 90260, Duke University, Durham, NC 27708-0260; or visit the web site at <http://www.duke.edu/web/slavic/>.

Slavic Languages and Literatures

Professor Andrews, *Chair*; Associate Professor Gheith, *Director of Graduate Studies*; Associate Professor of the Practice Flath; Assistant Professors of the Practice Maksimova and Van Tuyl; Associate Professor Emeritus Jezierski; Research Scholar Mickiewicz.

The Department of Slavic Languages and Literatures offers graduate work leading to the A.M. and Ph.D. degrees in Russian literature and Slavic linguistics. Beyond the strong commitment to increasing the language proficiency of its students and giving them solid training in research, the faculty of the department are also preparing students in a variety of adjacent fields, such as area and cultural studies, gender studies, history, media and film, and aspects of comparative literature, theory, and translation. Entering students should have had sufficient undergraduate courses in the Russian language to enable them to proceed to more advanced work. Requirements for the A.M. degree may be met by completion of course work and by passing a comprehensive exam. All students must demonstrate advanced knowledge of the Russian language. Reading knowledge of French or German is also required. The A.M. program is expected to take one to two years for completion. Candidates for the Ph.D. degree in Russian literature must demonstrate extensive knowledge of the subject, competence in another Slavic literature (or in Russian medieval literature, or, in special circumstances, in a non-Slavic literature), in literary theory, and reading competence in at least one other Slavic language. Required courses are at least four courses in Russian and Soviet literature, one course in Slavic linguistics, at least two courses in literary theory, of which one is to be taken outside of the department, one course in another Slavic literature, or one course in medieval Russian literature, and two courses (one year of study) of a second Slavic language or demonstration of equivalent.

Duke University has suspended admissions to the Ph.D. program in Slavic Languages and Literature until further notice. Admission to the A.M. programs are open.

Students in Slavic linguistics must demonstrate competence in Russian and Slavic diachronic linguistics, and in general linguistic theory. Linguistic students must demonstrate knowledge of one Slavic language from the West and one from the South Slavic area, in addition to Russian. Required courses are at least four courses in Slavic linguistics (including Old Church Slavonic), one course in the history of the West/Slavic languages, one course in the history of the South Slavic languages, at least two courses in general linguistics and semiotics, and one course in Russian literature.

Tutorial work complements formal instruction. Knowledge of both areas will be determined through the preliminary exams, comprised of four written examinations and one comprehensive oral examination. Following successful completion of preliminary exams, students will be expected to write and defend a dissertation based

on original research. All Ph.D. candidates are required to teach at least one full academic year as teaching experience is essential in completing one's professional training.

Further information about the graduate programs, including specific requirements, can be obtained from the director of graduate studies.

RUSSIAN (RUSSIAN)

For Seniors and Graduates

201S. Topics in Comparative Slavic Linguistics. A cycle of survey courses on the phonology, morphology, and dialects of the Slavic languages. Each course has a comparative Slavic component. Taught in English. Readings in Russian, French, German and English.

- A. East Slavic
- B. West Slavic
- C. South Slavic
- D. Common Slavic.

Instructor: Andrews. 3 units.

202. Semiotics of Culture. The theory of literature, arts, ethnicity, modernity, and culture from a cross-cultural perspective. Texts include the critical works of Lotman and the Tartu School, Bakhtin, Eco, Kristeva, Voloshinov, Medvedev, Barthes, Todorov, Jakobson, Ivanov, and Sebeok, as well as authentic culture texts from Slavic and European traditions. Research project required. Instructor: Andrews. 3 units. C-L: Cultural Anthropology 202, English 206.

205. Semiotics and Linguistics. A survey of modern semiotics, particularly the works of C. S. Peirce, Roman Jakobson, Yury Lotman, Roland Barthes and Umberto Eco. Analysis of semiotic works directly related to questions of the construction of cultural and linguistic meaning, and linguistic sign theory. Emphasis on semiotic theories from a multi-cultural perspective, especially the European, Tartu, Soviet, and American schools. Research project required. Instructor: Andrews. 3 units. C-L: English 205, Linguistics 205.

206. Russian Modernism. Russian culture between the 1890s and the 1920s, including visual, musical, literary arts, and developments ranging from Neo-Christian mysticism, cosmism, synthesis of the arts, and revolutionary activism. Focus on literary-philosophical thought of that period. Taught in English. Instructor: Mickiewicz. 3 units.

207S. Semantics. Survey of modern semantic theory, including a range of theoretical approaches: communication theory, structuralism, markedness, formal, cognitive and generative semantics. Emphasis on lexical meaning in two or more languages with a strong comparative semantic component. Examples from the world's languages. Final research project required. Taught in English. Instructor: Andrews. 3 units.

208. Stylistic and Compositional Elements of Scholarly Russian. Intensive study of Russian scholarly and scientific texts from a variety of disciplines, including biology, business, anthropology, economics, law, history, mathematics, physics, political sciences, sociology, psychology, linguistics, and literary criticism. Mastery of stylistic and discourse strategies. Analysis of cultural patterning in textual construction in the humanities, social and natural sciences. Taught in Russian. Prerequisite: Russian 64 or consent of instructor. Instructor: Maksimova. 3 units.

211. Legal and Business Russian. Analysis of Russian language and culture in the area of legal studies and conducting business in or with Russia and other Commonwealth of Independent States countries. Primary materials include legal codes, law journals, contracts, advertising, financial documents, redactions of the Soviet and Russian constitutions (1905-present). Specific attention given to the analysis of evolution of

property and ownership legislation, the workings of the legislative, executive and judicial branches of the Russian Federation government and contrastive analysis of Soviet, Russian (and where relevant Western) systems of jurisprudence. Taught in Russian. Prerequisite: Russian 102S or equivalent. Instructor: Andrews or Maksimova. 3 units. C-L: Women's Studies.

215. Theory and Methods of Comparative Linguistics. Diachronic and synchronic approaches to the study of comparative linguistics in phonology, morphology, morphophonemics, syntax, and lexical categories in the context of the world's languages. Both Indo-European and non-Indo-European languages. Topics include theories of reconstruction, languages in contact, abductive processes, questions of linguistic typology and cultural-based approaches to the analytical study of human languages. Research project required. Instructor: Andrews. 3 units.

216. Cognitive Linguistics. 3 units. C-L: Linguistics 201.

217S. Global Issues in Feminism. An interdisciplinary investigation of feminist, postcolonial, and nationalist theories as they apply to international women's issues, including social, economic, and political situations. Open to advanced undergraduates and graduates. Research paper regarding women's agency in selected locations required; students who enroll under Russian expected to focus on Russian issues. Consent of instructor required. Instructors: Gheith and staff. 3 units. C-L: Women's Studies 209S.

245. Theory and Practice of Translation. Detailed study of the American, European, and Slavic scholarly literature on translation combined with close analysis of existing literary and journalistic translations and a program of practical translation exercises and projects from English to Russian and Russian to English. Prerequisite: three years of Russian language study or consent of instructor. Instructor: Flath. 3 units.

250. Trends in Russian and East European Literary Criticism and Beyond. The major critical movements in the nineteenth and twentieth centuries in Russia, East-Central Europe, and the West. Authors and theories include the Belinsky school, formalism, Bakhtin, structuralism, semiotics, and psychoanalytic and feminist theory. Taught in English or Russian. Readings in English and Russian. Instructor: Gheith. 3 units.

258. The Russian Novel. Close reading of Tolstoy's *Anna Karenina*, Dostoevsky's *Possessed*, Andrey Bely's *Petersburg*, Bulgakov's *Master and Margarita*, Nabokov's *The Gift*, and Makine's *Memoirs of My Russian Summers*. Discussions will focus on these representative writers' changing perceptions of, and responses to social and ethical issues and of creativity, itself, as the genre evolved in the modern times between the 1870s and now. Final research paper required and can include in-depth discussion of one of the works or the comparison of one or more aspects of several texts. Taught in English. Readings in Russian. Instructor: Mickiewicz. 3 units.

261. Masterpieces of Nineteenth-Century Russian Literature I. Selected nineteenth-century authors, works, and genres. Authors include Pushkin, Lermontov, Gogol, Turgenev, Herzen, Goncharov, and Dostoevsky. Taught in English. Readings in Russian. Instructor: Staff. 3 units.

262. Masterpieces of Nineteenth-Century Russian Literature II. Selected authors, works, and genres from the second half of the nineteenth century. Authors include Turgenev, Chernyshevsky, Dostoevsky, Tolstoy, Saltykov-Shchedrin, and Chekhov. Taught in English. Readings in Russian. Instructor: Staff. 3 units.

264. Symbolist Movement in Russia. History and theory of the philosophy, poetry, prose, and criticism of the Russian variant of the interdisciplinary and international movement. The momentous movement spawning a variety of other creative schools that constitute twentieth-century Russian modernism. Taught in English. Readings in Russian. Instructor: Mickiewicz. 3 units.

269. Women and Russian Literature. Issues of gender and society in women's writing in Russian from the eighteenth to the twentieth centuries. Both autobiographical writings and prose fiction. Discussions of whether Russian women's writings constitute a tradition and what role these works have played in Russian literature and culture. Taught in English. Readings in Russian. Instructor: Gheith. 3 units.

276. Dostoevsky. Introduction to life, works, and criticism. Readings include: *Crime and Punishment*, *The Idiot*, and *The Brothers Karamazov*. Taught in English. Readings in Russian. Instructor: Flath, Gheith, or Van Tuyl. 3 units.

281. The Soviet 1920s: The Road to a New Synthesis. The literary struggle of the 1920s; proletarian literature from the Smithy to RAPP, LEF and the fate of the avant-garde, the aesthetic conception of Pereval, the literature of the absurd, Oberiu and the Serapion Brothers. Authors include Kirillov, Gladkov, Babel, Pilnyak, Olesha, Zamyatin, Platonov, Kharms, and Pasternak. Readings in Russian. Instructor: Lahusen. 3 units. C-L: History 242B.

282. Socialist Realism: Soviet Literature of the 1930s and 1940s. The Stalin era of Russian literature, the genesis and development of socialist realism, Soviet literature and the theme of boundaries and war. Authors include Sholokhov, Ostrovsky, Fadeev, Azhaev, Babaevsky, Kochetov, and Simonov. Readings in Russian. Instructor: Lahusen. 3 units.

283. Post-Stalinist and Contemporary Soviet Literature. Literature of the thaw after Stalin: the young prose, little realism, new modernism, and rural prose. Authors include Akseyonov, Trifonov, Baranskaya, Bitov, Solzhenitsyn, Rasputin, Shukshin, and Zalygin. Readings in Russian. Instructor: Lahusen. 3 units.

288S. Bulgakov. Analysis of Bulgakov's journalistic works, short stories, novels and plays, including *Master and Margarita*, *The White Guard*, *A Theatrical Novel*, and *The Heart of a Dog*. Analysis of Russian, European and American criticism on Bulgakov. Comparison with Russian film versions of Bulgakov's works and study of Bulgakov's multiple play redactions and the role of censorship. Readings in English or Russian. Instructor: Andrews and Maksimova. 3 units.

299S. Special Topics. Seminars in advanced topics, designed for seniors and graduate students. Instructor: Staff. 3 units.

For Graduates

301. Elementary Russian. Introduction to understanding, speaking, reading, and writing. Audiolingual techniques are combined with required recording-listening practice in the language laboratory. Instructor: Staff. 3 units.

302. Elementary Russian. Introduction to understanding, speaking, reading, and writing. Audiolingual techniques are combined with required recording-listening practice in the language laboratory. Instructor: Staff. 3 units.

303. Intermediate Russian. Intensive classroom and laboratory practice in spoken and written patterns. Reading in contemporary literature. Prerequisite: Russian 301, 302 or consent of instructor. Instructor: Staff. 3 units.

304. Intermediate Russian. Intensive classroom and laboratory practice in spoken and written patterns. Reading in contemporary literature. Prerequisite: Russian 301, 302 or consent of instructor. Instructor: Staff. 3 units.

305. Advanced Russian Conversation and Readings. Nineteenth- and twentieth-century literature in the original. Conducted in Russian. Prerequisite: Russian 303, 304 or consent of instructor. Instructor: Staff. 3 units.

306. Advanced Russian Conversations and Readings. Nineteenth- and twentieth-century literature in the original. Conducted in Russian. Prerequisite: Russian 303, 304 or consent of instructor. Instructor: Staff. 3 units.

307. Advanced Russian. Advanced grammar review with an emphasis on the refinement of oral and written language skills. Development of writing style through compositions and essays. Prerequisite: Russian 306 or consent of instructor. Instructor: Andrews. 3 units.

308. Advanced Russian: Readings, Translation, and Syntax. Intensive reading and conversation with emphasis on contemporary Russian literary and Soviet press texts. English-Russian translation stressed. Russian media, including television and films. Prerequisite: Russian 307 or consent of instructor. Instructor: Andrews. 3 units.

309. Russian Stylistics and Conversation. Refinement of stylistic control and range in spoken and written Russian. Emphasis on fluent discursive skills, as well as development of expository prose style. Prerequisite: Russian 307 and 308, or consent of instructor. Instructor: Maksimova. 3 units.

310. Russian Stylistics and Conversation. Refinement of stylistic control and range in spoken and written Russian. Emphasis on fluent discursive skills, as well as development of expository prose style. Prerequisite: Russian 307 and 308, or consent of instructor. Instructor: Maksimova. 3 units.

311S. Advanced Russian Language and Culture. Advanced grammar review with additional emphasis on phonetics and conversation. Culture component includes literature, films, museums, and theater performances. (Taught in St. Petersburg in Russian.) Prerequisite: Russian 306 or equivalent. Instructor: Staff. 3 units.

312S. Advanced Russian Language and Culture. Advanced grammar review with additional emphasis on phonetics and conversation. Culture component includes literature, films, museums, and theater performances. (Taught in St. Petersburg in Russian.) Prerequisite: Russian 306 or equivalent. Instructor: Staff. 3 units.

335. Contemporary Russian Media. Analytical readings and study of change and development in all the primary forms of former Soviet mass media from 1985 to the present (newspapers, journals, and television). Topics include censorship, TASS, samizdat. Taught in English. Readings in Russian. Prerequisite: Russian 64 or equivalent. Instructor: Andrews. 3 units.

350. Methods in Teaching Russian. The theory and practice of teaching Russian language to English-speaking students. Instructor: Andrews. 2 units.

351. Topics in Teaching Methodology. Application of linguistic principles in the classroom. No prior knowledge of linguistics required. Instructor: Staff. 3 units.

399. Special Readings. Advanced readings in nineteenth- and twentieth-century Russian literature in the original. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

203S. Old Church Slavonic

204S. Russian Folklore and Popular Culture

209. Intensive Advanced Stylistics

210. Literature and Criticism of Socialist Realism

212S. Proseminar

213. Silver Age of Russian Literature

214. Gender, Nationalities, and Russian Literary Traditions

230. Soviet Cinema

240S. Russian Literary Discourse

257. Law, Culture, and the Russian Legal Tradition

265S. Literature of Early Russia

266S. The Sources of Modern Russian Literature: The Eighteenth Century

272S. Pushkin and His Time

- 273S. Gogol
- 275. Tolstoy
- 277S. Chekhov
- 278. Russian Short Fiction
- 279S. Literature of the Former Soviet Republics
- 280. Early Twentieth-Century Russian Literature: From Symbolism to the 1920s
- 284. Late- and Post-Soviet Literature
- 285. Babel and the Russian-Jewish Cultural Dialogue of the Twentieth Century
- 286S. Zamyatin
- 287S. Platonov
- 290. Trifonov, or the Life and Death of the Soviet Intelligentsia
- 297. Russian Poetry
- 298. Akhmatova

BALTO-FINNIC (BALTFIN)

For Graduates

301. Elementary Estonian. Introduction to understanding, speaking, reading, and writing Estonian. No preliminary knowledge of Estonian necessary. Instructor: Staff. 3 units.

302. Elementary Estonian. Introduction to understanding, speaking, reading, and writing Estonian. No preliminary knowledge of Estonian necessary. Instructor: Staff. 3 units.

303. Elementary Finnish. Introduction to understanding, speaking, reading, and writing Finnish. No preliminary knowledge of Finnish necessary. Instructor: Staff. 3 units.

304. Elementary Finnish. Introduction to understanding, speaking, reading, and writing Finnish. No preliminary knowledge of Finnish necessary. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

- 200. Balto-Finnic Linguistics

POLISH (POLISH)

For Graduates

301. Elementary Polish. Introduction to understanding, speaking, reading, and writing in Polish. No preliminary knowledge of Polish necessary. Instructor: Staff. 3 units.

302. Elementary Polish. Introduction to understanding, speaking, reading, and writing in Polish. No preliminary knowledge of Polish necessary. Instructor: Staff. 3 units.

303. Intermediate Polish. Intensive classroom and laboratory practice in spoken and written patterns. Readings in contemporary literature. Prerequisite: Polish 1 and 2, or consent of instructor. Instructor: Staff. 3 units.

304. Intermediate Polish. Intensive classroom and laboratory practice in spoken and written patterns. Readings in contemporary literature. Prerequisite: Polish 1 and 2, or consent of instructor. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

- 274S. Topics in Polish Literature
- 287. Introduction to Polish Literature

SERBIAN AND CROATIAN (SCR)

For Graduates

301. Elementary Croatian and Serbian. Introduction to understanding, speaking, reading, and writing Croatian and Serbian. No preliminary knowledge of Croatian and Serbian necessary. Instructor: Andrews. 3 units.

302. Elementary Croation and Serbian. Introduction to understanding, speaking, reading, and writing Croatian and Serbian. No preliminary knowledge of Croatian and Serbian necessary. Instructor: Andrews. 3 units.

UKRAINIAN (UKRAIN)

For Graduates

301. Elementary Ukrainian. Introduction to understanding, speaking, reading, and writing Ukrainian. No preliminary knowledge of Ukrainian necessary. Instructor: Staff. 3 units.

302. Elementary Ukrainian. Introduction to understanding, speaking, reading, and writing Ukrainian. No preliminary knowledge of Ukrainian necessary. Instructor: Staff. 3 units.

Sociology (SOCIOL)

Professor Spenner, *Chair* (268 Sociology-Psychology); Associate Professor Zhou, *Director of Graduate Studies* (346 Sociology-Psychology); Professors Carroll (divinity), P. Cook (public policy), DiPrete, George, Gereffi, Land, Lewin (business), Lin, Morgan, O'Barr (cultural anthropology), O'Rand, Simpson, Tiryakian, and Wilson; Associate Professor Gold (psychiatry and aging center); Assistant Professors Buchmann, Gao, Hughes, Jackson, Parrado, Shanahan, and Thornton; Professors Emeriti Kerckhoff, Maddox, Myers, Preiss, and Smith; Research Professor Manton (demographic studies); Assistant Professor of the Practice Brown (public policy)

The department offers graduate work leading to the A.M. and Ph.D. degrees in sociology. Entering graduate students should already have completed a minimum of 12 semester hours in sociology and an additional 12 semester hours in related work (e.g., other social sciences, statistics, computer science, philosophy, mathematics). Accepted applicants who have not had such preparation may be required to take work beyond the usual requirements. Applicants for admission are required to take the verbal and quantitative aptitude tests of the Graduate Record Examination.

The Ph.D. program requires the student to take five core courses and courses in two areas of specialization. In addition, the student is to take three year-long professionalization seminars for the exposure of frontier research issues and professional activities in sociology. The core courses include: Sociological Theory (206), Social Statistics I and II (212, 213), and two out of three methods courses (208, 214, 215). Specializations (with the associated proseminars indicated in parentheses) include Demography, Life Course and Aging Studies (Sociology 221S, 224S); Comparative and Historical Sociology (Sociology 222S); Organizations, Markets and Work (Sociology 225S); Medical Sociology (Sociology 227S); and Stratification, Mobility and Labor Force Behavior (Sociology 228S). A student entering with only an undergraduate degree and adequate course preparation would need to take seventeen courses to satisfy degree requirements. Up to three courses may be transferred for graduate work taken elsewhere.

Further details concerning the general departmental program, the specialities and their requirements, departmental facilities, the faculty, ongoing research, and stipends available may be obtained from the director of graduate studies.

206. Sociological Theory. Structure, foundations, and historical antecedents of recent formulations of such theoretical approaches as phenomenological sociology, exchange theory, critical theory, structuralism, neo-Marxist sociology, sociobiology, and action theory. Instructor: Tiryakian or Wilson. 3 units.

208. Survey Research Methods. Theory and application of survey research techniques in the social sciences. Sampling, measurement, questionnaire construction and distribution, pretesting and post testing, response effects, validity and reliability, scaling of data, data reduction and analysis. Instructor: Lin or staff. 3 units.

211S. A-E. Proseminars in Sociological Theory. Development of sociological thought; systematic sociological theory; interrelations with other social and behavioral sciences.

- A. Background of Sociology
- B. Formal Aspects of Theory
- C. Sociology of Knowledge
- D. Evolutionary Theory and Sociobiology
- E. Special Topics in Sociological Theory.

Instructor: Tiryakian or Wilson. 3 units.

212. Social Statistics I: Linear Models, Path Analysis, and Structural Equation Systems. Model specification, review of simple regression, the Gauss-Markov theorem, multiple regression in matrix form, ordinary and generalized least squares, residual and influence analysis. Path analysis, recursive and nonrecursive structural equation models; measurement errors and unobserved variables. Application of statistical computing packages. Instructor: DiPrete or Land. 3 units.

213. Social Statistics II: Discrete Multivariate Models. Assumptions, estimation, testing, and parameter interpretation for the log-linear, logit, logistic, and probit models. Model comparisons; applications of statistical computing packages and programs. Prerequisite: Sociology 212 or equivalent. Instructor: DiPrete or Land. 3 units.

215. Basic Demographic Methods and Materials. Population composition, change, and distribution. Methods of standardizing and decomposing rates, life tables and population models, analysis of data from advanced and developing countries. Applications of computer programs for demographic analysis. Instructor: Hughes or Morgan. 3 units.

217S. A-F. Proseminars in Social Statistics and Research Methods. Selected topics in the collection and analysis of social science data.

- A. Discrete and Continuous Models of Measurement
- B. Hazards Models, Event History Analysis, and Panel Data
- C. Dynamic Models and Time Series Analysis
- D. Research Design
- E. Evaluation Research Methods
- F. Special Topics in Social Statistics and Research Methods.

Instructor: DiPrete or Land. 3 units.

221S. A-D. Proseminars in Aging and Life Course Analysis. Selected topics in socialization, human development, status attainment and careers, and the sociology of aging.

- A. Social Structure and the Life Course
- B. Social Patterns of Personal Development
- C. Social Gerontology
- D. Special Topics in Aging and Life Course Analysis.

Instructor: George, Jackson, or O'Rand. 3 units.

222S. A-G. Proseminars in Comparative and Historical Sociology. Selected topics in the differentiation and transformation of societies.

- A. Theories of Social Change
- B. Globalization and Comparative Development
- C. Societal Transformations and Social Institutions
- D. Culture, Values, and Ideas
- E. Social Movements and Political Sociology
- F. Comparative Social Policies
- G. Special Topics in Comparative and Historical Sociology.

Instructor: Buchmann, Gao, Gereffi, Lin, Simpson, or Tiryakian. 3 units.

223S. A-E. Proseminars in Crime, Law, and Deviance. Selected topics in crime and the institutions of social control.

- A. Theories of Crime Causation
- B. Human Development and Criminal Careers
- C. Social Control and the Criminal Justice System
- D. Sociology of Law
- E. Special Topics in Crime, Law, and Deviance.

Instructor: Land, Simpson, or Wilson. 3 units.

224S. A-F. Proseminars in Population Studies. Selected topics.

- A. Population Dynamics
- B. Mortality, Morbidity, and Epidemiology
- C. Urbanization and Migration
- D. Demography of the Labor Force
- E. Demography of Aging
- F. Special Topics in Population Studies.

Instructor: DiPrete, Hughes, Land, Manton, Morgan, or O'Rand. 3 units.

225S. A-H. Proseminars in Organizations, Markets, and Work. Selected topics in complex organizations, the labor process, and changing occupations.

- A. Basic Concepts, Theories, and Methods
- B. Organizations and Environments
- C. Social Psychology of Organizations
- D. Markets and Market Systems
- E. Careers and Labor Markets
- F. Sociology of Work and Industrial Relations
- G. Special Topics I: Micro Issues
- H. Special Topics II: Macro Issues.

Instructor: DiPrete, Gao, O'Rand, Spenner, or Thornton. 3 units.

226S. A-G. Proseminars in Social Institutions and Processes. Selected topics in the sociology of institutions and social and institutional behavior.

- A. Social Psychology
- B. Social Stratification
- C. Political Sociology
- D. Sociology of Religion
- E. Sociology of Science
- F. Sociology of Education

G. Special Topics in Social Institutions and Processes.

Instructor: Staff. 3 units.

227S. A-D. Proseminars in Medical Sociology. Selected topics in medical sociology.

A. Social Structure and Health

B. Social Behavior and Health

C. Organization and Financing of Health Care

D. Special Topics in Medical Sociology (for example, social epidemiology, stress and coping, health and aging).

Instructor: George, Gold, Jackson, Lin, or Thornton. 3 units.

228S. A-F. Proseminars in Stratification, Mobility, and Labor Force Behavior.

Core and special topics in social stratification, including explanations for the existence, amount, and various dimensions of stratification in society; institutions that produce stratification; forces that cause the structure of stratification to vary both over time and across societies; and structures that govern social mobility within and across generations.

A. Intergenerational Mobility

B. Social Structure and the Life Course

C. Social Inequality and the Structure of Poverty

D. Careers and Labor Markets

E. Societal Transformation

F. Special Topics in Stratification and Mobility Research.

Instructor: Buchmann, DiPrete, Lin, Spenner, or O'Rand. 3 units.

229S. A-F. Proseminars in Social Psychology. Selected topics in microsociology and social psychology, including social interaction, decision making, social exchange, group processes, intergroup relations, self and identity, social structure and personality, social networks, and applications in organizations and health care.

A. Introduction to Social Psychology

B. Rational Choice and Social Exchange

C. Sociology of Self and Identity

D. Group Processes and Intergroup Relations

E. Experimental Research: A Practicum

F. Special Topics in Social Psychology.

Instructor: George, Jackson, Lin, or Spenner. 3 units.

234S. Political Economy of Development: Theories of Change in the Third World. 3 units. C-L: Political Science 234S, Cultural Anthropology 234S.

282S. Canada. 3 units. C-L: Canadian Studies 282S, Cultural Anthropology 282S, History 282S, Political Science 282S.

291. Research Methods in Japanese. Introduction to various research approaches to literary, sociological, and historical studies of Japan. Emphasis on bibliographical sources that best serve needs in chosen area of specialization. Consent of instructor required. Instructor: Staff. 3 units. C-L: Japanese 291, Cultural Anthropology 290, History 292, Political Science 291.

298S. Seminar in Selected Topics. Substantive, theoretical, or methodological topics. Instructor: Staff. 3 units.

299S. Seminar in Selected Topics. Substantive, theoretical, or methodological topics. Instructor: Staff. 3 units.

For Graduates

301. Methodological Issues in Sociology. Selected issues central to sociological research and sociological knowledge. Epistemological and ontological matters, differences over what sociological questions are, preferred styles of doing research, standards for adequate and appropriate data, and the language of sociological discourse. Examines selected controversial matters, for example, quantitative and qualitative, ethnomethodology, micro- and macrosociology, survey and comparative-historical research, case study and the case, and feminist research. Instructor: Smith. 3 units.

392. Individual Research in Sociology. Students will conduct on an individual basis research designed to evaluate a sociological hypothesis of their choice. The process must be completed by preparation of a report on this research in adequate professional style. Prerequisite: Sociology 207, 208 or consent of instructor. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

214. Comparative and Historical Methods (B)

216. Advanced Methods of Demographic Analysis

Institute of Statistics and Decision Sciences (STA)

Professor West, *Director* (214 Old Chemistry); Associate Professor Lavine, *Director of Graduate Studies*; Professors Berger, Johnson, Sacks, Winkler, and Wolpert; Associate Professors Burdick, Clyde, Edwards; Mueller, Parmigiani, Rosner, and Stangl; Assistant Professors Dukic, and Higdon; Research Assistant Professor Iversen; Visiting Assistant Professors Lee, McBride, Spang, Swall, and Zuzan; Senior Lecturing Fellow Ulmer

The Institute of Statistics and Decision Sciences offers graduate study leading to the Ph.D. degree in statistics. It also offers the M.S. degree to students pursuing a Ph.D. degree in the institute or in another department at Duke. The institute is a regular teaching and research department of the university that is internationally recognized as a center of research in theoretical and applied statistics. The faculty are active in the areas of Bayesian statistics and decision sciences, statistical computing, and interdisciplinary applications of statistics. These areas of faculty interest are reflected in the course of study for students in the Ph.D. program offered by the institute.

Distinguishing features of graduate study are the opportunity for thorough preparation in Bayesian as well as classical statistics, and research opportunities at the interface between statistics, decision sciences, and statistical computing. The institute also enjoys close working relationships and research collaborations with other departments at Duke, and with the National Institute of Statistical Sciences (NISS), providing opportunities for graduate students to become involved in applied projects.

Requirements for the Ph.D. degree in statistics include study of statistics, probability, statistical computing, decision sciences and related areas; passing a comprehensive examination (covering those topics) given at the end of the first year, and a preliminary examination (covering areas of possible research interest) at the end of the second year; and completing a dissertation written under the supervision of a faculty advisor. For an up-to-date faculty list and description of the graduate programs in the Institute of Statistics and Decision Sciences, visit the department web site at: <http://www.stat.duke.edu>.

For Seniors and Graduates

205. Probability and Measure Theory. Introduction to probability spaces, the theory of measure and integration, random variables, and limit theorems. Distribution functions, densities, and characteristic functions; convergence of random variables and of their distributions; uniform integrability and the Lebesgue convergence theorems.

Weak and strong laws of large numbers, central limit theorem. Prerequisite: elementary real analysis and elementary probability theory. Instructor: Wolpert. 3 units.

207. Probability. 3 units. C-L: Mathematics 287.

210A. Statistics and Data Analysis for Policymakers. Elements of statistical inference and estimation including exploratory data analysis, regression, and analysis of variance. Emphasis on public policy applications. Not open to students who have had Mathematics 136 or Statistics 110A, 110B, 112, 113, 114, 210B, or 213. Instructor: Stangl. 3 units. C-L: Public Policy Studies 222.

210B. Statistics and Data Analysis in Biological Science. Elements of statistical inference and estimation including exploratory data analysis, regression, and analysis of variance. Emphasis on biological science applications. Not open to students who have had Mathematics 136 or Statistics 110A, 110B, 110C, 110E, 112, 113, 114, 210A, or 213. Instructor: Staff. 3 units.

213. Introduction to Statistical Methods. Emphasis on classical techniques of hypothesis testing and point and interval estimation, using the binomial, normal, t , F , and chi square distributions. Not open to students who have had Statistics 114 or Mathematics 136. Prerequisite: Mathematics 103 (may be taken concurrently) or equivalent, or consent of instructor. Instructor: Staff. 3 units.

214. Probability and Statistical Models. An introduction to applied probability and to the parametric probability models commonly used in statistical analysis. The generation of random variables with specified distributions, and their use in simulation. Mixture models; linear regression models; random walks, Markov chains, and stationary and ARMA process; networks and queueing models. Prerequisite: Statistics 213 and 244 or consent of instructor. Instructor: Staff. 3 units.

215. Statistical Inference. Classical, likelihood, and Bayesian approaches to statistical inference. Foundations of point and interval estimation, and properties of estimators (bias, consistency, efficiency, sufficiency, robustness). Testing: Type I and II errors, power, likelihood ratios; Bayes factors, posterior probabilities of hypotheses. The predictivist perspective. Applications include estimation and testing in normal models; model choice and criticism. Prerequisite: Statistics 213 and 244 or consent of instructor. Instructor: Staff. 3 units.

216. Generalized Linear Models. Likelihood-based and Bayesian inference of binomial, ordinal, and Poisson regression models, and the relation of these models to item response theory and other psychometric models. Focus on latent variable interpretations of categorical variables, computational techniques of estimating posterior distributions on model parameters, and Bayesian and likelihood approaches to case analyses and goodness-of-fit criterion. Theory and practice of modern regression modeling within the unifying context of generalized linear models. A brief review of hierarchical linear models. Students expected to use several software packages and to customize functions in these packages to perform applied analyses. Prerequisite: Statistics 213 and 244 or consent of instructor. Instructor: Staff. 3 units.

221. Bayesian Inference and Decision. 3 units. C-L: Business Administration 510.

226. Statistical Decision Theory. Formulation of decision problems; criteria for optimality: maximum expected utility and minimax. Axiomatic foundations of expected utility; coherence and the axioms of probability (the Dutch Book theorem). Elicitation of probabilities and utilities. The value of information. Estimation and hypothesis testing as decision problems: risk, sufficiency, completeness and admissibility. Stein estimation. Bayes decision functions and their properties. Minimax analysis and improper priors. Decision theoretic Bayesian experimental design. Combining evidence and group decisions. Prerequisite: Statistics 215 or consent of instructor. Instructor: Staff. 3 units.

231. Behavioral Decision Theory. 3 units. C-L: Business Administration 525, Psychology 316.

234. Choice Theory. 3 units. C-L: Business Administration 513.

240. Applied Data Analysis for Environmental Sciences. Graphical and exploratory data analysis; modeling, estimation, and hypothesis testing; analysis of variance; random effect models; nested models; regression and scatterplot smoothing; resampling and randomization methods. Concepts and tools involved in data analysis. Special emphasis on examples drawn from the biological and environmental sciences. Students to be involved in applied work through statistical computing using software, often S-plus, which will highlight the usefulness of exploratory methods of data analysis. Other software, such as SAS, maybe introduced. Instructor: Staff. 3 units.

241. Environmental Experimental Design. 3 units. C-L: Environment 257.

242. Applied Regression Analysis. 3 units. C-L: Environment 255.

244. Linear Models. Multiple linear regression and model building. Exploratory data analysis techniques, variable transformations and selection, parameter estimation and interpretation, prediction, Bayesian hierarchical models, Bayes factors and intrinsic Bayes factors for linear models, and Bayesian model averaging. The concepts of linear models from Bayesian and classical viewpoints. Topics in Markov chain Monte Carlo simulation introduced as required. Corequisite: Statistics 213 or equivalent. Instructor: Staff. 3 units. C-L: Mathematics 217.

245. Introduction to Multivariate Statistics. Multinormal distributions, multivariate general linear model, Hotelling's T^2 statistic, Roy union-intersection principle, principal components, canonical analysis, factor analysis. Not open to students who have taken the former Mathematics 242. Prerequisite: Statistics 244 or equivalent. Instructor: Burdick. 3 units. C-L: Mathematics 218.

253. Applied Stochastic Processes. 3 units. C-L: Mathematics 216.

273. Numerical Analysis. 3 units. C-L: Computer Science 250, Mathematics 221.

290. Statistical Laboratory. Introduction to statistical thinking, data management and collection, sampling and design, exploratory data analysis, graphical and tabular displays, summarizing data. Introduction to applied work. Computer orientation, statistical packages and operating systems, especially unix on high-speed workstations, and the statistical package S-Plus. Graphics and numerical computing. Examples from various disciplines. Instructor: Staff. 3 units.

291. Independent Study. Directed reading and research. Consent of instructor and director of graduate studies required. Instructor: Staff. 1 to 4 units. Variable credit.

292. Independent Study. Directed reading and research. Consent of instructor and director of graduate studies required. Instructor: Staff. 1 to 4 units. Variable credit.

293. Special Topics in Statistics. Advanced topics of current interest. Prerequisite: Statistics 213 or consent of instructor. Instructor: Staff. 3 units.

294. Special Topics in Statistics. Prerequisite: Statistics 213 or consent of instructor. Instructor: Staff. 3 units.

295. First-Year Seminar. Weekly seminar covering a variety of statistical subjects. Coregistration in Statistics 213 and Statistics 244 or consent of instructor. Instructor: Staff. 1 to 4 units. Variable credit.

For Graduates

333. Sequential Statistical Analysis. Bayesian analysis of sequential statistical procedures. Multi-armed bandit problems: sampling costs and decision costs, Bayesian updating, myopic rules, dynamic programming. Contemporary design of clinical trials. At the level of Sheldon Ross, *Introduction to Stochastic Dynamic Programming* and part four of Morris H. DeGroot, *Optimal Statistical Decisions*. Prerequisite: Statistics 215 or equivalent. Instructor: Berry. 3 units.

345. Multivariate Statistical Analysis. Review of matrix algebra, transformations, and Jacobians. The multivariate normal, Wishart, multivariate t , and related distributions are given special emphasis. Topics such as principal components, factor analysis, discrimination and classification, and clustering treated both from classical and Bayesian viewpoints. Additional topics depending on. Instructor and background of students. Prerequisite: Statistics 215 and Statistics 216. Instructor: Staff. 3 units.

346. Experimental Design and Optimization. Traditional and modern concepts and techniques in statistical design and experimentation. Industrial experimentation and statistical design in complex, high-dimensional control spaces. Fractional factorial designs and highly fractionated experiments. Response surface methodology. Determination of nonlinearities in response surfaces. Efficient allocation of experimental units to control and treatments, especially with small numbers of expensive units. Bayesian and classical design criteria of optimality. Sequential design and allocation. Prediction from designed experiments. Screening and sensitivity. Data assimilation and tuning. Possible illustrations from studies in semiconductor manufacturing and drug design. Instructor: Sacks. 3 units.

356. Time Series and Forecasting. Time series data and models: trend, seasonality, and regressions. Traditional models: EWMA, EWR, ARMA. Dynamic linear models (DLMs). Bayesian learning, forecasting, and smoothing. Mathematical structure of DLMs and related models. Intervention, forecast monitoring, and control. Structural change in time series. Multiprocess models and mixture analysis. Multivariate models, constrained and aggregate forecasting, and forecast combination. Applications using computer software. Other topics, including spectral analysis, as time permits. Prerequisite: Statistics 215 or equivalent. Instructor: West. 3 units.

357. Stochastic Processes. Conditional probabilities and Radon-Nikodym derivatives of measures; tightness and weak convergence of probability measures, measurability and observability. Markov chains, Brownian motion, Poisson processes. Gaussian processes, birth-and-death processes, and an introduction to continuous-time martingales. Prerequisite: Statistics 205 (or Mathematics 290) and Statistics 215 (or Mathematics 136.) Instructor: Wolpert. 3 units.

365. Survival and Reliability Analysis. Statistical models and techniques useful in the comparative study of lifetime distributions. Censoring mechanisms. Empirical and nonparametric methods of survival-curve estimation, graphical methods. Classical, likelihood, and Bayesian inference in parametric models. Survival regression models: proportional and nonproportional hazards models. Accelerated failure time models. Stochastic mechanisms inducing lifetime distributions. Multivariate failures. Competing risks. Multivariate exponential, and other distributions. Mixtures of failure time distributions. Applications in medicine, engineering, economics. Prerequisite: Statistics 215 and 216. Instructor: Parmigiani, West, or Wolpert. 3 units.

376. Advanced Modeling and Scientific Computing. An introduction to advanced statistical modeling and modern numerical methods useful in implementing statistical procedures for data analysis, model exploration, inference, and prediction. Topics include simulation techniques for maximization and integration. Prerequisite: Computer Science 221 or equivalent. Instructor: West. 3 units.

386. Noncooperative Game Theory. 3 units. C-L: Economics 315, Political Science 315.

390. Statistical Consulting Workshop. Under faculty supervision, students address and solve consulting problems submitted to ISDS's campus-wide consulting program, and present their solutions to the class. May be taken more than once. Consent of instructor required. Instructor: Staff. 3 units.

395. Readings in Statistical Science. Advanced seminar on topics at research frontiers in statistical sciences. Consent of instructor required. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

203S. Senior Seminar in Statistics

246. Experimental Design

282. Optimization Methods

297. Topics in Probability Theory

381. Nonlinear Regression

The Master of Arts in Teaching Program (MAT)

Rosemary Thorne, *Director*

The Master of Arts in Teaching program (M.A.T.) is designed for talented liberal arts graduates who wish to teach their discipline in secondary schools. The M.A.T. degree requires 36 units of graduate credit, consisting of 18 units (six courses) within the student's discipline, six units (two courses) of M.A.T.-specific education courses, and 12 units devoted to a year-long internship/seminar and a master's portfolio. The program is open to students with strong undergraduate preparation in English, mathematics, the sciences, or social sciences. A joint-degree program (Master of Environmental Management/Master of Arts in Teaching General Science) is available.

More information on the program is available from the M.A.T. office, 213 West Duke Building, Box 90093, Duke University, Durham, North Carolina 27708-0093, or on the web at: <http://www.duke.edu/web/MAT/> or by email to MAT-Program@duke.edu.

The University Program in Toxicology

Professor Levin, *Director of Graduate Studies* (341 Bell Building)

The Duke University Integrated Toxicology Program (ITP) provides students with the theoretical and practical bases for research and teaching in toxicology. This interdepartmental program brings together graduate students, postdoctoral fellows, and faculty members from a variety of scientific disciplines to address toxicological problems from their molecular basis to clinical and environmental consequences. The ITP includes participation of faculty members from the Departments of Biochemistry, Cell Biology, Chemistry, Microbiology, Neurobiology, Pathology, Pharmacology, Psychiatry, Psychology, and the School of the Environment including the Duke Marine Laboratory. Among the principal areas of concentration in the program are environmental toxicology, neurotoxicology, cellular development, and molecular mechanisms of oxidative stress. Duke faculty members have a variety of collaborative research efforts and student rotations are available with scientists at the nearby laboratories of the National Institute of Environmental Health Sciences (NIEHS), the Chemical Industry Institute of Technology (CIIT), and the Environmental Protection Agency (EPA).

Students seeking a Ph.D. in one of the participating Graduate School departments must make initial application to that department. Students who apply initially for graduate study in one of the departments may also be nominated by that department for admission to the program. Such students should list toxicology as their "Special Field" on the application form. It is expected that most students will have a strong undergraduate preparation in mathematics and the physical and biological sciences with demonstrated excellence of performance as judged by grades in coursework and letters of recommendation from former instructors. Each student in the program will take a series of courses in toxicology as well as courses specified by his or her department. A student will be expected to choose a dissertation advisor in his or her department at least by the end of the first two semesters in the program and will normally be expected to begin dissertation research during the third semester in

residence. Upon satisfactorily completing all degree requirements in the program and in the department, students will be jointly recommended for the Ph.D. degree.

Further information may be obtained from Professor Levin, Director of Graduate Studies, 341 Bell Building, Box 3412 DUMC, Durham, North Carolina, 27710; telephone (919) 681-6273; email: edlevin@duke.edu

Women's Studies (WOMENST)

Professor of the Practice J. O'Barr, *Director* (210 East Duke Building); Assistant Professor of the Practice Rudy; Research Professor Giddings; Associate Research Professor Pierce-Baker. Affiliated faculty: Associate Professors Fulkerson (divinity), Gheith (Slavic languages) and Sieburth (Romance studies); Assistant Professor of the Practice Curtis (political science); Adjunct Professor White

Graduate and professional students enrolled at Duke University are encouraged to participate in women's studies. Participation includes doing graduate level work in women's studies courses, earning a graduate certificate in women's studies, conducting research on gender-related topics, selecting feminist theory and/or women's studies as a prelim area, writing master's and doctoral theses in feminist scholarship, joining a community of advanced graduate students called Women's Studies Scholars, teaching courses on women, gender, and feminist theories, and attending lectures, seminars, conferences, discussion groups, and other campus events sponsored by Women's Studies.

Graduate students affiliate with the program by stating their intention to take courses and do research on women and gender systems during the course of their studies here. Affiliated students on the mailing list receive newsletters, lecture notices, and invitations to special events. A variety of workshop and discussion programs is planned each year.

Graduate work in women's studies takes place both in interdisciplinary seminars and in courses offered through departments. In addition to these possibilities, graduate students are encouraged to develop independent study courses, either with a member of the faculty affiliated with women's studies or in conjunction with the courses offered through the undergraduate curriculum.

Women's Studies offers a certificate to qualified students in A.M., Ph.D., and professional degree programs of the university. To qualify for the graduate certificate, students must pass a minimum of three graduate level courses on women and gender. The graduate core courses in women's studies—WST 211, WST 212, WST 213, and WST 214—are described below. Any one of the four fulfills the core course requirement for the graduate certificate. The second and third courses are chosen by the student from departmental offerings to build on their disciplinary training and demonstrate a breadth and depth of knowledge about women, culture, and society. Students' course plans are approved by the director of Women's Studies as early as possible in their graduate careers. Students in the Divinity School and those earning an A.M. in liberal studies have individualized graduate certificate requirements and need to consult the director. The award of the graduate certificate in women's studies is carried on the student's official university transcript upon completion of the work. A recognition ceremony is held each year for students who have earned the certificate.

There are many courses on women, gender, and feminist theories offered by departments and professional schools at Duke. A list of these is compiled each semester and is available from the women's studies office by request.

For additional information contact the program web site at <http://www.duke.edu/womstud/>.

209S. Global Issues in Feminism. An interdisciplinary investigation of feminist, postcolonial, and nationalist theories as they apply to international women's issues, including social, economic, and political situations. Open to advanced undergraduates

and graduates. Research paper regarding women's agency in selected locations required; students who enroll under Russian expected to focus on Russian issues. Consent of instructor required. Instructors: Gheith and staff. 3 units. C-L: Russian 217S.

211. Intellectual and Institutional Foundations of Women's Studies: An Overview. An interdisciplinary overview of feminist theorists prior to the twentieth century and of the rise of feminist scholarship in the disciplines. Consideration of the institutional origins and characteristics of Women's Studies and the future contours of feminist scholarship. Instructor: O'Barr, Rudy, and staff. 3 units.

212. Foundations of Women's Studies: The Beginnings. An interdisciplinary investigation of selected writings by women about the evolution of women's social and cultural positions in primary and secondary sources. Sources include those of antiquity and the Middle Ages although the emphasis is on writings from the Enlightenment through the early twentieth century, including liberal feminist and materialist feminist thought. Instructor: O'Barr, Rudy, and staff. 3 units.

213. Foundations of Women's Studies: From 1960s to the Present. An interdisciplinary investigation of feminist theories from the mid-twentieth century to the present using primary and secondary sources. Emphasis on the multiplicities of feminist thought and the incorporation of theorists on a global basis. Instructor: O'Barr, Rudy, and staff. 3 units.

214. Foundations of Women's Studies: Institutional Issues. An interdisciplinary investigation of the history of the education of women and the evolution of women's studies as an academic discipline. Examination of the relationships between gender and the academy with an emphasis on the changing patterns of higher education, including feminist pedagogy and epistemology. Instructor: O'Barr, Rudy, and staff. 3 units.

300. Advanced Topics in Feminist Studies. A selected topics seminar on emergent theoretical and empirical questions in feminist scholarship. Prerequisite: must have taken either Women's Studies 211, 212, 213, or 214 or have Consent of instructor. Instructor: Staff. 3 units.

391. Tutorial in Special Topics. Directed research and writing in areas unrepresented by regular course offerings. Consent of instructor required. Instructor: Staff. 3 units.

392. Tutorial in Special Topics. Directed research and writing in areas unrepresented by regular course offerings. Consent of instructor required. Instructor: Staff. 3 units.

Special Study Centers, Programs, and Opportunities



Center for the Study of Aging and Human Development

The center is a multidisciplinary program devoted to research, training, and clinical activities in gerontology and geriatrics. Although the center does not offer degrees, the varied programs, research laboratories, and clinical settings provide a context and resource for undergraduate and graduate students and for health professionals with special interests in adult development and aging. The center conducts multidisciplinary, two-year programs for postdoctoral fellows interested in focused training for independent research on many varied aspects of aging and adult development. Resources of this all-university program include data from two longitudinal studies, a wide range of archival data of special interest to social scientists, a human subjects registry, and the center's basic and applied research laboratories. A division of geriatrics coordinates research, training, and services related to the care of older adults. Undergraduate and graduate students of the university are welcome to inquire about participation in all programs at the center. Inquiries should be addressed to Harvey Jay Cohen, M.D., Director, Duke University Center for the Study of Aging and Human Development, Box 3003, Duke University Medical Center, Durham, North Carolina 27710, or visit the website at www.geri.duke.edu for more information.

Asian/Pacific Studies Institute (APSI)

Nan Lin, Ph.D., *Director*

The institute sponsors an agenda of conferences, visiting speakers and scholars, and research clusters and also coordinates study abroad programs in China and Japan. APSI administers one-year FLAS fellowships (stipend and tuition). Incoming graduate students and students in good standing in the Graduate School may be considered for these fellowships. Further information may be obtained from the Asian/Pacific Studies Institute, 2111 Campus Drive, Box 90411, Duke University, Durham, North Carolina 27708-0411. Send email to: mmayer@duke.edu, or contact the web site at: <http://www.duke.edu/APSI/main.html>.

Center for Cognitive Neuroscience

The newly established Center for Cognitive Neuroscience (CCN) is committed to research, education and training in the psychological, computational and biological mechanisms of higher mental functions, including attention, memory, language, emotion, and consciousness, among others. Cognitive neuroscience is a new discipline and is not only addressing long-standing, unanswered questions about the brain and mind from new perspectives, but is also defining new questions to be asked. The CCN brings together the expertise of talented faculty from several university and medical school departments including but not limited to Psychology, Neurobiology, Computer Science, Biomedical Engineering, Linguistics, Philosophy, Neurology, Psychiatry and Radiology.

Students interested in graduate training in cognitive neuroscience can apply to existing programs such as the graduate programs in Psychology, Neurobiology, Philosophy, Biomedical Engineering, or Computer Science (indicating an interest in cognitive neuroscience), or apply directly to the Graduate Training Program in Cognitive Neuroscience (pending approval in 2000). The goal is to train the best and the brightest scientist scholars for leading positions in cognitive neuroscience in the year 2000 and beyond.

For additional information and updated instructions, please contact the Center for Cognitive Neuroscience, B203 Levine Science Research Center, Box 90999, Duke University, Durham, North Carolina 27708 or visit our web site at www.mind.duke.edu

Center for Demographic Studies

The Center for Demographic Studies promotes the pursuit of advanced degrees in sociology or economics with a specialization in population studies. Its facilities include a population library, the Joseph J. Spengler Collection of publications and research materials, and extensive data resources. The center's program provides opportunities for direct student participation in ongoing research projects. A federally supported predoctoral and postdoctoral training program on the social and medical demography of aging is coordinated by the center. Inquiries for training and research opportunities may be directed to Dr. Kenneth G. Manton, Director, Center for Demographic Studies, Duke University, Box 90408, Durham, North Carolina 27708-0408.

Program for the Study of Developed Shorelines

Orrin Pilkey, Ph.D., *Director*

The Program for the Study of Developed Shorelines was established in recognition of a critical need for both academic programs and geologic research on national coastal issues. The goal of the program is promotion of research, education, and publication concerned with oceanic shorelines already under development. Students from the Coastal Environmental Management Program as well as the Earth and Ocean Sciences Program are involved in coastal research. This includes studies of beach nourishment, impact of hard stabilization, shoreface processes and critical review of mathematical models of beach behavior. Limited research support is available to both graduate and advanced undergraduate students. To learn about research programs and program accomplishments, visit our web site at <http://www.eos.duke.edu/research/psds/psds.htm>. For more information contact Professor Orrin Pilkey, Director, Program for the Study of Developed Shorelines, Division of Earth and Ocean Sciences, Nicholas School of the Environment, Duke University, Box 90228, Durham, North Carolina 27708-0228.

Center For Documentary Studies

The Center for Documentary Studies, established in 1989, supports interdisciplinary teaching and research along with the practice and dissemination of documentary work. Dedicated to a vision of the documentary process that connects personal experience and creative expression to education and community life, the center supports and encourages the work of photographers, filmmakers, historians, ethnographers, journalists, novelists, and others who work by direct observation and participation in the lives of individuals and communities. The Center's graduate-level research focuses on a collaborative project titled "Behind the Veil: Documenting African American Life in the Jim Crow South," directed by Duke professors William Chafe, Raymond Gavins, and Robert Korstad, but other research opportunities also exist. The center emphasizes documentary fieldwork and encourages students to become engaged in projects in communities outside the university. Graduate students may participate in a variety of courses that the center offers under the

auspices of several Duke departments and programs, including history, public policy studies, English, education, and cultural anthropology. Center-sponsored projects offer a limited number of assistantships to graduate students in the arts and humanities. For more information, check the CDS website at <http://cds.aas.duke.edu/> or contact the Education Director, Center for Documentary Studies, 1317 West Pettigrew Street, Durham, NC 27705. Telephone: (919)660-3663. Fax: (919)681-7600.

Center for Emerging Cardiovascular Technologies

Olaf von Ramm, *Director*

The Center for Emerging Cardiovascular Technologies is a National Science Foundation/Engineering Research Center (NSF/ERC) established at Duke University in 1987. Located in the School of Engineering, the center integrates engineering and biomedical researchers and students from Duke, the University of North Carolina at Chapel Hill, North Carolina State University, Case Western Reserve University, and the University of Alabama at Birmingham with industrial investigators into active, interdisciplinary research programs. Research at the center focuses on discovery and innovation in custom integrated electronics, sensors, systems design, and simulation toward the development of a new generation of cardiovascular interventional and imaging systems. For more information, contact Center for Emerging Cardiovascular Technologies, Duke University, Box 90295, Durham, North Carolina 27708-0295.

Center for International Development Research

The Center for International Development Research (CIDR) is one of several active research and training facilities in Duke's Terry Sanford Institute of Public Policy. The center's core faculty are drawn from a variety of academic disciplines including economics, political science, environmental studies, public policy, history, and sociology. The faculty's teaching, research, and consulting experience are international in scope, encompassing a broad range of development policy issues.

The center offers both long- and short-term programs of study, including the Program in International Development Policy (PIDP), which provides from one semester to two years of training in policy analysis and problems related to sustainable development. Professionals with several years' experience as practitioners or applied researchers in a development-related field are eligible to apply to the program. Participants in the program—known as PIDP fellows—pursue either a certificate or A.M. in International Development Policy while at Duke.

The center also sponsors short-term professional education programs, conferences, and a monthly "Rethinking Development Policy" speaker series. In addition to faculty publications, the center's Working Papers series provides a forum for new research on key issues in development policy. For additional information, contact the center by telephone at (919) 613-7333, by fax at (919) 684-2861, by email at cidr@pps.duke.edu, or visit the web site at www.pubpol.duke.edu/centers/cidr/

Center for International Studies

This center is one of the major coordinating units in the university which stimulates dialogue and research on global issues. The center sponsors a number of faculty committees on major world regions and on transnational analytical themes. As a U.S. Department of Education National Resource Center in International Studies, the center funds a series of courses on global issues of interest to graduate students. These courses provide opportunities for teaching assistantships for graduate students in the humanities and social sciences. In addition, the center sponsors a program of awards for graduate students who wish to undertake research abroad. For more information contact the Center for International Studies, 2122 Campus Drive, Box 90404, Durham, North Carolina 27708-0404.

Kenan Ethics Program

The Kenan Ethics Program at Duke University supports the study and teaching of ethics and promotes moral reflection and commitment in personal, professional, community and civic life. The program encourages moral inquiry across intellectual disciplines and professions and moral reflection about campus practices and policies. The program also supports efforts to address ethical questions of public concern within and across communities. Its work is guided by the conviction that universities have a responsibility to prepare students for lives of personal integrity and reflective citizenship by nurturing their capacities for critical thinking, compassion, courage, and their concern for justice. For information, contact Kenan Ethics Program, Box 90432, 102 West Duke Bldg., Durham, NC 27708; (919) 660-3033; or visit the web site at <http://kenan.ethics.duke.edu/>.

Center for Latin American and Caribbean Studies

The Center for Latin American and Caribbean Studies coordinates graduate education in Latin American studies, and promotes research and dissemination of knowledge about the region. Chaired by Professor Orin Starn, the Council on Latin American Studies oversees the activities of the Center. The Council is made up of Latin Americanist faculty and staff members representing Arts and Sciences disciplines as well as professional schools. The center sponsors a speakers series which provides a forum for presentations by visiting Latin Americanists from throughout the U.S. and overseas, as well as Duke and UNC faculty and graduate students. Each year, the center also cosponsors a number of conferences and other special events, including the annual Latin American Labor History Conference. Through the Duke-UNC Program in Latin American Studies, graduate students can take advantage of funding opportunities and participate in research and training working groups in various fields of interest.

For additional information about Latin American and Caribbean Studies at Duke and courses with Latin American content offered by departments, see the section on "Courses of Instruction" in this bulletin. Graduate students interested in obtaining a certificate in Latin American Studies should contact the Academic Coordinator. For other inquiries, please contact the Director or Associate Director, Center for Latin American and Caribbean Studies, 2114 Campus Drive, Box 90255, Duke University, Durham, NC 27708-0255, telephone (919) 681-3980, email: las@duke.edu.

Center for Mathematics and Computation in Life Sciences and Medicine

The Center for Mathematics and Computation in Life Sciences and Medicine was established in 1986 to meet the growing need for quantitative methods in the understanding of complex biological and medical systems. Many important research problems, both basic and applied, now require the collaboration of experimental biologists, mathematicians, and computer scientists. The purpose of the center is to facilitate such collaborations between researchers in different departments and institutions, as well as between academic and industrial laboratories. Address inquiries to Professor Michael C. Reed, Director, Center for Mathematics and Computation in Life Sciences and Medicine, Department of Mathematics, Duke University, Box 90320, Durham, North Carolina 27708-0320; email: reed@math.duke.edu.



Center for North American Studies

Frederick W. Mayer, *Director*

North American Studies is Duke's newest interdisciplinary international center and the first U.S. Department of Education Title VI National Resource Center devoted to the study of North America as a region. The center focuses on the political, social and cultural consequences of regionalization, and attempts to place them within the long history of the interaction of Canada and Mexico with the United States. Consistent with this focus are six areas of emphasis. They are: regional political economy, environment, labor, migration, communication and cultural industries, and regional, national and subnational identities. For more information, contact the Center for North American Studies, P.O. Box 90422, 2016 Campus Drive, Durham, North Carolina 27708; or visit the web site at: <http://www.duke.edu/web/northamer/>.

Oak Ridge Associated Universities

Since 1946, students and faculty of Duke University have benefited from its membership in Oak Ridge Associated Universities (ORAU). ORAU is a consortium of colleges and universities and a management and operating contractor for the U.S. Department of Energy (DOE) located in Oak Ridge, Tennessee. ORAU works with its member institutions to help their students and faculty gain access to federal research facilities throughout the country; to keep its members informed about opportunities for fellowship, scholarship, and research appointments; and to organize research alliances among its members.

Through the Oak Ridge Institute for Science and Education, the DOE facility

managed by ORAU, undergraduates, graduates, postgraduates, as well as faculty enjoy access to a multitude of opportunities for study and research. Students can participate in programs covering a wide variety of disciplines including business, earth sciences, epidemiology, engineering, physics, geological sciences, pharmacology, ocean sciences, biomedical sciences, nuclear chemistry, and mathematics. Appointment and program length range from one month to four years. Many of these programs are especially designed to increase the numbers of underrepresented minority students pursuing degrees in science- and engineering-related disciplines. A comprehensive listing of these programs and other opportunities, their disciplines, and details on locations and benefits can be found in the Resource Guide, which is available on the web at <http://www.orau.gov/orise.htm>.

ORAU'S Office of Higher Education Initiatives seeks opportunities for partnerships and alliances among ORAU's members, private industry, and major federal facilities. Activities include faculty development programs, such as the Junior Faculty Enhancement Awards and the Visiting Industrial Scientist Program, and various services to chief research officers. For more information about ORAU and its programs, visit the ORAUweb page at <http://www.orau.org/>.

Office of Research Support

The Office of Research Support, located in 327 North Building on Research Drive, assists graduate students and faculty in locating information about external funding for research, travel, publication, and other projects. The ORS web site, located at <http://www.ors.duke.edu>, contains the Duke "Guide to Sponsored Projects," policies governing research, and extensive information on funding opportunities, such as links to government and private funding sources, three electronic funding databases, tips on proposal writing, and various specialized funding and deadline listings. Funding Alert, the weekly ORS on-line and print newsletter, publicizes new and updated funding resources, including graduate fellowships. ORS maintains a library of reference materials, with directories of grants, fellowships and loans, international listings, and guides to proposal preparation, as well as many guidelines and application forms.

Graduate students may take advantage of the resources at ORS by browsing through the information on-line. Students needing more in-depth consultation should make an appointment to talk with a funding opportunities specialist by telephoning (919)684-3030.

ORS staff will work with faculty members to develop departmental workshops or classroom presentations for graduate students on funding opportunities, proposal planning, and other topics specific to various disciplines. ORS also reviews all grant proposals submitted to external funding sources, negotiates with the sponsoring agency, and processes the award. Office hours are from 8:30 a.m. to 5:00 p.m. daily.

Center for Teaching, Learning, and Writing

The Center for Teaching, Learning, and Writing (CTLW) supports active learning throughout the curriculum at Duke. We are especially interested in the uses of writing as a means of critical inquiry. The Center houses an ambitious First-Year Writing Program and supports a wide-ranging Writing-in-the-Disciplines Program. We also sponsor a number of annual Teaching Awards for faculty, as well as a series of workshops and resources for graduate student teachers, including a set of mini-grants supporting the pedagogical work of TAs in their departments. In collaboration with the Cynthia Sulzberger Interactive Learning Lab, the CTLW also supports new uses of technology in teaching through workshops and individual consulting with faculty.

Center for Tropical Conservation

The Center for Tropical Conservation was established to focus the activities of

Duke faculty and students who share a common concern for tropical biodiversity. The primary goal of the Center is to unite biological scientific inquiry with sound political economic analysis and conservation advocacy. Disciplines represented include botany, zoology, anthropology, forestry, history, political science and economics. The Center serves to gather and disseminate pertinent information; to promote and coordinate research relevant to biodiversity and the sustainable development of natural resources; and to sponsor interdisciplinary workshops and courses. Inquiries should be addressed to Professor John W. Terborgh, Co-Director, Center for Tropical Conservation, 3705-C Erwin Road, Simons Building, P.O. Box 90381, Durham, North Carolina 27708-0381.

Organization for Tropical Studies

Duke University is a member and the administrative home of the Organization for Tropical Studies (OTS), a nonprofit consortium that provides leadership in education, research, and the responsible use of natural resources in the tropics. OTS offers the following English language courses in Costa Rica: Tropical Biology: An Ecological Approach (summer & winter - OTS-1, January to March and OTS-3, June to August); Tropical Plant Systematics (OTS-9, offered on even numbered years) and Tropical Biodiversity (OTS-10, August). OTS also offers the following courses in Spanish: Ecología Tropical y Conservación (OTS-2, offered in Costa Rica) and Ecología de Ecosistemas Amazónicos (OTS-13 - offered in Iquitos, Peru). OTS has a fellowship program for research at the OTS field stations in Costa Rica (La Selva, Palo Verde and Las Cruces) and in the Amazon region. Outstanding proposals for research at other locations are also considered. Proposals are accepted twice each academic year. Through OTS, students can also apply for courses in East Africa. Course and fellowship information is available from OTS delegate Dan Richter in the School of the Environment. For more information contact OTS at 410 Swift Avenue, Durham, North Carolina 27708; Phone: (919) 684-5774, Email: nao@duke.edu, or visit the web site at: <http://www.ots.duke.edu>.

Resources for Study



The Libraries

The libraries of the university consist of the William R. Perkins Library and its seven branches on campus: Biology and Environmental Sciences; Chemistry; Lilly; Engineering; Music; Mathematics-Physics; Rare Book, Manuscript and Special Collections; the Pearse Memorial Library at the Duke Marine Laboratory in Beaufort; and the independently administered libraries of Divinity, Law, Medicine, and Business (Fuqua). As of June 1996, these libraries contained over 4.5 million volumes. The collection includes 11 million manuscripts, and over 2,000,000 public documents. The library web site is: <http://www.lib.duke.edu>.

The William R. Perkins Library. The William R. Perkins Library, the main library of the university, houses books, journals, and online resources supporting the humanities and social sciences, as well as a large collection of United States federal and state documents, and public documents of many European and Latin American countries. The library is a depository for U.S., North Carolina, and European documents. An international focus is evident throughout the library collections, reflecting the global strengths of area programs at the university. Included are extensive research collections from and about South Asia, Latin America, Africa, Europe, Russia, and Poland, as well as the country's largest collection of Canadiana. The East Asian Collection offers resources in Japanese, Chinese, and Korean on a variety of topics, predominantly history, politics, literature, and language. The newspaper collection includes many eighteenth-century titles; strong holdings of nineteenth-century New England papers; and antebellum and Civil War papers of North Carolina, South Carolina, Virginia, and Georgia; as well as many European and Latin American papers.

The holdings of the Rare Book, Manuscripts and Special Collections Library range from ancient papyri to records of modern advertising. They number more than 200,000 printed volumes and more than 10.9 million items in manuscript and archival collections. They support research in a wide variety of disciplines and programs, including African American studies, anthropology, classics, economics, history, literature, political science, religion, sociology, and women's studies. Areas of particular strength in the collections include the history and culture of the American South, English and American literature, history of economic theory, British and American Methodism, and the history of modern advertising.

The Circulation/Reserves Department houses the required reading materials placed on reserve for most graduate and undergraduate courses. The department is phasing in campus online access to reserve readings.

The Lilly Library houses the university's research collections for the fine arts; these include art and art history, architecture, and photography, as well as the decorative arts. In addition, resources which cover the performing arts and allied areas such as dance and dance history, drama (focusing on the practice, including play and film scripts), and costume are found at Lilly. The film and video collection includes over 8,000 film titles; scholarship and reference material about film and film history is also located at Lilly. Besides the arts collections, Lilly also houses the university's research collection of philosophy titles.

The Music Library, located in Room 113 of the Mary Duke Biddle Music Building, and the Music Media Center, located in Room 027 of the same building, are administered as a single branch library within the Perkins Library system. The Music Library contains a rapidly expanding collection of scholarly reference materials, books on music, music scores, and over 200 journals in the field. The Music Media Center has a collection of over 20,000 media items, including compact discs, cassettes, LP recordings, laser discs, and videotapes, plus a collection of over 10,000 microforms, along with various facilities for listening and viewing.

The branch libraries serve the academic disciplines bearing their names. The Lilly Library on East Campus, however, contains a small general and reference collection, as well as the university's principal collections of art and art history materials.

The libraries at Duke, North Carolina Central University, the University of North Carolina at Chapel Hill, and North Carolina State University are connected by a computer network. Members of the Duke community can easily and quickly determine what books and other library materials are held by UNC, NCCU, and NCSU. Through a reciprocal borrowing agreement, faculty and students at Duke may borrow materials from both of these libraries.

Reference librarians are on duty in Perkins Library for most of the hours the library is open. Their primary responsibility is to assist patrons in making the most effective use of library collections and facilities. In addition to answering specific questions, the reference librarians also help patrons access information by identifying and explaining the use of library sources and by giving formal and informal instruction to groups of students, faculty, or staff. Professional reference service is available to students in all other campus libraries.

Tours of the Perkins Library are given frequently during Orientation Week and upon request throughout the year. Information about other campus libraries may be obtained from the staff in each of the libraries. The library has both facsimile and copying services. The rules with regard to copyright and a schedule of fees for reproduction services are available in the library at the point of service.

THE DIVINITY SCHOOL LIBRARY

The Divinity School Library contains a collection of more than 295,000 volumes in the field of religion and related disciplines. Although an integral part of the university's twelve-unit library system, the Divinity School Library has its own separate facilities in the Divinity School building. Its book collection is operated on the open stack system, and its reading rooms provide study facilities for students, space for the special reference collection in religion, and for the more than 600 religious periodicals to which the library currently subscribes.

Staffed by a librarian and a reference librarian trained in both theology and library administration, by a supporting staff of three persons, and by a number of student assistants, the Divinity School offers a variety of reference services to assist the student in selecting and locating materials. The staff, in cooperation with the faculty, maintains a book and periodical collection to support basic course work as well as advanced research in all major fields of religious studies.

THE FUQUA SCHOOL OF BUSINESS LIBRARY

The Fuqua Library houses the principal business collections for the university, and includes books, journals, reports, videotapes, working papers, and data bases in accounting, entrepreneurship, finance, human resources management, industry studies, information science, international business, managerial economics, marketing, organizational behavior, and operations management. The library's collections are tailored to the needs of the students and faculty of the Fuqua School and recent acquisitions include important business issues in the curriculum, such as diversity, business in the environment, global business management, health services management, reengineering, and total quality management.

THE MEDICAL CENTER LIBRARY

The Medical Center Library, located in the Seeley G. Mudd Communications Center and Library Building, provides services and informational resources necessary to further educational, research, and clinical activities in the medical field. In addition to the faculties and students in the Schools of Medicine, Allied Health, Nursing, and Medical Center graduate departments, the library serves the professional and technical staffs of Duke Hospital as well as other health professionals throughout North Carolina. Over 290,000 volumes are available; approximately 2,250 journal subscriptions are received currently, in addition to extensive back files of older materials. Professional reference librarians are available for assistance in the use of library resources, and arrangements may be made for individual or group tours, instruction, or specialized seminars.

The History of Medicine Collections, including the Josiah C. Trent Collection, consist of rare books and manuscripts and a supporting group of histories, biographies, bibliographies, pictures, and ephemeral materials. The rare books are available to all, but are restricted to library use. Most modern books may be borrowed. The History of Medicine Collections also include the Duke Authors Collection, which preserves an archival copy of each book published by a member of the Duke medical faculty. The Frank Engel Memorial Collection consists of a small group of books for leisure reading in nonmedical subjects, supplemented by several newspapers and popular magazines. A reserve collection of heavily used books and journals is maintained in the Medical Sciences Branch Library located in the Nanaline Duke Building and covers the fields of biochemistry, genetics, pharmacology, and physiology.

THE SCHOOL OF LAW LIBRARY

The School of Law Library, with over 535,000 volumes, serves both the university and the local legal community. It features comprehensive coverage of basic Anglo-American primary source materials, including nearly all reported decisions of federal and state courts, as well as current and retrospective collections of federal and state codes and session laws. Digests, legal encyclopedias, and other indexing devices provide access to the primary documents. A large section of the library collection is devoted to treatises on all phases of law, as well as history, economics, government, and other social and behavioral sciences relevant to legal research. The treatises are organized in the Library of Congress classification system and are accessible through a public catalog. Special treatise collections are maintained in several subject areas, including the George C. Christie collection in jurisprudence and the Floyd S. Riddick collection of autographed senatorial material. The library is a selective depository for United States government publications, with concentration on congressional and administrative law materials. The library receives the records and briefs from the United States Supreme Court, the Fourth Circuit Court of Appeals, and the North Carolina Supreme Court and Court of Appeals. In addition to its U.S. holdings, the library holds substantial research collections in foreign and international law. The foreign law collection is extensive in coverage, with concentrations in Australia, Canada, France, Germany, Great Britain, India, and South Africa. The international law collection is strong in primary source and treatise material on both private and public international law topics. Undergraduate and graduate students whose course of study requires access to legal literature may use the library. However, access to the library may be restricted during certain times.

UNIVERSITY ARCHIVES

The Duke University Archives, the official archival agency of the university, collects, preserves, and administers the records of the university having continuing administrative or historical value. The institutional archives, which also include

published material, photographs, papers of student groups and faculty, and selected memorabilia, are available for research under controlled conditions in 341 Perkins Library.

Science Laboratories

The Office of Information Technology (OIT). OIT is the home of information technology for the university community; it is responsible for computing, telephony, and tele-video services and support. OIT's web site, at <http://www.oit.duke.edu>, offers information, instructions, software downloads, and more.

Computing. OIT provides students with a range of computer support services including Internet access. All undergraduate residence halls and Central Campus apartments are wired for direct access to DukeNet, the campus-wide computer network. During the first weeks of school, OIT helps students establish their "dorm net" connections: with a computer and an ethernet adapter, students get high-speed access to e-mail, the World-Wide Web, and all the rest the Internet has to offer.

Located throughout the campus, OIT's public computer clusters offer up-to-date UNIX, Windows, and Macintosh computers for student use. All offer laser printers and DukeNet access. OIT's Help Desk staff is available to assist students with Duke-supported software, hardware, and services. The Help Desk web site is at <http://www.oit.duke.edu/helpdesk>; you can send electronic mail to helpdesk@duke.edu; or you can call 684-2200 for more information.

Biological Laboratories. Facilities for graduate study in the Department of Biology are located on the West Campus, together with those of supporting departments (physics, chemistry, geology, and the basic medical sciences). Scientists in plant and animal biology with common interests are clustered in three buildings. The Biological Sciences building houses systematics, population genetics and evolution, animal physiology and functional morphology; the Duke Phytotron contains plant ecology; and the recently constructed Levine Science Research Center is home for developmental, cellular, and molecular biology, as well as the School of the Environment, Computer Science Department, and two basic medical science departments. The three buildings are within a five-minute walk and maximal interaction occurs between the different groups in biology through seminars, shared instrumentation and collaborative research projects. Special facilities available to botanists and zoologists include animal rooms, greenhouses, darkrooms, refrigerated and controlled environment laboratories, scanning and transmission electron microscopes, a Van de Graaf accelerator, X-ray machines, radiation and radioisotope equipment, a computerized morphometrics laboratory, and other modern research facilities. Extensive facilities for experimentation in environmental control of plant growth are available in the phytotron adjacent to the botany greenhouses.

The herbarium contains approximately 700,000 specimens and includes notable collections of mosses and lichens. Other assets for teaching and research are the Sarah P. Duke Gardens on the West Campus; the eleven-acre experimental plot and field laboratory; the Duke Forest, comprising 7,900 acres of woodland adjacent to the West Campus; the field station for the study of animal behavior and ecology; and the Duke University School of the Environment Marine Laboratory, an interdepartmental facility located on a small island on the coast at Beaufort, North Carolina, where twenty-two buildings and a small flotilla of ships and boats provide teaching and research facilities for resident graduate students and faculty as well as visiting individuals or groups.

Duke University, through the biology department, is a member institution of the Organization for Tropical Studies, Inc., a consortium of universities with field station facilities in Costa Rica that provide opportunities for course work and research in tropical science.

Highlands Biological Station. Duke University holds a contributing membership in the Highlands Biological Station at Highlands, North Carolina, on the southern edge of the Blue Ridge Mountains at an elevation of 4,118 feet. The station and the region offer an excellent opportunity for field studies and some laboratory work. A limited number of qualified students in biology may make arrangements to carry out research here. Scholarships for advanced study during the summer months are available through the station.

The Phytotron. The Phytotron, a national facility for controlled environment research operated for the National Science Foundation, is adjacent to the Biological Sciences Building and is administered by the botany faculty. The Phytotron houses 48 plant growth chambers and six greenhouse units, providing more than 4,800 square feet of plant growing space. Environmental factors controlled in these units include light, temperature, nutrients, carbon dioxide concentration, and humidity. Founded in 1968, the facility has a long and distinguished history of plant controlled environment research, and has been an important tool in the development of the field of plant physiological ecology by Duke botany faculty. The Phytotron has also been an important center for global change research, supporting studies ranging from individual plant to whole ecosystem responses to changes in atmospheric carbon dioxide levels and/or temperatures. The facility boasts an exceptional staff with many years of experience in controlled environment research and includes associated research laboratories and equipment for studying and monitoring the biochemistry and physiology of plants.

Research space, plant care, and help with experimental design and implementation in the Phytotron are available to graduate students and faculty at Duke and to members of other educational and research organizations. For information about renting research space, contact Dr. James F. Reynolds, Director of the Phytotron, Box 90340, Duke University, Durham, NC, 27708-0340.

Duke Forest. The Duke Forest comprises approximately 7,900 acres of land in five major divisions and several smaller tracts. A ten-minute walk from campus will take one well into many parts of the Durham division, and a network of roads and fire trails make almost all areas of the forest easily accessible.

The forest lies primarily in Durham and Orange counties, near the eastern edge of the piedmont plateau, and supports a cross-section of the woodlands found in the upper coastal plain and lower piedmont of the Southeast. A variety of timber types, plant species, soils, topography, and past land use conditions are represented. Elevations range from 260 to 760 feet. Soils of the region are derived from such diverse parent materials as metamorphic rock of the Carolina slate formation, granite, Triassic sedimentary rock, and basic intrusives.

The forest serves for research in such areas as forestry, zoology, botany, and ecology by faculty and students at Duke and neighboring universities. Background information useful to researchers covers such features as soils, topography, inventory, plantation and cultural records, as well as a bibliography of past and current studies. Current work on problems associated with developmental pressures at the urban-rural interface and integrated approaches to natural resource management have multiplied the value and benefit of the forest. For information contact: Judson Edeburn, Duke Forest Resource Manager, A114 Levine Science Research Center, Duke University, Box 90332, Durham, North Carolina 27708-0332.

Earth and Ocean Sciences Laboratories. The Division of Earth and Ocean Sciences occupies recently renovated laboratories in the Old Chemistry Building. Analytical capabilities and facilities include: VG Inductively-Coupled Mass Spectrometer (ICP-MS) with laser ablation microprobe, Cameca automated electron microprobe with four wave length dispersive spectrometer and one energy dispersive spectrometer, direct current plasma spectrometer (DCP), ion

chromatograph, x-ray diffractometers, x-radiograph, atomic absorption spectrophotometer, electron particle analyzer, cathodoluminescope, carbon-nitrogen-sulfur analyzer, several research-grade petrographic microscopes including capability for fluorescence petrography, photomicrography and fluid-inclusion analysis, as well as darkrooms and several photographic systems. Other analytical equipment is available from the University of North Carolina and North Carolina State University via reciprocal agreement.

Computational facilities include a current-technologies computer network. The network is connected to both the North Carolina Super Computer network and high speed Internet. The interdepartmental network is based on a 20-plus node, SUN UNIX system, with gateways to a comparable number of personal and portable computers of all types. The main server is a SUN computer with 30 Gb of disk. Major peripheral devices include: a 24" electrostatic plotter, a 36" by 60" high resolution digitizing table, a 36" pen plotter, full video image transfer hardware, and several CD ROM, Exabyte tape, 9 track tape, and 1/4" tape devices. The task of administering this extended computer resource is handled on a full-time basis by the department's technical staff.

Forestry Sciences Laboratory. The Forestry Sciences Laboratory of the USDA Forest Service, Southeastern Forest Experiment Station is located in the Research Triangle Park near Durham. This research organization provides excellent opportunities to complement research conducted by students in the School of the Environment. Specialized research projects in timber investment opportunities, market efficiency, forest soils, insect toxicology, air pollution impacts, and the economics of forestry in developing countries are currently under way at the laboratory. The staff of the laboratory is available for consultation and participation in seminars. Arrangements may be made for students to conduct certain aspects of their research at the laboratory.

Marine Laboratory. The Nicholas School of the Environment Marine Laboratory, an educational and research facility of the university, is located on Pivers Island within the Outer Banks, adjacent to the historic seacoast town of Beaufort, North Carolina, with direct access to the Atlantic Ocean, Cape Lookout National Seashore Park, estuaries, sand beaches, wetlands, and coastal forests. The area provides an excellent opportunity for marine study and research at the undergraduate, masters, and doctoral levels. The laboratory accommodates nearly 3,700 visitors per year, including forty to fifty resident graduate students who are involved in year-round activities. (For additional information concerning the graduate program, refer to the section on marine sciences in the chapter "Courses of Instruction" in this bulletin and the current *Bulletins of Duke University: Nicholas School of the Environment and the Marine Laboratory*.) The modern physical plant consists of 23 buildings, including four dormitories, a large dining hall, one residence, a student commons, a storehouse for ship's gear, classroom laboratories, six research buildings, and a maintenance complex. The Marine Laboratory operates the R/V *Susan Hudson*, a 57-foot fully-equipped coastal oceans research vessel with the capacity to perform small-scale biological, chemical, geological, and physical oceanography. The Marine Laboratory is also the home port for the R/V *Cape Hatteras*, a 135-foot oceanographic research vessel operated for the NSF by the Duke/University of North Carolina Oceanographic Consortium. The laboratory also maintains an electronics shop, a workshop, a stockroom, and a purchasing department.

For information concerning teaching and research space, write to the Auxiliaries and Administrative Services Office, Duke University Nicholas School of the Environment, Marine Laboratory, 135 Duke Marine Lab Road, Beaufort, North Carolina 28516-9721; telephone (252)504-7504 or cba@duke.edu.

Primate Center. The Duke University Primate Center is located in Duke Forest about two miles from the main campus. The colony is composed of approximately

300 prosimian primates representing thirteen genera, twenty-one species, and twenty-eight sub-species. This is both the largest and most diversified colony of living lower primates in the world and the world's largest conservation center for primates. The center also houses frozen, preserved, and fossil primate collections. These collections and animals are utilized by faculty members and both graduate and undergraduate students in the Departments of Biological Anthropology and Anatomy, Biology, Earth and Ocean Sciences, Environment, and Psychology for all qualified research in primate paleontology, prosimian aging, locomotion, cytogenetics, comparative anatomy, behavior, and physiology. Applications for graduate study in one of these areas should be directed to the director of graduate studies of any of the five departments. For information pertaining to the use of the Primate Center, graduate studies, or availability of research space, write to Dr. Kenneth E. Glander, Director, Duke University Primate Center, 3705 Erwin Road, Durham, North Carolina 27705.

Animal Care and Use Program. The animal care and use program serves the research and teaching programs of the Duke University. The program is centrally managed by laboratory animal veterinarians in the Division of Laboratory Animal Resources (DLAR). DLAR maintains a central vivarium, satellite facilities and a farm where laboratory animals are housed. The institutional animal care and use committee monitors the program to ensure the humane care and treatment of animals. Duke University is registered with the United States Department of Agriculture and is fully accredited by the American Association for the Accreditation of Laboratory Animal Care (AAALAC), which assures compliance with standards of NIH.

Experimental Psychology Laboratories. The facilities of the Department of Psychology: Experimental include laboratories to study human memory, perception and cognition in children and adults, classical and operant conditioning in various species, maze learning, and taste and smell in animals and people. There are facilities for animal surgery, autoradiography, photographic darkrooms, histology, and psychophysiology to help relate vision, taste, and smell to brain aspects and to learning, memory, emotion, and development. There also are sound and speech processing capabilities, labs for visual observation of infant's and young children's social interactions, and various facilities for computational modeling. General purpose laboratories are well supplied with computers for various uses. To facilitate new projects, there are woodworking, metalworking, and electronic shop facilities staffed by full-time technicians. Additional facilities are available in Duke's new Cognitive Neurosciences Center, the Brain Imaging and Analysis Center, the nearby Primate Center, and the Duke and V.A. Medical Centers, as well as in area universities and in research companies in the Research Triangle Park.

Chemistry Laboratories. The Department of Chemistry is housed in the Paul M. Gross Chemical Laboratory, a building containing 146,400 square feet of total area. This well-equipped chemical laboratory provides conditions conducive to research in many areas of current interest. Nuclear magnetic resonance facilities include a broad band Varian INOVA 400, a GE QE-300, a Varian UNITY 600, a Varian Unity 500, a Varian Mercury 300, a GN-300 (25 mm wide bore probe) and a Varian 800 MHz is being installed. An ESR spectrometer, the Varian E-9, provides an excellent facility for research in electron spin resonance. Mass spectrometric service is provided by a high resolution JEOL SX-102, a low resolution Hewlett-Packard GC/MS system with HPLC/MS capacity, for matrix assisted laser desorption ionization MS there is a PerSeptive Biosystems Voyager DE, and electrospray ionization MS is provided using a PE Sciex API-150EX. An X-ray diffraction camera is available along with an Enraf-Nonius CAD-3 automatic diffractometer. Numerous instruments of varying sophistication for photoacoustic, fluorescence, infrared, routine FTIR, UV, Raman

and ORD-CD spectroscopy are available; various laser sources, monochromators, and computerized data acquisition systems are associated with these systems. Some other significant research facilities include an ultra dry lab facility. A variety of preparative and analytical gas and liquid chromatographs are also located in the building. Research in biological chemistry is facilitated by the availability of an autoclave, media prep room, high-speed centrifuges, and ultra centrifuges. In addition, collaborative studies with researchers in the Medical Center increases our access to other specialized instruments.

Computing facilities in chemistry include Sun UNIX workstations and Apple Macintosh computers. The UNIX cluster and many other computers associated with specific research groups are networked via Ethernet, which is linked to the university's fiber optic network. Among the resources available via the network is the North Carolina Supercomputer Center. In addition, the department has state-of-the-art computer/video projection systems in its lecture halls for incorporation of the latest computational research tools into the undergraduate chemistry curriculum.

The department has a machine shop and an electronics shop. The facilities of the Duke University Marine Laboratory on the coast at Beaufort, North Carolina, are available for specimen collecting and processing studies of chemicals of marine origin. The Department of Chemistry Library, with holdings of approximately 50,000 volumes, is also located in the P.M. Gross Chemical Laboratory. The library receives 500 current scientific periodicals and serial subscriptions and has computer facilities for complete information retrieval.

Physics Laboratories. The Physics Building houses research and instruction in the Departments of Physics and Mathematics. Additional space is provided by the adjacent Nuclear Building (TUNL) and Free Electron Laser (FEL) Laboratory Buildings. Graduate students studying in these two programs usually have offices in these buildings.

About half of the physics space is devoted to research laboratories for the department's programs. Special equipment includes: ultrafast, high power, short wavelength, and far-infrared lasers; a 45-MeV electron linear accelerator driving an infrared free electron laser (FEL) and a 1 GeV linear accelerator and high current electron storage ring driving an ultraviolet to soft X-ray FEL; a high-resolution 4 MeV Van de Graaff accelerator; a 20 MeV tandem Van de Graaff accelerator with polarized source and cryogenically-cooled polarized targets; cryostats, superconducting magnets, and associated equipment for research in the low temperature temperature range; several computers for data collection and processing in all of the research groups; a massively parallel computer system for particle, nuclear, and condensed matter theory; desktop computers are typically provided for all grad students.

The Mathematics-Physics Library is located in the Physics Building; it contains a large selection of books and scholarly periodicals. Also located in the building are appropriately staffed instrument and electronics shops.

Engineering Research Laboratories. The laboratories of the four departments of the Pratt School of Engineering contain extensive basic equipment that may be applied in several specialized fields. The facilities available for instruction and research are suggested by the following brief listing of equipment found in each department:

Biomedical Engineering. Biomechanics laboratories: hydraulic testing system, IBM PS/2 microcomputer, micro VAX II computer, optical displacement measuring system, silicon graphics/GE graphcon system, Sun micro systems SPARC station, Zonic modal analyzer. Biomedical materials and surface interactions laboratories: air- and water-cooled Argon lasers, air convection oven, capillary rheometer, FTIR infrared spectrometer, gamma counter, gel permeation chromatograph, Langmuir-Blodgett trough, liquid nitrogen cooled CCD camera, Nikon inverted microscope

with phase contrast and epifluorescence, Ultimege image analysis system and Macintosh II, vacuum oven, Zeiss axioplun microscope, electrophysiology and neurophysiology instrumentation. Ultrasound imaging and transducer laboratories; CAD/CAM stations for circuit development, diamond tip dicing saw, high-speed video system, image processing system, laminar flow hood, multiple PCs and work station, PC board maker, ultrasound mechanical scanner, VAX 11/780.

Civil and Environmental Engineering. Faculty in civil and environmental engineering routinely design, construct, and adapt laboratory equipment for specialized teaching and research tasks in engineering mechanics, environmental engineering, geomechanics, structural engineering, transportation and systems engineering, and water resources engineering. In addition, arrays of standard laboratory facilities are available to support each research area.

Research and teaching facilities in engineering mechanics, structural engineering, and geomechanics include four independent closed-loop electrohydraulic dynamic loading systems (MTS), with a frequency range up to 100 Hz, and ranges of load to capacity 6,000, 35,000, 50,000 and 220,000 lbs. The 6,000 lbs. actuator can develop a constant crosshead speed up to 50,000 in./min. For teaching and research, the department has a 10,000 lb. universal testing machine and a 10,000 lb. torsion machine both fully instrumented with computer data storage, as well as a Kistler force plate with 10 decades of sensitivity. Equipment is available for fabricating specimens and testing fiber-reinforced polymer composites. An environmental chamber tests in the temperature range of -100° to +350° F; equipment for spectral and modal dynamic analysis, and an ultra-high pressure triaxial shear apparatus is available for confining pressures up to 100,000 psi. Rock-testing facilities, model-testing equipment for anchored walls and penetrometer studies, a large-aperture research polariscope, a reflective photoelastic polariscope, and a sustained-loading facility for long duration in studies of prestressed concrete are routinely used in teaching and research procedures.

Research and teaching facilities in environmental engineering include wet and dry laboratories equipped to study a range of physical, chemical, and biological processes. A fully integrated resource recovery pilot plant, calorimetry for the measurement of heat values of secondary fuels, air classifiers interfaced with computer monitors, as well as indoor and outdoor water resources monitoring devices including flumes, Venturi meters, and digital computation hardware are available. The biotechnology and physical-chemical laboratories are equipped with autoclaves, a media preparation room, walk-in environmental rooms, numerous fume hoods, a biohazard containment facility for cultivation of genetically engineered microorganisms, fully instrumented bioreactors with on-line control, and various analytical instrumentation including liquid scintillation counting, autoradiography, atomic adsorption spectroscopy, total carbon analysis to ppb levels, gas chromatographs equipped with ECO, FID, and TCD detectors, HPLCs, computer-assisted image analysis microscopes, and a recently acquired fourier transfer infrared spectrometer facility.

Computer resources available to civil and environmental engineering students include a multitude of personal computers, two Digital Equipment Corporation Workstation clusters consisting of fifty workstations in total. Additionally, the department houses and maintains its own computing facility, providing five UNIX workstations (1DEC, 1 SUN, and PC's with silicon graphics 486 processors) and 9 IBM-compatible PC's also with 486 processors. This particular facility is dedicated to graduate student research and special undergraduate projects. Most of the computer resources are networked with the Pratt School of Engineering's ethernet backbone and are easily accessible from several locations in the department and across the campus. Depending on the specific application, students can successfully investigate problems in computational fluid and solid mechanics, rigid-body dynamics, particle and mathematical optimization as well as transportation and environmental systems

engineering research topics. If additional computing capabilities are needed, access to the Microelectronics Center of North Carolina's Cray YMP vector processing supercomputer is available. Numerous software packages are available to students through the existing Computational Resource Center. Many problems addressed by the faculty and students of the Department of Civil and Environmental Engineering are computationally complex and could not be approached without the substantial computing facilities available at Duke.

Electrical and Computer Engineering. General computing laboratory equipped with several IBM RS-6000s servers and a fast interconnect network in a UNIX environment for interactive design, graphics, computation, and computer-aided engineering; Sun SPARC workstations for VLSI design; ethernet network for connection to regional, national, and international data networks; Signal Processing Laboratory with Sun workstations; microwave facilities for experimentation up to 35 GHz; robotics with a GE P-50 robot; microprocessor laboratory; Digital Systems Laboratory; solid-state power conditioning laboratories with dedicated computers for controlling instruments, including digital processing oscilloscopes and network and impedance analyzers, and for computer-aided design; clean room and semiconductor nMOS fabrication laboratory for integrated circuits; a molecular beam epitaxy laboratory for III-V compound semiconductor crystal growth using a Riber Model 3R&D MBE system; access to the design, fabrication, and research facilities of the Microelectronics Center of North Carolina; and an ion implanter and MOCVD epitaxial growth system in a III-V compound semiconductor lab at the Research Triangle Institute.

Mechanical Engineering and Materials Science. The department has a number of well-equipped laboratories for studies in aerodynamics, acoustics, nonlinear dynamics and chaos, microscale and convective heat transfer, computational fluid mechanics and heat transfer, control theory, cell and membrane biomechanics, biorheology, polymer engineering, corrosion, electronic materials, physical metallurgy, positron annihilation spectroscopy, and expert systems. Equipment in these laboratories includes a wind tunnel, a scanning electron microscope, a scanning tunneling microscope, doppler broadening and lifetime positron systems, a liquid helium cryostat, DSC/DMA facilities and diffusion furnace, inverted microscopes, low-light-level video cameras and a photon counter, cell-culture systems, an anechoic chamber, a dynamic signal analyzer and laser velocimeter for bearing analysis, an X-ray generator and diffractometer, FTIR spectrometer, a high-power laser with lock-in amplifier, and a fluorescence microscope. A variety of computational equipment is available including a mini-supercomputer access to a regional supercomputer.

The Duke Hypo-Hyperbaric Center is a major center for research, treatment and training involving hyperbaric and hypobaric exposure and simulation. The facility includes the F. G. Hall Laboratory, a large multi-chamber complex, and supporting clinical and laboratory services. Hyperbaric oxygen is used in the treatment of many disorders, including decompression illness, gas gangrene, carbon monoxide poisoning and wound healing. The hyperbaric facility is fully equipped with state-of-the-art hemodynamic and blood gas monitoring equipment, allowing uninterrupted delivery of critical care for patients requiring intermittent hyperbaric oxygen therapy.

As the headquarters of the National Diver's Alert Network (DAN), the lab is a major resource for the referral and treatment of serious diving accidents and air embolism cases and for the largest recreational diving illness data base in the world. The laboratory provides opportunities for research and for training for physicians, postdoctorates, and graduate students in pressure-related medicine and physiology. The program is multidisciplinary with major participation by the Departments of Anesthesiology, Medicine, Surgery, Cell Biology, Neurobiology, and the Pratt School of Engineering.

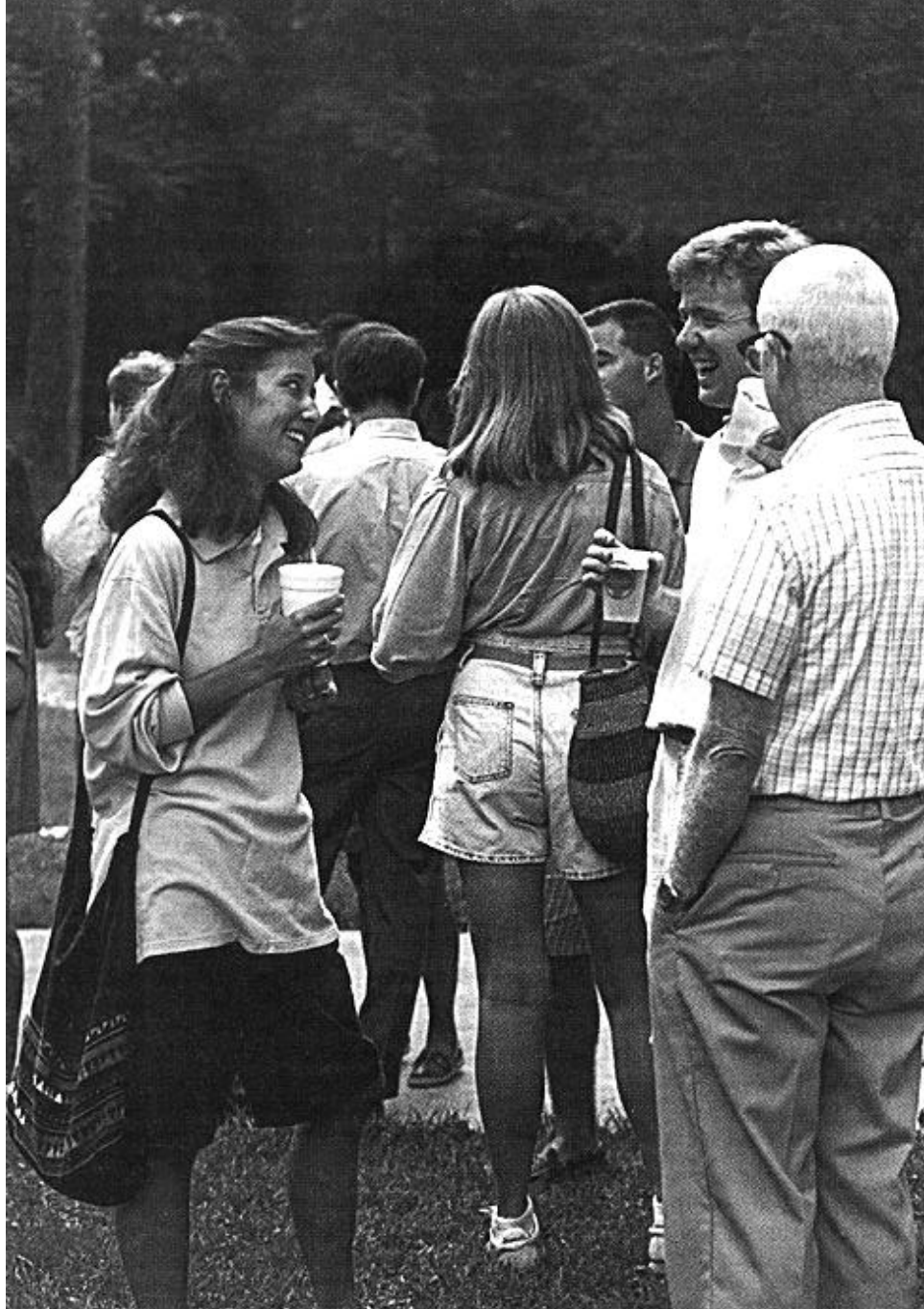
The Medical Center. Currently the Medical Center at Duke University occupies approximately 140 acres on the West Campus. The southern quadrant is contiguous with the main quadrangle of the university and consists of the following: Davison Building, Duke Hospital South, Baker House, Barnes Woodhall Building, Diagnostic and Treatment Building, Ewald W. Busse Building, Eugene A. Stead Building, Clinical Research II, and the Edwin A. Morris Clinical Cancer Research Building.

The northern portion includes the Joseph and Kathleen Bryan Research Building for Neurobiology, Nanaline H. Duke Medical Sciences Building, Alex H. Sands Medical Sciences Building, Edwin L. Jones Basic Cancer Research Building, Clinical and Research Laboratory Building, Bell Building, Seeley G. Mudd Communications Center and Library, Joseph A. C. Wadsworth Building (Eye Center), Duke Hospital North Division and Anlyan Tower, and Lenox Baker Hospital.

In the western section of the campus are: Surgical Oncology Research Building; Environmental Safety Building; Research Park Buildings I, II, III, and IV; the Vivarium; and the Cancer Center Isolation Facility.

In the eastern section of the campus are Pickens Rehabilitation Center, Civitan Mental Retardation and Child Development Center, and Trent Drive Hall.

Student Life



Living Accommodations

Duke University has two apartment facilities on campus. One is dedicated solely to graduate and professional students (Town House Apartments) and the other is a subset of the undergraduate housing on Central Campus. The apartments are available for either continuous or academic term occupancy, are fully furnished and wired for cable, telephone and DukeNet. Floor plans and furnishing lists are sent out in the housing application packet or an application may be found on the Housing Management web site at <http://www.housing.duke.edu>.

Both facilities house single and married students. Single students may choose their own roommates or the Department of Housing Management will assign students with similar interests and schedules together. Each single student pays rent per academic term to Duke University. Married rental rates are available on the web site.

The **Town House Apartments** are located approximately 3 blocks from the main East-West Campus bus line. These apartments are more spacious than other apartments on campus and the facility only houses 64 residents. Because of its location and size, residents find that these apartments offer more privacy and a change from the routine campus life and activities.

Each air-conditioned apartment includes a living room, a master bedroom, a second bedroom, a bath and a half and an all electric kitchen with dining room. Spacious closets and storage space are provided within each apartment. A swimming pool, located in the center of the complex, is open during the late spring and throughout the summer months.

All utilities — water, heat, air-conditioning, gas and electricity — are provided. Residents must make arrangements with Duke University OIT Residential Services to connect cable, voice and data services.

A portion of the **Central Campus Apartment** complex is set aside for graduate and professional students. Air-conditioned efficiency, two-bedroom and three-bedroom apartments are rented to students. Efficiency units are very limited in number and are generally not available to new students.

All utilities — water, heat and electricity — are provided. Telephone, cable and data jacks are provided in each apartment. Residents must make arrangements with Duke University OIT Residential Services to connect cable, voice and data services.

To apply for either of these facilities, please return the postcard sent with your acceptance to Graduate School indicating your preference for University housing or fill out an application on-line after your acceptance at <http://www.housing.duke.edu>. Assignment to all university housing is made on a first-apply, first assigned basis and is NOT guaranteed.

The Department of Housing Management also maintains a listing of **off-campus** rental apartments, room and houses provided by property owners or real estate agencies in Durham. These listings are available in the department only. Information on commercial apartment complexes in the Durham area may be obtained by indicating

a preference for off-campus housing on the postcard sent with your acceptance to Graduate School or by visiting the website listed above. Except for assuring that owners sign a statement of nondiscrimination, off-campus property is in NO way verified and neither the University nor its agents negotiate between owners and interested parties.

Further details regarding off-campus housing will be distributed to all new matriculants during the summer preceding their first registration. This material comes in the form of *A Guide to Duke and Durham*, a handbook prepared annually by the Graduate and Professional Student Council.

Dining Services

Graduate students are welcome to dine on campus at any Duke Dining Services facility. Dining Services provides cafeterias, both ethnic and fast food restaurants, delis, snack bars, bagel shops, authentic Kosher food, and a juice bar at the new Wilson Recreational Facility on West Campus. The unique campus restaurants and cafés offer options sure to satisfy your taste preferences.

On West Campus, dine at The Great Hall (West Union) for traditional cafeteria style dining. The Oak Room (West Union), a tradition in Duke Dining, offers restaurant service in a quiet, relaxed atmosphere. Han's Chinese Cuisine (West Union) offers a wide variety of Chinese food Sunday through Friday. Chick-fil-A (West Union) offers the traditional menu served at Chick-fil-A restaurants, in addition to salad plates and burritos made by The Cosmic Cantina. Alpine Bagels & Brews (West Union Building) and The Alpine Atrium, (Bryan Center) offers bagels, assorted coffees, fresh-squeezed orange juice, smoothies and salads/desserts. The Armadillo Grill (Bryan Center) offers a wide variety of Tex-Mex options. McDonald's, our newest addition to Duke Dining, is a one-of-a-kind facility, unlike the typical McDonald's at the mall. We also have operations in the Law School that offers sandwiches (JD's) and the Sanford Institute for Public Policy offering a typical deli-style menu (Sanford Deli). The Center for Jewish Life offers authentic Kosher dining options. Quenchers Juice Bar (Wilson Center) offers refreshing drinks that complement your healthy lifestyle. The Perk (Perkins Library) is a traditional coffee bar, offering a wide variety of coffees, sandwiches and pastries.

On East Campus, visit The Marketplace (East Union Building), and select from a wide variety of choices including pasta, pizza, deli, rotisserie, grill and salad bar stations. Trinity Café (East Union Building) has a diverse selection of quality coffees and snacks.

On North Campus (Trent), Grace's Café offers a variety of American and authentic Chinese cuisine.

On Science Drive, Li'l Dino's (Nanaline Duke) and George's Express (LSRC) offer hot and cold sandwiches and entrees, snacks, desserts and drinks.

Food purchases may be made in one of three ways: cash, a dining account (points), or a flexible spending account. Both the dining and flexible spending accounts allow students to make purchases on campus by accessing a prepaid account carried on the student identification card, or DukeCard. Information about DukeCard accounts is available from the DukeCard Office, 100 West Union Building, Box 90911, Durham, NC 27708-0911, (919) 684-5800.

Further information about campus dining facilities and dining plan options is available from Duke Dining Services, 029 West Union Building, Box 90898, Durham, NC 27708-0898, (919) 660-3900. Stay up to date for the latest in Dining news by visiting our web site at <http://auxweb.duke.edu/Dining/>. We look forward to serving your dining needs soon!

Services Available

Services for Students with Disabilities. Duke University admits students without regard to disability and offers reasonable accommodations to the needs of students with disabilities. The Office of Institutional Equity has been designated to

ensure that the university is in compliance with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act of 1990. The Office of Graduate Student Affairs assists that office in a continuing effort to make university programs and services accessible to members of the Duke community. Graduate students who have special needs, including those related to physical and learning disabilities, may seek assistance at GSA, located in 120 Allen Building, telephone (919) 684-2056.

Student Health Service, William A. Christmas, M.D., Director, 357 Hanes Hall. The Duke Student Health Service is administered by the Department of Community and Family Medicine, Duke University Medical Center. Medical services are provided by board-certified faculty and by physician assistants, nurse-practitioners, and resident physicians under faculty supervision..

Duke Family Medicine Center. The D.F.M.C. (684-3180), located on the corner of Erwin Road and Trent Drive in the Marshall Pickens Building, is the primary location for medical care. Students are seen by appointment Monday-Friday, 8:00 A.M.-5:30 P.M. A wide variety of services are available: general medical care, health education, laboratory, pharmacy, travel and immunization, x-rays, cold/flu self-help table, allergy clinic, and nutrition counseling.

Students are encouraged to use the Duke Family Medicine Center as their portal of entry to other health resources when needed, including the specialty clinics at Duke University Medical Center. This helps with coordination of appropriate care.

For problems arising after hours and on weekends, students should call the Infirmary (684-3367). The nurse may advise the student to come to the Infirmary or to the Duke Emergency Department (684-2413) for further evaluation. In the event of an obvious life-threatening emergency, students should go directly to the Emergency Department. If necessary, Duke Public Safety (call 911 or 684-2444) provides on-campus transportation to the Emergency Department or the Infirmary.

The Infirmary. The 24-hour Infirmary (684-3367), located on the fourth floor of Duke University Hospital South Division, purple zone, provides inpatient treatment of illnesses too severe to manage in the residence hall or apartment, but not requiring hospitalization. Confidential HIV testing, flu shots, walk in assessments, and a cold, flu, allergy self help table and nurse assessments are also provided.

Health Education. This component of Student Health is headquartered at Hanes Hall and at the Healthy Devil Education Center in House 0 on West Campus. Health education staff are available to assist students in making informed decisions that promote their health. Topics of concern include alcohol and other drug usage, eating and nutrition, sexual activity and sexually transmitted diseases, stress management, and others. Consult the Healthy Devil online at <http://healthydevil.stuaff.duke.edu>.

Student Health Physical Therapy Clinic. The Student Health Physical Therapy Clinic is located in the Wilson Recreation Center on West Campus in the basement of Card Gym. A physical therapist is available from 2:00 p.m.-5:00 p.m. weekdays when undergraduate classes are in session, on a walk-in basis, to assess exercise-related problems and to outline short-term treatment plans, aid recovery, and help prevent re-injury. Call 684-6480 during the summer months for hours.

Confidentiality. Information regarding the physical or mental health of students is confidential and is released only with the student's permission.

Student Accident and Hospitalization Insurance. Health insurance is essential to protect against the high cost of unexpected illnesses or injuries which would require hospitalization, surgery, or the services of specialists outside the Student Health Service. Therefore, all students are required to have such insurance. At the beginning of each fall semester, students must provide proof to the bursar's office of coverage under an accident and hospitalization insurance policy or purchase the Duke Student Accident and Hospitalization Insurance policy. This insurance policy

provides protection twenty-four hours per day during the twelve-month term of the policy of each student insured and is specifically designed to complement the coverage provided by the student health fee (see below). Students are covered on and off the campus, at home, while traveling between home and school, and during interim vacation periods. Coverage for the student's spouse and dependent children also may be purchased. Further information about this plan may be obtained from Hill, Chesson, and Associates (489-7426).

Health Fee. All currently enrolled full-time students and part-time degree candidates are assessed a mandatory student health fee. This covers most services rendered within the Student Health Service during each enrolled semester. An optional summer health fee for students not enrolled in summer sessions is also available through the Bursar's Office.

Services Covered by the Health Fee. The health fee covers most of the services at Duke Family Medicine Center if medically indicated and rendered by a student health provider:

- Medical care for acute and chronic illness, and minor injuries;
- One annual health maintenance examination every two years and most associated studies;
- Annual gynecological exam;
- Most routine laboratory and x-ray services;
- Allergy shots;
- Confidential pregnancy testing;
- Most medications required for short-term treatment of acute problems;
- Some immunizations required for programs receiving academic credit at Duke (note: a supplemental fee may be required for certain immunizations), excluding premarital immunizations.

The health fee covers a variety of other services at Duke Family Medicine Center and other locations:

- Health education and health promotion, including nutrition consultation;
- Infirmary service, not including meals and not including diagnostic testing ordered by specialist consultants;
- Mental health and career counseling at C.A.P.S.

Services not covered by the Health Fee. If you are unsure whether a service is covered, please ask the staff of the Duke Family Medicine Clinic business office prior to receiving service. You are financially responsible for the following:

- Medical care provided in the Emergency Department, hospital, or other non-student health facility;
- Care provided by specialist consultants, including those working within the student health facilities;
- Dental care;
- Pregnancy care or deliveries;
- Tests, procedures, prescriptions not medically indicated, not on the approved list, or not ordered by student health providers;
- Immunizations required for entrance to Duke or other universities, or for personal travel,
- Medications not on the student formulary and those required for long-term use; contraceptives.

Counseling and Psychological Services. Counseling and Psychological Services (C.A.P.S.) is located in Suite 214, Page Building on West Campus. C.A.P.S., a component of student services, provides a range of counseling and psychological services designed to address the acute emotional and psychological difficulties of Duke students.

The professional staff is composed of psychologists, clinical social workers, and psychiatrists experienced in working with college students. They provide direct services to students including evaluation and brief counseling/psychotherapy, issues such as self-esteem and identity, family relationships, academic performance, dating, intimacy, and sexual concerns. Ordinarily students are seen for counseling by appointment. If the concern requires immediate attention, a C.A.P.S. staff member assists with the emergency at the earliest possible time.

Each year C.A.P.S. offers a series of counseling, therapy and support groups. These explore such interests as stress, relationships, awareness of diversity, and management of eating disorders. Support groups have been offered to graduate and professional school women and gay and lesbian students.

Another function of C.A.P.S. is to provide consultation regarding student development and mental health issues affecting not only individual students but the campus community as a whole. The staff works with other campus personnel including administrators, faculty, the student health staff, and student groups in meeting needs identified through such liaisons. Contact C.A.P.S. at 660-1000.

The Career Center

The mission of the Career Center is to educate all students of Duke University, including those enrolled in the Graduate School, in the arts of self-assessment, career exploration, career planning, and job hunting so that they can negotiate a successful transition to the workplace and effectively navigate its lifelong challenges. The Center serves students and alumni/ae of Trinity College, the School of Engineering, and the Graduate School.

The Office of Continuing Education also offers career development services, with both individual consultations and group workshops. The office provides help with resume preparation and offers guidance tests, including the Myers-Briggs Type Indicator, a test of personality preferences that allows students to better understand their own personalities, gain insight into differences they experience with others, and begin to look at career fields that fit their personality preferences. The office does charge a fee for these services. For more information, please call 684-6259.

Student Affairs

The Office of Graduate Student Affairs is dedicated to enhancing the quality of graduate student life at Duke. By interacting with other university offices to increase accessibility for graduate students and awareness of graduate student concerns, Graduate Student Affairs works to foster a greater sense of graduate student connection to Duke's interdisciplinary scholarly community.

Graduate Student Affairs has a general counseling component that provides support for students with special concerns. Through individual and group meetings and referral to other resources within the university and the larger community, the Office of Graduate Student Affairs assists in the adjustment of students to life at Duke. The importance of relationships with faculty and involvement in departmental research activities is particularly stressed.

Additionally, social events are planned to provide opportunities for graduate students to interact with each other across disciplines and with the community as a whole, as well as educational programs, designed to increase awareness of the many resources available to graduate students.

Cocurricular Activities. Graduate students at Duke University are welcome to use such university recreational facilities as swimming pools, tennis courts, the golf course, and to affiliate with the choral, dance, drama, music, and religious groups. They may become junior members of the American Association of University Professors and may affiliate with Phi Beta Kappa and social fraternities.

A full program of cultural, recreational, and religious activities is presented by the Office of Cultural Affairs, the Duke University Campus Ministry, the Duke University Union, the Office of Student Activities, and recreational clubs. The Duke University Union sponsors a wide range of programs through its committees, which are open to all segments of the campus community. Included are touring Broadway shows; rock, jazz, and pop concerts; speakers; films; a film-making program; the largest fully student-run television station in the country; art exhibits in three galleries; and a broad program in crafts located in Southgate Dormitory and the Bryan University Center. The Aquatic Center and the East Campus Gymnasium pool are available to students, faculty, and staff families. The handball, racquetball, squash, and tennis facilities and the weight rooms on East and West Campus are also available. Interested students may participate in softball and other team sports.

The University Center complex includes the Bryan University Center, which houses the Information Center, two drama theaters, a film theater, lounges, stores, meeting rooms, games room, the Rathskeller, art gallery, and other facilities; the West Union, which includes dining facilities; and Flowers Building, which includes student publications, Page Auditorium, and the university box office.

Inquiries should be directed to the Recreation Office, 105 Card Gymnasium; the Office of Cultural Affairs, 109 Page Building; Duke Chapel; the Duke University Union, Bryan University Center; or the Office of Student Activities, Bryan University Center.

Full information regarding the scheduling of major events and programs for the entire year will be found in the *Duke University Yearly Calendar*; detailed and updated information for the fall and spring semesters in the *Duke Dialogue*, available each Friday; updated information for the summer session in the *Summer Session Calendar*, published at the beginning of each summer term; and the *Duke Chronicle*, published each Monday through Friday during the fall and spring and each Thursday during the summer. Copies of the Duke University calendars may be obtained at the information desk, Bryan University Center, or the calendar office, Page Building. Also during the summer, the *Summer Session Calendar* is published weekly by the summer session office and is available at convenient locations.

Office of Intercultural Affairs. The Office of Intercultural Affairs (OIA) has responsibility for identifying and assisting with changes in the Duke University Community which promote optimum growth and development for African American, Asian American, Latino American, and Native American undergraduate and postbaccalaureate students. The office conducts such activities as public forums on student life, mentorship projects with university alumni, seminars on current issues for students of color, institutional research on development of students of color, and serves as a resource on issues of students of color for the university community.

The Community Service Center. The Community Service Center is a clearinghouse for the numerous volunteer and community service activities available to students, faculty, and employees. Through the center, members of the Duke community can become involved with student service groups and Durham area agencies doing everything from tutoring and mentoring, helping to care for people with AIDS, and serving meals at local homeless shelters, to befriending senior citizens. The Community Service Center also sponsors speakers, special events, training sessions, and many other programs. In these ways, the center strives to raise awareness about contemporary social issues and to be a catalyst for creative partnerships between Duke University and the wider community. Visit the center's web site at <http://csc.stuaff.duke.edu/>.

The Center for Lesbian, Gay, Bisexual, and Transgender Life. The mission of the Center for Lesbian, Gay, Bisexual, and Transgender Life (Center for LGB Life) is to provide education, advocacy, support, and space for lesbian, gay, bisexual,

transgender, and questioning students, staff, and faculty at Duke, as well as members of neighboring communities. Questioning persons include anyone interested in issues of sexual orientation and gender identity. The center does not discriminate based on sexual orientation or gender identity. Among its many purposes, the center offers: (1) a safe haven to discuss issues of sexuality as they relate to self, family, friends, and others, (2) a friendly and comfortable location for lesbians, gays, bisexual, transgender persons and allies to socialize and discuss issues affecting the community; (3) a place for groups to meet and organize activities; (4) a resource center and library containing magazines, books, and information by, for, and about lesbians, gays, bisexual, and transgender persons; (5) advocacy on lesbian, gay, bisexual, and transgender matters at Duke; and (6) a broad array of cocurricular, educational programming aimed at diverse audiences in and around the university. Through these services, the Center for LGB Life presents opportunities for people to challenge intolerance and to create a more hospitable campus climate.

The Mary Lou Williams Center for Black Culture was dedicated in memory of the "great lady of jazz" and former artist-in-residence whose name it bears. Since its establishment in 1983, the center has served as a significant gathering place on campus where broadly based issues of social/cultural relevance are addressed to a cross-section of the Duke community. The center sponsors programs that honor black culture (African American, South American, Caribbean and African). These programs promote a better understanding of black history and culture. Among past programs have been art exhibits by renowned African American artists, dance performances, musical performances, African American film, film seminars, and a number of lecture-discussions on various aspects of the black diaspora. Visit the web site at <http://mlw.stuaff.duke.edu>.

The Women's Center. Located in 126 Few Fed, across the traffic circle from the Allen Building, the Women's Center works to promote the full and active participation of women in higher education at Duke by providing advocacy, support services, referrals, and educational programming on gender-related issues. Women's Center programs and services address a wide variety of issues, including leadership, safety, harassment, health, campus climate concerns, personal and professional development, and the intersection of gender with race, class, and sexual orientation. The center seeks to assess and respond to the changing needs of the university community, to raise awareness of how gender issues affect both women and men on campus, and to serve as an advocate for individuals and groups experiencing gender-related problems, such as sexual harassment or gender discrimination. Duke's office of Sexual Support Services (providing twenty-four-hour-a-day crisis counseling) is also housed in the Women's Center.

Graduate and Professional Student Council. The Graduate and Professional Student Council is the representative body for the students of graduate departments and professional schools. The council provides a means of communication between schools and between graduate students and the administration. The council selects graduate students for membership on university committees. Representatives of each department and officers of the council are selected annually.

Religious Life. The Duke University Chapel, open from 8:00 a.m. until 10:00 p.m., provides a magnificent setting for daily prayer and meditation. In addition, a variety of worship experiences are provided throughout the week including the university service of worship at 11:00 A.M. each Sunday, noonday prayer each weekday during term, and choral vespers each Thursday at 5:15 P.M. The one hundred and fifty-voice Chapel Choir is open by audition to all interested singers. The Graduate and Professional Student Fellowship, sponsored by Duke Chapel, provides ecumenical fellowship as well as service opportunities for interested students. Duke Campus Ministry also invites graduate students to participate in the

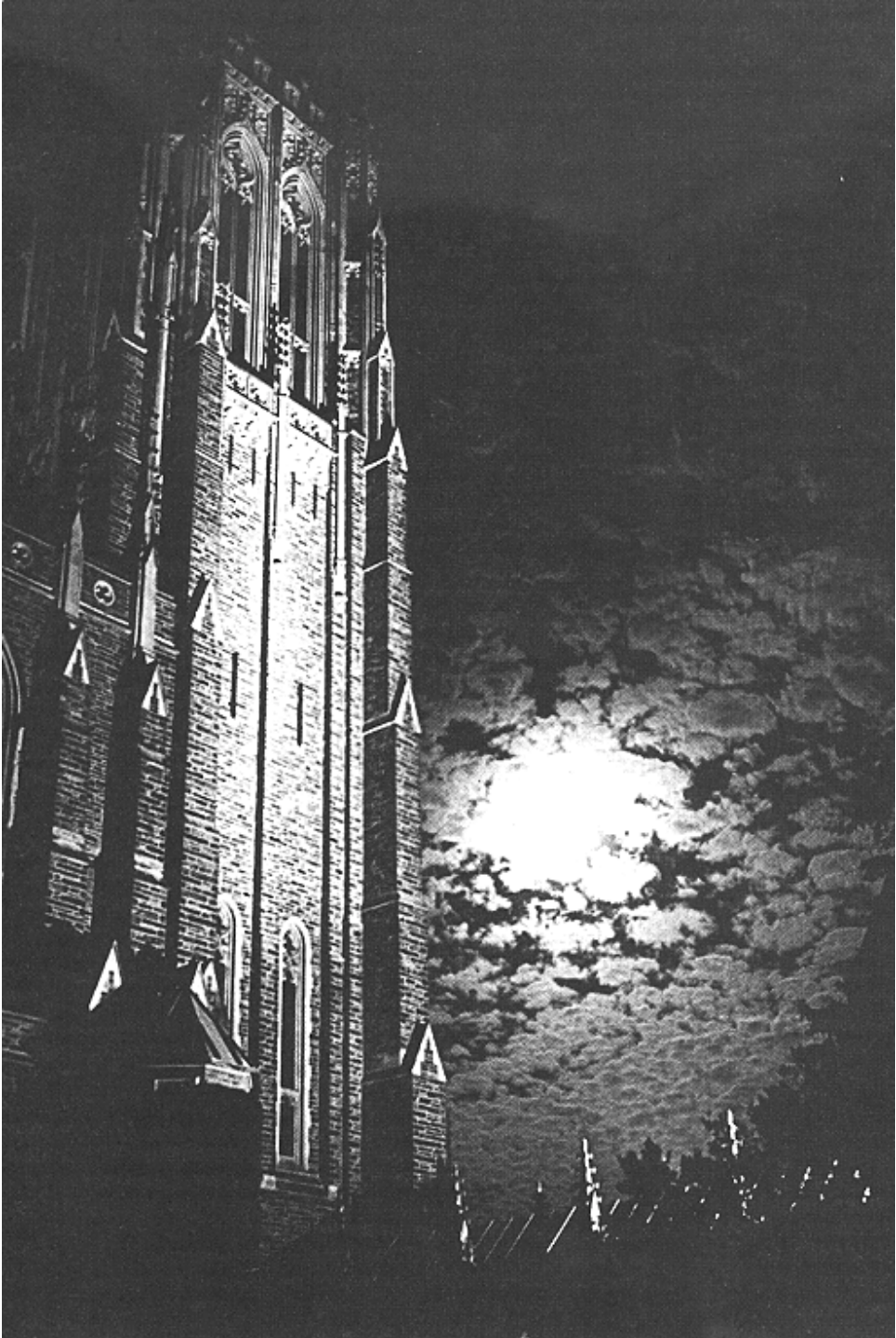
various religious life groups. Contact the Office of Dean of the Chapel or the assistant dean of the Chapel, Duke Chapel, for further details.

Visiting Scholars

The libraries and other facilities of Duke University are made available, to the extent practicable, to faculty members of other colleges and universities who wish to pursue their scholarly interests on the Duke campus. Such visitors are not charged unless they wish to participate in activities for which a special fee is assessed. Inquiries pertaining to visiting scholars should be addressed to the relevant department chairman or the dean of the Graduate School.

Postdoctoral Research

Scholars engaged in postdoctoral research often find it advantageous to use the resources of Duke University during the summer. The university welcomes these visitors and makes living accommodations available to them during the summer sessions from May 9 to August 8. Persons desiring research privileges (library and/or laboratory) should request approval through the department in which their research interests lie or through the Graduate School.



Index

A

Academic and Cooperative Programs 29, 30
Academic Calendar 4
Academic Regulations 53
Administration 7
 Executive Committee of the Graduate Faculty 7
Admission 33
African and African-American Studies 65
Aging and Human Development, Center for the Study of 277
Anatomy, see Biological Anthropology and Anatomy
Animal Care and Use 291
Anthropology, see Biological Anthropology and Anatomy, and Cultural Anthropology
Application
 Deadlines 35
 examinations for 33
 fee 34
 Foreign Students, Procedures for 34
 Prerequisites, General 33
 Procedures 34
 Summer Session 35
Archaeology, see Classical Studies 98
Art and Art History 66
Asian and African Languages and Literature Studies 73
Asian/Pacific Studies Institute 277
Assistantships 41
Audit Fee 45

B

Balto-Finnic languages, see Slavic Languages and Literatures
Biochemistry 74
Biological Anthropology and Anatomy 76
Biological Chemistry, University Program in 79
Biology 79
Biomedical Engineering 126
Business Administration 86

C

Calendar 4
Canadian Studies Program 88
Cardiovascular Technologies, Center for Emerging 279
Career Center 301
Cell and Molecular Biology, University Program in 89
Cell Biology 90
Cellular and Biosurface Engineering, University Program in 93

Chemistry 94
Civil and Environmental Engineering 131
Classical Studies 97
Cocurricular Activities 301
Cognitive Neuroscience, Center for 277
Commencement 59
Community Service Center 302
Computational Science and Engineering 105
Computer Science 100
Conduct, Standards of 59
Continuing Education Application Procedures 35
Counseling and Psychological Services 300
Course Load 49
Courses of Instruction (departmental and subject listings) 65
Croatian, see Slavic Languages and Literatures
Cultural Anthropology 106

D

Degrees Offered 29
Democracy, Institutions, and Political Economy, Program for the Study of 109
Demographic Studies, Center for 278
Developed Shorelines, Program for the Study of 278
Dining Services 298
Disabilities, Services for Students with 298
Dissertation, see Doctoral Degree
Doctoral Degree
 Committee to Supervise the Program of Study 57
 Deposit of Dissertation 59
 Dissertation 58
 English Language Proficiency 57
 Final Examination 59
 Foreign Language Requirements 57
 Major and Related Work 57
 Preliminary Examination 58
 Time Limits for Completion of Degree 58
Documentary Studies, Center for 278
Duke Forest 289

E

Earth and Ocean Sciences 109
East Asian Studies 114
Ecology, University Program in 116
Economics 117
Electrical and Computer Engineering 137
Engineering 125
 Biomedical 126
 Civil and Environmental 131
 Electrical and Computer 137
 Mechanical and Materials Science 143
English 149

English Language Requirements for Foreign Students 34
Entrance Tests 34
Environment 151

F

Faculty, Graduate School 7
Family Medicine Center 299
Fees
 Audit 45
 Marine Laboratory 45
 Recreation 45
 Registration 45
 Student Health 45
 Thesis or Dissertation 45
 Tuition 44
 Vehicle 45
Fellowships and Scholarships 39–42
Financial Aid 42
 See also Fellowships and Scholarships 42
Financial Information 39–47
Food Services 298
Foreign Students, Additional Procedures for Application 34
Forestry Sciences Laboratory 290
French, see Romance Studies

G

Genetics, department of 165
Genetics, University Program in 166
German Studies Program 167
Grades 53
Graduate and Professional Student Council 303
Graduate Record Examination 34
Graduate Student Affairs, Office of 301
Greek, see Classical Studies
Grievance Procedures 61

H

Harassment Policy 60
Health Fee 300
Health Policy, Law and Management, Center for 171
Health Service for Students 299
Highlands Biological Station 289
History 173
Housing 297
Humanities, Master of Arts Program in 180
Hydrologic Science, Center for 181
Hypo-Hyperbaric Center 294

I

Identification Cards 54
Immunizations 35
Immunology 181
Information Technology, Office of 288

Insurance, Student Accident and Hospitalization 299
Insurance, Student Health 45
Intercultural Affairs, Office of 302
Interinstitutional Agreements 54
International Development Policy, Program in 183
International Development Research, Center for 279
International Studies, Center for 279
Italian, see Romance Studies

J

Japanese 74
Judicial Code and Procedures 62

K

Kenan Ethics Program 280

L

Laboratories
 Biological 288
 Chemistry 291
 Earth and Ocean Sciences 289
 Engineering Research 292
 Experimental Psychology 291
 Forestry Sciences 290
 Marine (Beaufort) 290
 Physics 292
 Phytotron 289
Latin American and Caribbean Studies, Center for 280
Latin American Studies Program 183
Latin, see Classical Studies
Leave of Absence 55
Lesbian, Gay, Bisexual, and Transgender Life, Center for 302
Liberal Studies, Master of Arts Program in 186
Libraries 285
Literature Program 187
Living Accommodations 297
Loans 42

M

Marine Laboratory 290
Marine Sciences, University Program in 190
Mary Lou Williams Center for Black Culture 303
Master of Arts/Science Degrees
 Examining Committee and Examination 56
 Filing Intention to Receive Degree 56
 Language Requirements 55
 Major and Related Subjects 55
 Prerequisites 55
 Thesis Requirements 56
 Time Limits for Completion of Degree 57
 Transfer of Credits 56

Mathematics 192
 Mathematics and Computation in Life Sciences
 and Medicine, Center for 280
 Mechanical Engineering and Materials Science
 143
 Medical Care 299
 Medical Center 295
 Medical Historian Training Program 197
 Medical Scientist Training Program 197
 Medieval and Renaissance Studies 198
 Microbiology 201
 Mission Statement of Duke University 1
 Molecular Biophysics, University Program in 202
 Molecular Cancer Biology, University Program
 in 203
 Music 205

N

Neurobiology 208
 Nondegree Admission 33
 Nonlinear and Complex Systems, Center for 209
 North American Studies, Center for 281

O

Oak Ridge Associated Universities 281
 Organization for Tropical Studies 283

P

Parking Fees 45
 Part-Time Graduate Study 34
 Pathology 212
 Payment of Accounts 46
 Pharmacology 214
 Philosophy 216
 Physics 219
 Placement Services, see Career Center
 Polish, see Slavic Languages and Literatures
 Political Science 223
 Portuguese, see Romance Studies
 Postdoctoral Research 304
 Primate Center 290
 Psychology 230
 Public Policy Studies 237

R

Refunds for Withdrawal from School 46
 Registration 49

- Fall and Spring 49
- Late 49
- Requirements 49
- Summer 50

 Religion 242
 Religious Life 303
 Research Support, Office of 282
 Romance Studies 251
 Russian, see Slavic Languages and Literatures

S

Satisfactory Progress 42
 Scholarships, see Fellowships and Scholarships
 Serbian, see Slavic Languages and Literatures
 Slavic Languages and Literatures 258
 Slavic, Eurasian, and East European Studies 257
 Sociology 264
 Spanish, see Romance Studies
 Standards of Conduct 59
 Statistics and Decision Sciences, Institute for 268
 Student Aid 42

- Fellowships and Scholarships 39
- Loans 42
- Payment of Awards 42
- Summer Session 44
- Work-study Program 44

 Student Council, Graduate and Professional 303
 Summer Session

- Admission Procedures 35
- Financial Aid 44
- Registration 50

T

Teaching, Learning, and Writing, Center for 282
 Teaching, Master of Arts Program in 272
 Thesis, Master's 56
 Toxicology, University Program in 272
 Transcript 45
 Transfer of Graduate Credits 53
 Tropical Conservation, Center for 282
 Tropical Studies, Organization for 283
 Tuition 44

U

Undergraduates

- Courses Primarily for 54
- Duke Students, Graduate Credit for 53

V

Visiting Scholars 304

W

Withdrawal from a Course 54
 Withdrawal or Interruption of Program 55
 Women's Center 303
 Women's Studies 273
 Work-study 44