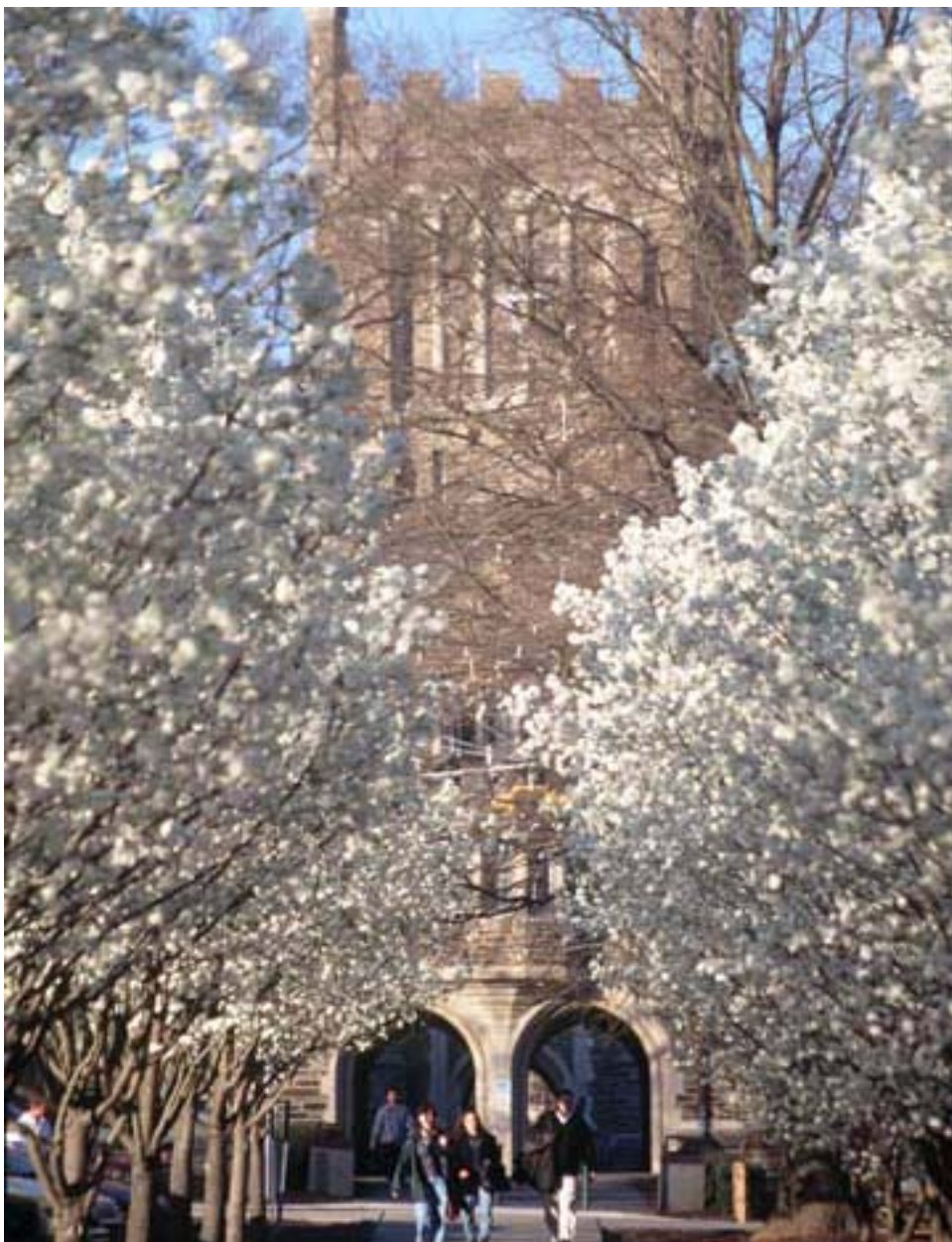

bulletin of
Duke University
2005-2006

The Graduate School



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The information in this bulletin applies to the academic years 2005-2006 and is accurate and current, to the extent possible, as of May 2005. The university reserves the right to change programs of study, academic requirements, teaching staff, the calendar, and other matters described herein without prior notice, in accordance with established procedures.

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Academic Calendar—2005-2006*

Summer 2005

February

28 Monday—Registration begins for all Summer sessions

May

19 Thursday—Term I classes begin

23 Monday—Drop/Add for Term I ends

30 Monday—Memorial Day. Classes in session

June

15 Wednesday—Last day to withdraw WP or WF from Term I classes

27 Monday—Term I classes end

28 Tuesday—Reading period

29 Wednesday—Term I final examinations begin

30 Thursday—Term I final examinations end

July

5 Tuesday—Term II classes begin

7 Thursday—Drop/Add for Term II ends

August

1 Monday—Last day to withdraw WP or WF from Term II classes

11 Thursday—Term II classes end

12 Friday—Term II final examinations begin

13 Saturday—Term II final examinations end

Fall 2005

August

23 Tuesday—New graduate student orientation

25 Thursday, 4:00 P.M.—Convocation for graduate and professional school students

29 Monday, 8:00 A.M.—Fall semester classes begin. Drop/Add continues

September

5 Monday—Labor Day. Classes in session

9 Friday, 5:00 P.M.—Drop/Add ends

October

2 Sunday—Founders' Day

7 Friday, 7:00 P.M.—Fall break begins

12 Wednesday, 8:00 A.M.—Classes resume

November

2 Wednesday—Registration begins for Spring semester, 2006

16 Wednesday—Registration ends for Spring semester, 2006

17 Thursday—Drop/Add begins

22 Tuesday, 10:30 P.M.—Thanksgiving recess begins

28 Monday, 8:00 A.M.—Classes resume

30 Wednesday—Graduate classes end

December

1-11 Thursday-Sunday—Reading period; length of the 200-level course reading period is determined by the professor

12 Monday, 7 P.M.—Final examinations begin

18 Sunday, 10:00 P.M.—Final examinations end

* The dates in this calendar are subject to change. Information on registration dates is available from the Office of the University Registrar. For information on the academic calendars of Duke University's undergraduate and professional schools, consult the calendars of those various schools for additional information.

Spring 2006

January	
11	Wednesday, 8:00 A.M.—Spring semester classes begin: ALL classes normally meeting on Mondays meet on this Wednesday only; Wednesday ONLY classes begin Wednesday, January 18; Drop/Add continues
16	Monday—Martin Luther King, Jr. Day holiday: classes are rescheduled on Wednesday, January 11
25	Wednesday, 5:00 P.M.—Drop/Add ends
February	
27	Monday—Registration begins for all summer sessions
March	
10	Friday, 7:00 P.M.—Spring recess begins
20	Monday, 8:00 A.M.—Classes resume
April	
5	Wednesday—Registration begins for Fall semester, 2006
14	Friday—Registration ends for Fall semester, 2006; Summer 2006 registration continues
15	Saturday—Drop/Add begins
21	Friday—Graduate classes end
22-30	Thursday-Sunday—Reading period; length of the 200-level course reading period is determined by the professor
May	
1	Monday—Final examinations begin
6	Saturday, 10:00 P.M.—Final examinations end
12	Friday—Commencement begins
14	Sunday—Graduation exercises. Conferring of degrees

University Administration

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Robert S. Shepard, Ph.D., *Vice-President for Alumni Affairs and Development*

Robert L. Taber, Ph.D., *Vice-Chancellor for Corporate and Venture Development*

Huntington F. Willard, Ph.D., *Director of the Institute for Genome Sciences and Policy and Vice-Chancellor for Genome Sciences*

Gordon D. Williams, B.A., *Vice-Chancellor for Operations, Duke University Medical Center; Vice-Dean for Administration and Finance, School of Medicine; and Vice-President for Administration, Duke University Health System, Inc.*

R. Sanders Williams, M.D., *Vice-Chancellor for Academic Affairs and Dean of the School of Medicine*

GRADUATE SCHOOL ADMINISTRATION

Lewis Siegel, Ph.D., *Dean of the Graduate School*

David F. Bell III, Ph.D., *Associate Dean*

Bertie S. Belvin, M.A., *Associate Dean*

Jacqueline Looney, Ph.D., *Associate Dean*

Valarie Piper James, M.P.A., *Assistant Dean*

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Elizabeth Clark (Religion)

Phil Costanzo (Psychology: Social and Health Sciences)

Michael Fitzgerald (Chemistry)

Garnett Kelsø (Immunology)

Ken Kreuzer (Biochemistry)

Nan Jokerst (Electrical and Computer Engineering)

Ann Marie Pendergast (Pharmacology)

Ann Marie Rasmussen (German Studies)

Alex Roland (History)

Lynn Smith-Lovin (Sociology)

Roxanne Springer (Physics)

Lawrence Virgin (Mechanical Engineering and Materials Science)

Priscilla Wald (English)

Annabel Wharton (Art and Art History)



Graduate School Faculty

(As of July 1, 2005.)

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

Alejandro Aballay (2002), Ph.D., Assistant Professor of Molecular Genetics and Microbiology
Stanley Kenji Abe (1994), Ph.D., Associate Professor of Art and Art 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., Professor of Pathology and Professor of Molecular Genetics and Microbiology
Francisco-Javier Hernández Adrián (2002), Ph.D., Assistant Professor of Romance Studies
David Aers (1994), Ph.D., Professor of English and Professor of Religion
Pankaj K. Agarwal (1990), Ph.D., Professor of Computer Science
Boris Akhremitchev (2002), Ph.D., Assistant Professor of Chemistry
Susan Alberts (1998), Ph.D., Associate Professor of Biology
John Albertson (2001), Ph.D., Associate Professor of Civil and Environmental Engineering
John H. Aldrich (1987), Ph.D., Pfizer, Inc./Edmund T. Pratt, Jr. University Professor of Political Science
Kenneth Alexander (1995), M.D., Ph.D., Assistant Professor of Molecular Genetics and Microbiology
Dimitri Alexandrou (1987), Ph.D., Associate Professor of Electrical and Computer Engineering
Julio Aliberti (2003), Ph.D., Assistant Professor of Immunology
William K. Allard (1975), Ph.D., Professor of Mathematics
Anne Allison (1992), Ph.D., Associate Professor of Cultural Anthropology
J. Andrew Alspaugh (2000), M.D., Assistant Professor of Genetics
Oscar Alzate (2003), Ph.D., Assistant Research Professor of Neurobiology
Wilfred Amaldoss (2002), Ph.D., Associate Professor of Business Administration
Andrea Amalfitano (1996), Ph.D., Assistant Professor of Genetics
Page A. W. Anderson (1973), M.D., Assistant Professor of Cell Biology
Edna Andrews (1984), Ph.D., Professor of Slavic Languages and Literatures
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Miriam L. Wahl (2002), Ph.D., Assistant Professor of Pathology
 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., Associate Professor of English
 Lise Wallach (1970), Ph.D., Research Professor of Psychological and Brain Sciences and Research
 Professor of Psychology: Social and Health Sciences
 Priscilla Wald (2000), Ph.D., Associate Professor of English
 Christopher Walter (2004), Ph.D., Assistant Professor of Physics
 Ingeborg Walther (1994), Ph.D., Associate Professor of the Practice of Germanic Languages and Literature
 Fan Wang (2003), Ph.D., Assistant Professor of Cell Biology
 Xiao-Fan Wang (1992), Ph.D., Professor of Pharmacology and Cancer Biology
 Benjamin Ward (2001), Ph.D., Adjunct Associate Professor of Philosophy
 Russell Ware (1998), Ph.D., Associate Professor of Pathology
 David Warner (1994), M.D., Professor of Neurobiology
 Adam Wax (2002), Ph.D., Assistant Professor of Biomedical Engineering
 Robert Wechsler-Reya (2001), Ph.D., Assistant Professor of Pharmacology and Cancer Biology
 Kathi Weeks (2002), Ph.D., Associate Professor of Women's Studies
 J. Brice Weinberg (1978), M.D., Professor of Immunology
 Kevin Weinfurt (1999), Ph.D., Assistant Research Professor of Psychology: Social and Health Sciences
 Kent Weinhold (1999), Ph.D., Professor of Immunology
 E. Roy Weintraub (1970), Ph.D., Professor of Economics
 Gennifer Weisenfeld (1998), Ph.D., Associate 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
 Michael West (1988), 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., Associate Professor of Genetics and Associate Professor of Molecular
 Genetics and Microbiology
 Kathryn Whetten-Goldstein (1999), Associate Professor of Public Policy Studies
 Curtis S. Whiddon (1995), Ph.D., Assistant Clinical Professor of Medical Physics
 Frances J. White (1987), Ph.D., Assistant Professor of Biological Anthropology and Anatomy
 Leonard White (1992), Ph.D., Assistant Professor of Neurobiology
 Richard Whorton (1979), Ph.D., Associate Professor of Pharmacology
 Ross Widenhofer (1997), Ph.D., Associate Professor of Chemistry
 Robyn Wiegman (2001), Ph.D., Associate Professor of Women's Studies
 Jonathan Wiener (1994), J.D., Professor of Public Policy Studies
 Robert L. Wilbur (1957), Ph.D., Professor of Biology
 Huntington Willard (2003), Ph.D., Professor of Molecular Genetics and Microbiology
 Christina L. Williams (1994), Professor of Psychological and Brain Sciences
 Redford B. Williams (1991), M.D., Professor of Psychology: Social and Health Sciences
 John Willis (2000), Ph.D., Associate Professor of Biology
 Susan Willis (1989), Ph.D., 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 Biology
 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., Associate Professor of Mathematics
 Myron L. Wolbarsht (1968), Ph.D., Professor of Ophthalmology in the Department of Psychology and
 Professor of Biomedical Engineering
 Marty Woldorff (1999), Ph.D., Associate Research Professor of Psychological and Brain Sciences
 Patrick Wolf (1993), Ph.D., Associate Professor of Biomedical Engineering
 Walt Wolfram (2001), Ph.D., Adjunct Professor of English
 Robert L. Wolpert (1984), Ph.D., Professor of Statistics and Decision Sciences and Associate Professor of
 the Environment
 David Wong (2000), Ph.D., Professor of Philosophy
 Fulton Wong (1989), Ph.D., Professor of Neurobiology
 Peter H. Wood (1975), Ph.D., Professor of History
 Wendy Wood (2003), Ph.D., Professor of Psychology: Social and Health Sciences
 Clare Woods (1999), Ph.D., Assistant Professor of Classical Studies
 Gregory Wray (1999), Ph.D., Professor of Biology
 Jo Rae Wright (1993), Ph.D., Professor of Cell Biology

Justin Wright (2004), Ph.D., Research Assistant Professor of Biology
 Ying Wu (2001), Ph.D., Assistant Professor of Physics
 José Wynne (2001), Ph.D., Associate Professor of Business Administration
 Zhi-Qi Xiong (2003), Ph.D., Adjunct Assistant Professor of Neurobiology
 Duncan Yaggy (1980), Ph.D., Professor of Public Policy Studies
 Jerrel Yakel (2003), Ph.D., Adjunct Assistant Professor of Neurobiology
 Hai Yan (2003), Ph.D., Assistant Professor of Pathology
 Jun Yang (2001), Ph.D., Assistant Professor of Computer Science
 Weitao Yang (1989), Ph.D., Professor of Chemistry
 Yiping Yang (2002), M.D., Ph.D., Assistant Professor of Immunology
 Tso-Pang Yao (1998), Ph.D., Associate Professor of Pharmacology and Cancer Biology
 William E. Yarger (1971), M.D., Assistant Professor of Cell Biology
 Ryohei Yasuda (2005), Ph.D., Assistant Professor of Neurobiology
 Gary Ybarra (1994), Ph.D., Associate Professor of the Practice of Electrical and Computer Engineering
 Huseyin Yildirim (2000), Ph.D., Assistant Professor of Economics
 Fang-Fang Yin (2005), Ph.D., Professor of Medical Physics
 John York (1996), Ph.D., Associate Professor of Pharmacology and Cancer Biology and Associate Professor of Biochemistry
 Terry T. Yoshizumi (1998), Ph.D., Associate Clinical Professor of Medical Physics
 Fan Yuan (1996), Ph.D., Associate Professor of Biomedical Engineering
 Michael Rod Zalutsky (1985) Ph.D., Associate Professor of Pathology and Associate Professor of Medical Physics
 Donna D.A. Zapf (1999) Ph.D., Director, Master of Arts in Liberal Studies Program
 Rebecca Zarutskie (2003), Ph.D., Assistant Professor of Business Administration
 Stefan Zauscher (2000), Ph.D., Assistant Professor of Mechanical Engineering and Materials Science
 Weiguo Zhang (1999), Ph.D., Assistant Professor of Immunology
 Yun Clement Zhang (2004), Ph.D., Assistant Professor of Business Administration
 Doncho Zhelev (1991), Ph.D., Assistant Professor of Mechanical Engineering and Materials Science
 Pei Zhong (1994), Ph.D., Assistant Professor of Mechanical Engineering and Materials Science
 Pei Zhou (2001), Ph.D., Assistant Professor of Biochemistry
 Su-Min Zhou (1995), Ph.D., Associate Research Professor of Medical Physics
 Xin Zhou (1993), Ph.D., Professor of Mathematics
 Xueguang Zhou (1994), Ph.D., Associate Professor of Sociology
 Yuan Zhuang (1996), Ph.D., Associate Professor of Immunology and Associate Professor of Molecular Cancer Biology
 Paul H. Zipkin (1995), Ph.D., T. Austin Finch, Sr., Professor of Business Administration

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
 Lewis Edward Anderson (1936), Ph.D., Professor Emeritus of Botany
 Nels C. Anderson (1966), Ph.D., Associate Professor Emeritus of Cell Biology
 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
 William Waldo Beach (1946), Ph.D., Professor Emeritus of Christian Ethics
 Alan Biermann (1974), Ph.D., Professor Emeritus of Computer Science
 Sandra H. Bigner (1977), M.D., Professor Emeritus of Pathology
 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
 Lloyd J. Borstelmann (1953), Ph.D., Professor Emeritus of Psychology
 John E. Boynton (1968), Ph.D., Professor Emeritus of Biology
 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
 H. Keith H. Brodie (1970), M.D., D.Lit., James B. Duke Professor Emeritus of Psychology: Social and Health Sciences
 Frances Campbell Brown (1931), Ph.D., Professor Emeritus of Chemistry
 Louis J. Budd (1952), Ph.D., James B. Duke Professor Emeritus of English
 Donald S. Burdick (1962), Ph.D., Associate Professor Emeritus of Statistics and Decision Sciences
 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
 Jackson W. Carroll (1993), Ph.D., Ruth W. and A. Morris Williams, Jr., Professor Emeritus of Religion and
 Professor of Sociology
 Robert C. Carson (1960), Ph.D., Professor Emeritus of Psychology: Social and Health Sciences
 H. Craig Casey, Jr. (1979), Ph.D., Professor Emeritus of Electrical and Computer Engineering
 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
 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
 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
 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
 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
 Carl J. Erickson (1966), Ph.D., Professor Emeritus of Psychological and Brain Sciences
 Robert P. Erickson (1961), Ph.D., Professor Emeritus of Psychological and Brain Sciences
 Lawrence E. Evans (1963), Ph.D., Professor Emeritus of Physics
 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
 John D. Forsyth (1978), D.B.A., Professor Emeritus of Business Administration
 Wallace Fowle (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
 Nicholas W. Gillham (1968), Ph.D., James B. Duke Professor Emeritus of Zoology
 Lawrence C. Goodwyn (1971), Ph.D., Professor Emeritus of History
 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 the 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
 Warren G. Hall (1979), Ph.D., Professor Emeritus of Psychological and Brain Sciences and Professor of
 Neurobiology
 John Hamilton Hollowell (1942), Ph.D., James B. Duke Professor Emeritus of Political Science
 William E. Hammond (1968), Ph.D., Professor Emeritus of Biomedical Engineering
 Charles M. Harman (1961), Ph.D., Professor Emeritus of Mechanical Engineering and Materials 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
 Robert M. Hochmuth (1978), Ph.D., Professor Emeritus of Mechanical Engineering and Materials Science

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
 B. Jon Jaeger (1972), Ph.D., Professor Emeritus of Health Administration
 Benjamin A. Jayne (1976), Ph.D., Professor Emeritus of Forestry
 Frans F. Jöbsis (1964), Ph.D., Professor Emeritus of Cell Biology
 Sheridan Johns III (1970), Ph.D. 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
 Thomas F. Keller (1959), Ph.D., R. J. Reynolds Industries Professor Emeritus of Business Administration
 Robert B. Kerr (1965), Ph.D., Professor Emeritus of Electrical Engineering
 Gregory A. Kimble (1952-68; 1977), Ph.D., Professor Emeritus of Psychology
 Joseph Weston Kitchen, Jr. (1962), Ph.D., Associate Professor Emeritus of Mathematics
 Peter H. Klopfer (1958), Ph.D., Professor Emeritus of Biology
 Kenneth R. Knoerr (1961), Ph.D., Professor Emeritus of Environmental Meteorology and Hydrology
 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
 Warren Lerner (1961), Ph.D. Professor Emeritus of History
 L. Sigfred Linderoth, Jr. (1965), M.E., Professor Emeritus of Mechanical Engineering and Materials Science
 Donald W. Loveland (1973), Ph.D., Professor Emeritus of Computer Science
 John M. McCann (1978), Ph.D., Professor Emeritus of Business Administration
 James H. McElhaney (1973), Ph.D., Hudson Professor Emeritus of Biomedical Engineering
 Thomas J. McManus (1961), M.D., Professor Emeritus of Cell Biology
 Andrew T. McPhail (1968), Ph.D., Professor Emeritus of Chemistry
 Alisdair MacIntyre (1994), D.Lit., Arts and Sciences Professor Emeritus of Philosophy
 Edward P. Mahoney (1965), Ph.D., Professor Emeritus of Philosophy
 Sidney David Markman (1947), Ph.D., Professor Emeritus of Art History and Professor Emeritus of
 Archaeology
 Gail R. Marsh (1969), Ph.D., Associate Professor Emeritus of Psychological and Brain Sciences
 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
 Francis Joseph Murray (1960), Ph.D., Professor Emeritus of Mathematics
 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
 John F. Oates (1967), Ph.D., Professor Emeritus of Ancient History in Classical Studies
 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
 George M. Padilla (1965), Ph.D., Professor Emeritus of Cell Biology
 Erdman B. Palmore (1967), Ph.D., Professor Emeritus of Sociology
 William Bernard Peach (1951), Ph.D., Professor Emeritus of Philosophy
 George W. Pearsall (1964), Sc.D., Professor Emeritus of Mechanical Engineering and Materials Science
 and Professor of Public Policy Studies
 Ronald D. Perkins (1968), Ph.D., Professor 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
 Jack J. Preiss (1959), Ph.D., Professor Emeritus of Sociology
 Louis DuBose Quin (1957), Ph.D., James B. Duke Professor Emeritus of Chemistry
 Naomi Quinn (1972), Ph.D., Professor Emeritus of Cultural Anthropology
 Dale B. J. Randall (1957), Ph.D., Professor Emeritus of English
 Jerome Reiter (2002), Ph.D., Assistant Professor of the Practice of Statistics and Decision Sciences
 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
 Mabel F. Rudisill (1948), Ph.D., Associate Professor Emeritus of Education
 Jerome Sacks (1992), Ph.D., Professor Emeritus of Statistics and Decision Sciences
 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 B. Searles (1965), Ph.D., Professor Emeritus of Botany
 Marion Shepard (1967), Ph.D., Professor Emeritus of Mechanical Engineering and Materials Science
 Elwyn L. Simons (1977), Ph.D., D.Phil., James B. Duke Professor Emeritus of Biological Anthropology and Anatomy and Professor of Biology
 Ida Harper Simpson (1959), Ph.D., Professor Emeritus of Sociology
 William H. Simpson (1930), Ph.D., Professor Emeritus of Political Science
 David A. Smith (1962), Ph.D., Associate Professor Emeritus of Mathematics
 D. Moody Smith (1965), Ph.D., George Washington Ivey Professor Emeritus of Religion, New Testament Interpretation
 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
 George G. Somjen (1964), M.D., Professor Emeritus of Cell Biology
 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
 John Strohbehn (1994), Ph.D., Professor Emeritus of Biomedical Engineering
 Charles Tanford (1960), Ph.D., James B. Duke Professor Emeritus of Physiology
 John J. TePaske (1967), Ph.D., Professor Emeritus of History
 Fredrick L. Thurstone (1967), Ph.D., Professor Emeritus of Biomedical Engineering
 Edward A. Tiryakian (1965), Ph.D., Professor Emeritus of Sociology
 Vance Tucker (1964), Ph.D., Professor Emeritus of Zoology
 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
 Michael A. Wallach (1962-72; 1973), Ph.D., Professor Emeritus of Psychological and Brain Sciences
 Richard L. Walter (1962), Ph.D., Professor Emeritus of Physics
 Paul P. Wang (1968), Ph.D., Professor Emeritus of Electrical and Computer Engineering
 Frances Ellen Ward (1969), Ph.D., Professor Emeritus of Immunology
 Seth L. Warner (1955), Ph.D., Professor Emeritus of Mathematics
 Robert E. Webster (1970), Ph.D., Professor Emeritus of Biochemistry
 Morris Weisfeld (1967), Ph.D., Professor Emeritus of Mathematics
 Henry Weitz (1950), Ed.D., Professor Emeritus of Education
 Richard L. Wells (1962), Ph.D., Professor Emeritus of Chemistry
 Robert W. Wheat (1958), Ph.D., Professor Emeritus of Microbiology
 Richard A. White (1963), Ph.D., Professor Emeritus of Biology
 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
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
Ronald G. Witt (1971), Ph.D., Professor Emeritus of History
Max A. Woodbury (1966), Ph.D., Professor Emeritus of Computer Science
Donald Wright (1967), Ph.D., Associate Professor Emeritus of Mechanical Engineering and Materials
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
Peter Zwadyk, Jr. (1971), Ph.D., Associate Professor Emeritus of Pathology and Associate Professor of
Microbiology

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 past two decades 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, while 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

A handwritten signature in cursive script, reading "Lewis M. Siegel". The signature is written in dark ink and is centered on the page.

Dean of the Graduate School

Admission



Degree and Non-degree Admission

Students who wish to undertake graduate work at Duke University, whether for degree or non-degree purposes, must be formally admitted to the Graduate School by the dean. Prerequisites for admission include a bachelor's degree (or the equivalent of a four-year U.S. bachelor's degree) from an accredited institution and, for degree programs, satisfactory scores on the Graduate Record Examination and Test of English as a Foreign Language or the International English Testing System (international applicants only). 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 non-degree admission. Such admission is granted in three different categories: (1) admission as a regular non-degree student with a particular department; (2) admission through the Office of Continuing Studies as a special non-degree student without departmental affiliation; and (3) admission as an unclassified student in the summer session only.

Credits earned by non-degree 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 *B* (*G* on previous scale) 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 may access application and program information from the Graduate School Web site at <http://www.gradschool.duke.edu>. All parts of the application form must be filled out completely and submitted to the Graduate School Enrollment Services Office along with the application fee. The necessary supporting documents must also be sent before or after the submission of the electronic application. The fee is \$75** U.S. 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, submitted on-line, or written on the downloadable forms provided and returned by the applicant in 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 (Exceptions: Master of Arts in Liberal Studies and the Program in International Development Policy); and (4) official scores on the Graduate Record Examination Subject Test for applicants to certain specified departments. Additional requirements for international applicants are described below. Please consult the current application guide 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.

*This chapter is a brief summary of information available electronically via the World-Wide Web at <http://www.gradschool.duke.edu>. This information 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.

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 International Students. Fully qualified students from outside the United States are invited to apply for admission to full-time study in the Graduate School. The international 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 International English Language Testing System (IELTS), Web site: <http://www.ielts.org>, or the Test of English as a Foreign Language (TOEFL), Web site: <http://www.toefl.org>. The Graduate School requires a minimum TOEFL score of 213 on the computer-based test or an IELTS score of 7.0.
- (2) A statement showing financial arrangements for the proposed term at Duke (estimated costs per academic year are about \$46,320).

English Language Requirements for International 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.

Master of Arts in Liberal Studies Procedures. Students seeking admission to MALS should contact that program directly for information.

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 Studies Procedures. A student seeking admission as a non-degree 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 Studies, Duke University, Box 90700, Durham, North Carolina 27708-0700, telephone (919) 684-2621, 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 Enrollment Services 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, program and degree specified in the letter of admission*. Students seeking the A.M. or M.S. degree must re-apply for admission to a Ph.D. program.

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 after their acceptance of the offer of admission.

Deadlines for Application

It is the applicant's responsibility to make certain that the Graduate School Enrollment Services Office has received all required materials by the appropriate deadlines. Only complete applications can be considered. To ensure that the Enrollment Services 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 completion of applications eligible for the reduced application fee of \$65. All applications submitted after this date must be accompanied by a fee of \$75 or they will not be processed.

December 31. Final deadline for admission and award to all programs for the fall semester.

Applications completed by this date are guaranteed a review; those 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 June 30. 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 contributions of graduate students are highly valued in the university and Duke has a strong commitment to financially support the students it selects for graduate study. 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 grants, training grants, and fellowships.

Selection of university award recipients is made on the basis of academic merit and departmental recommendations. Incoming students who wish to be considered for any of the institutional fellowships or assistantships mentioned in this section should so indicate on the application form for admission and award. Continuing students interested in applying for university awards for advanced students should follow the application procedures listed on the Graduate School web page and/or in the award announcement.

GRADUATE STUDENT FUNDING AT DUKE

Students studying for the Ph.D. are typically supported for a period of 5 to 6 years (or in some cases, until completion of the degree). Standard support packages for Ph.D. students may include a scholarship which covers all or a portion of tuition, and a fellowship stipend and/or assistantship to help defray cost of living expenses. Students in humanities and social science departments are supported for 9 months, with summer fellowship support available for advanced students on a competitive basis. In natural science and engineering departments, 9 month awards are also made, although summer support for Ph.D. students from research and/or departmental funds is frequently available. In the biomedical sciences, support is typically provided over a 12 month period. For students pursuing the master of arts and master of science degrees, some limited funds for tuition scholarships may be available; these are awarded by the individual departments and programs.

DEPARTMENT AND PROGRAM FELLOWSHIPS AND ASSISTANTSHIPS

The majority of funding available for graduate study is provided by the student's department or program. For information about student funding in a specific department or program, students should contact the program director of graduate studies. In general, a student's support package may be composed of several different types of funding, including:

Full or partial scholarships to cover tuition and fee expenses

Fellowship stipends, which require no service, and are awarded by the department or program. Many departments, including Chemistry, Economics, English, Psychology, and

Religion also offer *endowed fellowships*. Selection for these fellowships is usually made by faculty committee within the individual department.

Training program appointments, for US citizens and permanent residents participating in federally funded training programs,

Research Assistantships, available for graduate students whose special training and qualifications enable them to serve as assistants to individual staff members in certain departments, and

Teaching Assistantships, which are part-time instruction opportunities offered to qualified graduate students for work as instructors, preceptors and section leaders, tutors, and graders.

Several departments utilize, when possible, the federal work study program to help fund research and teaching assistantship positions. As a result, some departments may require or request that students complete the Free Application for Federal Student Aid so that eligibility for work study funds can be determined. This form can be completed on-line at www.fafsa.ed.gov.

Interdisciplinary Programs and Centers

In addition to the departmentally based awards, several interdisciplinary programs and centers offer fellowship and assistantship awards to both incoming and continuing students interested in the program areas. These include programs in Documentary Studies, Medieval and Renaissance Studies, Women's Studies, and centers such as the Kenan Center for Ethics and the John Hope Franklin Center for Interdisciplinary and International Studies.

COMPETITIVE GRADUATE SCHOOL FELLOWSHIPS

The Graduate School funds several competitive fellowships for incoming and continuing students. Incoming students do not apply for these awards; rather, selection is based on departmental nomination. Continuing students interested in awards for advanced students should follow the application procedures listed on the Graduate School web site or in the award announcement.

Students holding a competitive Graduate School fellowship are not permitted to hold other fellowships or employment concurrent with the Graduate School award without prior approval from the Dean of the Graduate School. The exception to this is the James B. Duke Fellowship supplement, which can be held with any other university or external award.

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 \$4,000 stipend supplement for four years to any other award the student receives from the department, the Graduate School, or external source.

The University Scholars Program was created in 1998 with a gift from former 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 9-month 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>.

Duke Endowment Fellowships. Are awarded to outstanding minority scholars. Nominees must be U.S. or naturalized citizens from traditionally underrepresented ethnic or minority groups. The fellowship is a four-year award, provided by the Graduate School in

conjunction with the admitting department, and offers full tuition, registration and health fees, a 9-month academic year stipend of \$17,000, plus a \$4,000 stipend for the summer. The Graduate School provides academic year support in years one and two, and summer support for all four years; academic year support in years three and four is provided through normal departmental mechanisms and may include service in the form of a research or teaching assistantship. In the fifth or final year, fellows are also eligible to compete for dissertation support.

Latin American Studies Fellowships are awarded on a competitive basis to students interested in Latin American studies at Duke. Fellowship recipients are expected to participate in Latin American studies program activities and to take Latin American studies courses, both within and outside their admitting departments. The fellowship includes a stipend for one year, and payment of tuition and university fees for four years.

Fellowships for Advanced Students

Dissertation fellowships such as the *Katherine Stern Fellowship* provide dissertation-year support for advanced graduate students.

Bass Named Instructorships in Arts and Sciences. Seven 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.

Summer Research Fellowships for students in Humanities and Social Sciences are available to students in the summer following years three through six who have passed their preliminary exams. The fellowships pay a summer stipend and fees.

Library Internships: The Graduate School and Perkins Library offer four 9-month internships to students working with special library materials.

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

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.

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 conduct 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. This fellowship provides an academic year stipend plus registration fees for one or two advanced students conducting research overseas.

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

Organization for Tropical Studies. The Graduate School provides limited funding to cover the cost of tuition and partial travel expenses, if possible, for students participating in this program in Costa Rica.

Exchange Programs. The Graduate School has developed exchange programs with a number of foreign universities, including the Free University of Berlin, Potsdam, Humboldt University, University of Salzburg, Trinity College-Dublin, University of Venice, University of Vienna, and the Deutscher Akademischer Austausch Dienst (DAAD) Exchange Program, which includes the University of Dresden, University of Erlangen-Nuremberg, and University of Wurzburg.

NATIONAL, REGIONAL, AND FOUNDATION AWARDS

In addition to those awards available through the university, applicants are urged to compete for national and foundation awards available for graduate study. A website maintained by Duke's Office of Research Support lists awards available from a variety of

federal and private sources, as well as awards funded by the university. (<http://www.ors.duke.edu/find/student/index.html>). External awards, which are prestigious and a valuable acknowledgement of a student's intellectual project and promise typically replace departmental or Graduate School awards.

PAYMENT OF AWARDS

Students must be registered in the Graduate School in order to receive fellowship or assistantship support. The payment of graduate assistantships 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.

Students supported on institutionally funded fellowships or assistantships are discouraged from seeking outside employment. It is the policy of the Graduate School that full-time students may not work in non-dissertation related research appointments, teaching assistantships or other instruction, or other employment (both on and off-campus) more than 19.9 hours per week. Students with institutional funding who do have compensatory commitments requiring on average more than 19.9 hours per week (non-dissertation related) may have their institutionally funded stipends and/or assistantships reduced.

Under the Tax Reform Act of 1986, both fellowship stipends and assistantships are taxable. For U.S. citizens, fellowship stipends may be reduced, for tax purposes, by the amounts paid for tuition, fees, and required books, supplies, and equipment. For general information about the taxability of scholarships and fellowships, students should see IRS publication 970 (see www.irs.gov).

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 withholding requirements.

Students have ultimate responsibility for ensuring that their tuition and fees are paid. Students should review statements received from the Bursar's Office regularly and quickly resolve payment problems or issues that arise. Students with questions about their Bursar accounts should contact the assistant to the director of graduate studies in their department, the Bursar's Office, or the Graduate School (116 Allen Building).

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 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.

LOANS

Students who anticipate a need to supplement their financial resources through loans or college work-study employment must complete a Free Application for Federal Student Aid form. Forms are available at most financial aid offices or from the Financial Aid Coordinator, Graduate School, Duke University, Durham, North Carolina 27708. Students may also complete the FAFSA on line at <http://www.fafsa.ed.gov>. In order for Duke Graduate School to obtain the information electronically, Duke's school code (E00165)

must be indicated on the form.

Students who are enrolled at least half time, who are U.S. citizens or 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 well as loans from state agencies, do not accrue interest charges while the borrower maintains student status, as well during a short period thereafter. Interest during the repayment period is at a favorable rate.

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 Application for Federal Student Aid. This can be completed on-line at www.fafsa.ed.gov. 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 Career Center maintains a listing of employment opportunities for students.

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

The following figures are estimates for 2005-06, 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. For new Ph.D. students entering in 2005-06, the charge for tuition is \$13,710 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 2005-06 is \$914 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 2005-06, the registration fee charge is \$2,000 per semester. Registration for summer 2006 is also \$2,000.

TRANSCRIPT FEE

All entering students will be charged in the fall semester a one-time mandatory fee of \$40 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 \$524 (\$262 each semester). For summer, the fee is estimated at \$180. 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 2005-06, the Student Health Insurance is estimated at \$1,589 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 \$10 per semester.

RECREATION FEE

All graduate students will be charged a recreation fee for the use of on-campus facilities. The fee is \$30 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, please contact the Nicholas School of Environment and Earth Science.

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. An audit fees is charged 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 Bursar's Office mails statements to registered students for tuition, fees, and other charges approximately four to six weeks prior to the beginning of classes each semester. The Amount Due on the statement is payable by the Due Date listed on the statement. Student account statements are also available on-line via ACES. Inquiries regarding statements can be directed to the Bursar's Office at bursar@duke.edu or (919) 684-3531.

As part of the admission agreement to Duke University, students is required to pay all statements as presented. If full payment is not received, a late payment penalty charge on the past due amount is charged on the subsequent statement. The past due amount is defined as the Amount Due from the previous statement minus payments, financial aid, loans and other credits received prior to the Due Date listed on the prior statement.

Failure to receive an invoice does not warrant exemption from the payment of tuition and fees nor from the penalties and restrictions. Non-registered students will be required to make payment for tuition, fees, and other charges at the time of registration

In addition to late payment charges, students with accounts in default may be subject to the following restrictions:

- blocked from registering for future terms
- blocked from access to copies of transcript of academic records
- not able to have academic credits certified
- not be permitted to go on leave of absence
- not eligible to receive a diploma at graduation
- subject to withdrawal from the University
- subject to having the past due student account referred to a collection agency and credit bureaus

Refunds for Withdrawal from School during Fall and Spring Semesters. In the event of death, refund of full tuition and fees for the term will be granted. In all other cases

of withdrawal from the university, students may have tuition refunded according to the following schedule:

- withdrawal before classes begin: full refund, including fees
- withdrawal during the first or second week of classes: 80% refund *
- withdrawal during the third, fourth, or fifth week of classes: 60% refund*
- withdrawal during the sixth week of classes: 20% refund*
- withdrawal after the sixth week: no refund

*fees are not refunded after the start of the term

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.

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 University provides a tuition assistance benefit to eligible employees enrolled in course work at Duke. Additional information is available at the Benefits Office at (919) 684-6723

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 continuous 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 degree-granting programs and departments. Students must be registered during the terms that they take qualifying, preliminary, and final examinations, and when they submit dissertations to the library.

Master’s students. Full-time master’s candidates must register for 12 units per semester until a minimum of 30 units of degree credit have been achieved (some programs require more than 30 units). Full-time students can enroll for fewer than 12 units only in the final semester in which they are completing the minimum number of degree credit. 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. Students must be registered during the terms that they take final examinations and submit their theses to the library.



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.

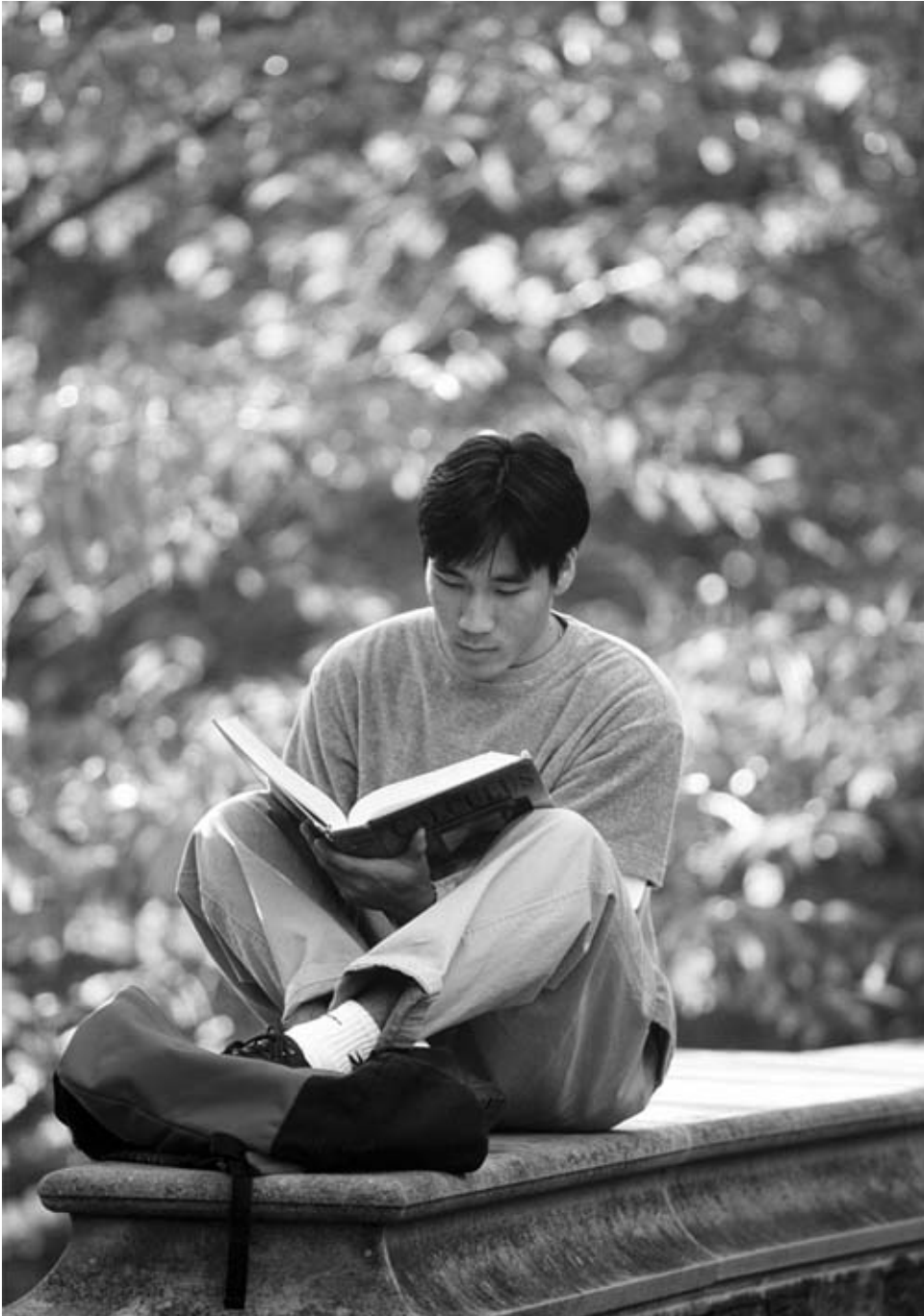
Summer session students may add a course or courses before or during the first three days of the term. Courses may also be dropped before and during the first three days, but a 20 percent tuition fee will be charged (1) if the course is not dropped before the first day,

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.”

Full-time students in any degree program may audit courses without charge during the fall and spring semesters, if this is acceptable to the faculty teaching these courses. Students should obtain faculty permission prior to registering for the class. If the student is not in full-time status, an audit fee is charged.

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.

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 relevant 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. Beginning with the fall 2004 semester, grades in the Graduate School are as follows: *A, B, C, F,* and *I*. *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.

In order to be certified as making satisfactory progress towards the degree, graduate students must maintain at least a 3.0 (*B*) cumulative grade point average. Students falling below this average jeopardize not only their financial support, but their continuation in the graduate program.

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, graduate students may enroll in undergraduate courses to round out their programs of study. Students pursuing a master's degree are limited to two undergraduate courses; doctoral students may take as many as required. In either case, students must receive a grade of *B-* or better to have such courses counted as part of their earned graduate credit.

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 (see "Standards of Conduct," p. 59). 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.

Students contemplating leaves of absence for reasons **other** than medical emergency should be aware that, for financial purposes, all guarantees of financial support are calculated from the date of initial matriculation. For example, if a graduate program has stated that a student will be supported through the fifth year of graduate study and the student subsequently takes a leave of absence for one of those years for reasons other than medical emergency, the student would forfeit a year of institutional support.

English Proficiency for International Students. All international students whose native language is not English must enroll in two sections of English 200 (one devoted primarily to written English, one primarily to spoken English) during their initial year at Duke, unless formally waived from this requirement by the Graduate School upon certification of competency in English.

Library Privileges. Graduate students are entitled to carrels only if registered as full-time students. Only students who have attained candidacy (passed the preliminary examination) are eligible for closed carrels.

Student Health and Insurance. The Student Health Fee entitles the student to outpatient treatment through the University Student Health Program, inpatient treatment in the University Infirmary, and services provided by Counseling and Psychological Services. The health fee should not be confused with the Duke Student Accident and Sickness Insurance Plan, which covers a large number of medical costs above and beyond the treatment available through the University Health Program. Full-time students who are entitled to coverage by the Student Health Program are also eligible for the supplementary

insurance policy. Application forms for the Student Accident and Sickness Insurance Plan may be obtained from the Bursar's Office.

All in-residence students are required to have some kind of supplemental health insurance. Students will automatically be enrolled in the Student Accident and Sickness Insurance Plan unless they submit a waiver indicating that they are covered by a comparable plan. The University requires all students to be responsible for health costs over and above what is covered by the student health fee. **Foreign students should be especially careful to ensure that they are covered by an adequate Accident and Sickness Insurance Plan. They should contact the International House for more specific recommendations.**

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. Six units of the required 24 is often in a minor subject or in a related field which is approved by the student's major department.

Individual programs and 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 and on the Duke University Graduate School Web site.

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 program or 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. A student must be registered during the term in which he/she takes the final examination.

Non-thesis examinations take several forms within the Graduate School. The most common are written or oral exams on a prescribed reading list or body of material; oral exams on a paper or a set of papers submitted by the student; or an oral exam on a research project or memorandum. The doctoral preliminary examination may also serve as the final examination for the master's degree.

The master's committee will conduct the examination and certify the student's success or failure by signing the card provided by the Graduate School office. If more than one member of the committee casts a negative vote on the final examination, the student will fail. The committee may recommend additional work and/or a second examination. If it is a successful examination, the 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 the "Courses" chapter under Public Policy for a description of the M.P.P. degree.

MASTER OF ARTS IN TEACHING

See the "Courses" chapter, under "Teaching" 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, 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/degreere.htm>. The Intention to Receive Degree form is not valid for more than one semester: if the student does not graduate in the term the intent is filed, a new form will need to be filed for a subsequent completion of the degree.

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, even though it may relieve the student of coursework required by the major department. 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 B 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 last weekday 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) training in the Responsible Conduct of Research, (5) a supervisory committee for the student's program of study, (6) residence, (7) preliminary examination, (8) dissertation, and (9) 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 such requirements. For specific departmental language 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 36 of this bulletin.

Responsible Conduct of Research. Beginning with the entering class of Fall 2003, all doctoral students at Duke University will be required to complete a series of training sessions in the Responsible Conduct of Research (RCR). These sessions will consist of two components: the first is an orientation workshop given at the beginning of each academic year. All students in the Biomedical Sciences will attend the general introductory workshop at the Duke University Marine Laboratory; students in the Humanities and Social Sciences will attend a similar introductory workshop on the main campus, as will students in non-medical Biological Sciences, Physical Sciences and Engineering programs. All Ph.D. students will subsequently attend a minimum number of RCR forums or other training experiences (including workshops and courses) scheduled throughout the academic year on individual topics related to responsible conduct of research. The number and content, as well as the annual schedule of, such forums, courses or workshops will be published at the beginning of each fall semester. Students should complete their RCR training requirement by the end of their third year at Duke.

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 program or 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.

Progress towards Degree. All Ph.D. students must file annually, beginning with their second year of study, a report to their director of graduate studies summarizing their progress towards the degree. For students who have passed the preliminary examination and are

working on their dissertations, it is expected that this progress summary will also be given to their doctoral committees. Failure on the part of a student to submit an annual progress report will jeopardize the Graduate School's ability to certify satisfactory progress towards the degree and thus both the student's continuation in their graduate program and their eligibility for financial support.

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.

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 examinations. 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.

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 or programs cover such field expertise in a separate qualifying examination. Please consult the chapter on "Courses of Instruction" for individual department or program procedures. In the summer a preliminary examination may be scheduled only between the opening and closing dates of the summer session. A student must be registered during the term in which he or she takes the preliminary examination.

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 original 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 qualifying and/or preliminary examination may also be used as the completion exercise for awarding a master's degree either for a terminal master's or, where appropriate, for awarding a master's degree en route to the Ph.D.

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/degreere.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 and on the Graduate School Web site.

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, who must have at least two weeks to read and review the completed dissertation before the final examination. 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. A student must be registered during the term that he/she takes the final examination.

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. A student must be registered during the term that he or she submits the dissertation to the library.

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. The May commencement also includes a hooding ceremony. 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

The Duke Community Standard

Duke University is a community of scholars and learners, committed to the principles of honesty, trustworthiness, fairness, and respect for others. Students share with faculty and staff the responsibility for promoting a climate of integrity. As citizens of this community, students are expected to adhere to these fundamental values at all times, in both their academic and non-academic endeavors.

The Pledge. Students affirm their commitment to uphold the values of the Duke University community by signing a pledge that states:

1. I will not lie, cheat, or steal in my academic endeavors, nor will I accept the actions of those who do.
2. I will conduct myself responsibly and honorably in all my activities as a Duke student.

Duke University Graduate School 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 workings followed for a complaint or 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.

- 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. 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.

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 Payne, Director (201 Franklin Center); Professors H. Baker, Gaspar, Holloway, McClain and Powell; Associate Professors L. Baker, Lubiano and Piot; Assistant Professors Glymph and Wallace

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: see Asian & African Languages and Literature Studies 200S; also C-L: Cultural Anthropology 288S, Literature 200S
- 209S. Race, Class, and Gender in Modern British History.** 3 units. C-L: see History 209S
- 213S. African Modernities.** Encounters between African societies and global forces, including colonialism, capitalism, development initiatives. Instructor: Holsey. 3 units. C-L: Cultural Anthropology 203S
- 221S. Ethnicity, Culture, and Family Processes.** 3 units. C-L: see Psychology 221S
- 235S. The Antebellum South.** 3 units. C-L: see History 235S
- 254. Justice, Law, and Commerce in Islam.** 3 units. C-L: see Religion 254; also C-L: Medieval and Renaissance Studies 254
- 262S. Minority Mental Health: Issues in Theory, Treatment, and Research.** 3 units. C-L: see Psychology 262S
- 269S. Harlem Renaissance.** 3 units. C-L: see Art History 269S
- 270S. Topics in African Art.** 3 units. C-L: see Art History 270S
- 278S. Race and American Politics.** 3 units. C-L: see Political Science 278S; also C-L: Public Policy Studies 278S
- 279S. Race, Racism, and Democracy.** 3 units. C-L: see Cultural Anthropology 279S
- 293. Special Topics in Literature and History.** Instructor: Staff. 3 units.
- 297S. Teaching Race, Teaching Gender.** Interdisciplinary analyses of the problematics of teaching about social hierarchies, especially those of race, class, and gender. Curricular content and its interaction with the social constructions of students and teachers. Instructor: Payne. 3 units. C-L: Women's Studies 297S, History 297S
- 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

- 216S. Gender, Race, and Class**
- 241. Classical Islamic Theology and Ethics**
- 255. Anthropology as Public Discourse**
- 264S. Poverty and Social Policy: Life Course Human Resource Development**
- 292S. Slavery and Freedom in Africa, to 1960**

Art and Art History (ARTHIST)

Professor Leighton, Chair (112A East Duke Building); Professor Wharton, Director of Graduate Studies (114A East Duke); Professors Bruzelius, McWilliam, Powell, and Van Miegroet; Associate Professors Abe, Antliff, Stiles and Weisenfeld; Assistant Professors Dillon, and Gabara; Professor Emeritus Markman; Adjunct Professor Rorschach; Adjunct Associate Professor Schroth; Adjunct Assistant Professor Schroder

The Department of Art & 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. We are committed to full and equal funding of our students during their time in residence at Duke. Admission to the program is limited to between four and six new students per year.

The Ph.D. program in the history of art is integrally connected with 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 form and meaning of objects and sites, as well as in their theoretical and historical 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 are expert in a broad range of areas of art history, as well

as in a variety of media, from architecture, sculpture and painting to video cybernetics. 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 look at the Department's website (www.duke.edu/web/art) or write to the director of graduate studies.

For Seniors and Graduates

201S. Topics in Greek Art. Specific aspects of the art or architecture in the Greek world from the late Geometric to the Hellenistic periods. Subject varies from year to year. Consent of instructor required. Instructor: Staff. 3 units. C-L: Classical Studies 220S

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: see Classical Studies 233S

206S. Roman Architecture. 3 units. C-L: see Classical Studies 235S

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

233S. Topics in Early Christian and Byzantine Art. Specific conceptual, institutional, or formal problems in the art of the late antique world or of the east Roman Empire. Subject varies from year to year. Consent of instructor required. Instructor: Wharton. 3 units. C-L: Classical Studies 230S, Medieval and Renaissance Studies 233S, Religion 275S

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

238S. Greek Sculpture. 3 units. C-L: see 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. C-L: Medieval and Renaissance Studies 242

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

256S. Inventing the Museum: Collecting and Cultural Discourses of the Nineteenth Century. 3 units. C-L: see German 286S

265S. Topics in Nineteenth-Century Art. Focus on a major artist, movement, or trend in nineteenth-century art. Subject varies from year to year. Consent of instructor required. Instructor: Antliff or Leighten. 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.

283S. Topics in Modern Art. Selected themes in modern art before 1945, with emphasis on major movements or masters. Subject varies from year to year. Consent of instructor required. Instructor: Antliff, Leighten, or Stiles. 3 units.

284AS. Caricature and Popular Journalism in England 1760-1850. Social and political caricature from the accession of George III to the early Victorian era. Caricature and party politics; satires of fashionable society; reactions to the American War of Independence, the French Revolution and the Napoleonic Wars. Caricature, radical journalism and the reform movement; the emergence of comic journalism. Instructor: McWilliam. 3 units.

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

296S. Methodology of Art History. Various theoretical perspectives that have shaped different disciplinary perspectives and practices in art history. Introduction to particular types of methodologies (i.e. Marxism, feminism, race and gender, psychoanalysis, post-colonial theory, and deconstruction) as fields of inquiry through which the study of the visual arts and culture have been practiced. Historiography of the last two decades in art history; selected contemporary debates. 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.

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: Museum Staff. 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: Museum Staff. 3 units.

303. Critical Approaches to Exhibitions and Museums. The historical context and critical analysis of exhibition theory and practices from curiosity cabinets to ethnological museums to postmodern spectacles with special attention to the development of the fine art museum as a distinctive site of visual display and consumption. Instructor: Abe. 3 units.

340. Goya and David: Enlightenment and Unreason. A comparative study exploring the artists' contrasting responses to contemporary currents in art, philosophy and politics; examination of Goya and David as historiographical subjects; exploration and critique of biographical strategies in art history. Instructor: McWilliam. 3 units.

350. 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.

362. Theatricality in Art: Staging Public Life in the Classical World. The idea that life is a stage was a pervasive one in antiquity and reflects the importance of the theater as a cultural and civic institution. Exploration of the concept of theatricality and its effects on art and life in Hellenistic and Roman worlds. Topics include public funerals, festival processions, the statesman as actor, costumes, masking, and portraiture, and the popularity of theatrical imagery in domestic decoration. Exploration of the influence of and resistance to the Greek theater and theatricality in Roman politics and culture. Consent of instructor required. Instructor: Dillon. 3 units.

363. Imagery of Empire: Roman Historical Reliefs. Genre of sculpture that emerged in late Republic as major vehicle for visual transmission of imperial ideology. Representing the emperor engaged in a variety of activities, these images helped to construct and communicate the power and grandeur of the Roman Empire to its citizens. In examining a broad range of Roman historical reliefs, course considers how sculptured styles and narrative strategies were used to represent imperial histories and explores the range of messages these images conveyed. Also considers issues of center versus periphery and the visual dynamics of 'Romanization.' Consent of instructor required. Instructor: Dillon. 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 Carr, 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, Cèzanne, 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, neocatholicism, 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: 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. The Paris Salon; Artists, Critics, and Institutions 1815-1900. Approaches the major exhibition of contemporary French painting and sculpture from multiple perspectives, highlighting involvement of successive political regimes in regulating the artistic economy. Analysis of artists' relationship with-and attempts to modify-the Salon structure, the emergence of alternative exhibiting venues, and the growth of the commercial art market. Particular emphasis on contemporary critical responses to artworks, viewed in the light of wider changes in journalism and the literary market place. Crucial texts and controversies over particular works will be examined in depth. The implications of reception theory for art history will be explored. Instructor: McWilliam. 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; Disney World) studied through primary sources and theoretical texts. Instructor: Wharton. 3 units. C-L: Religion 381

382. Art and Commodity. Exploration of relations between unique objects (relic, monument, art work) and evolving markets in the West from late antiquity to the present. Economic and theoretical texts (e.g. Aquinas, Adam Smith, Mauss, Appadurai) as well as historical and art historical works (e.g. Schapiro, Greenberg, Belting, Mitchell) will provide the ground for both formal and social understanding of particular works of art. The course will focus on Jerusalem and its representations in the West. 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, recapitulation, 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.

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.

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

217. Islam and Islamic Art in India

218S. Topics in Islamic Architecture and Art

237S. Greek Painting

247S. Topics in Italian Renaissance Art

257S. Topics in Pre-Columbian Art and Culture

260S. Topics in Italian Baroque Art

298S. Topics in Modern and Postmodern Architecture

299S. Critical Theory

375. Landscape and Memory in the Later Middle Ages

388. Topics in Modern and Postmodern Architecture

Biochemistry (BIOCHEM)

Professor Raetz, Chair (255 Nanaline H. Duke); Professor Spicer, Director of Graduate Studies (235 Nanaline H. Duke); Professors Bennett, Been, Beese, Beratan, Casey, Greenleaf, Hammes, Hellinga, Hershfield, Hill, Hsieh, Kreuzer, Lefkowitz, McLendon, Modrich, Newgard, Rajagopalan, D. Richardson, J. Richardson, Siegel, Simon, Spicer, Stamler, Steege, and Toone; Associate Professors Fitzgerald, Greene, Oas, and York; Assistant Professors Kuehn, Rudolph, Rusche, and Zhou; Professors Emeriti Fridovich, Gross, Kirshner, Sage, and Webster; 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, Structural Biology and 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. Instructors: Raetz, Garcia-Blanco, and Nicchitta. 4 units.

210. Research Independent Study. Individual research in a field of special interest, under the supervision of a faculty member, the major product of which is a substantive paper or written report containing significant analysis and interpretation of a previously approved topic. 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. Variable credit.

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: Molecular Biophysics 222

227. Introductory Biochemistry I. Chemistry of the constituents of proteins, lipids, carbohydrates, and nucleic acids and their metabolic interrelationships. Structure, function, and biosynthesis of biological macromolecules. Prerequisite: two semesters of organic chemistry. Instructors: Greenleaf 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: Been 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 and Molecular Biology 258, Cell Biology 258, University Program in Genetics 258, Immunology 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, Immunology 259, Molecular Biophysics 259, University Program in Genetics 259

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

267. Biochemical Genetics I: DNA and Genome Stability. Chromosome structure, replication, repair, genetic recombination, mutation and chromosome rearrangement. Minicourse, 1st half-semester. Instructors: Hsieh and Staff. 2 units.

268. Biochemical Genetics II: From RNA to Protein. Mechanisms of transcription, splicing, catalytic RNA, RNA editing, mRNA stability and translation. Mini-course, 2nd half semester. Instructors: Steege and Staff. 2 units. C-L: Cell Biology 268, Immunology 268, University Program in Genetics 268

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: Molecular Biophysics 291

336. Bioorganic Chemistry. 4 units. C-L: see Chemistry 336

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. Instructor: Caron, Casey, Means, and invited lecturers. 3 units. C-L: Cell Biology 417, Molecular Cancer Biology 417, Pharmacology and Cancer Biology 417

Bioinformatics and Genome Technology (BGT)

The Duke University PhD in Bioinformatics and Genome Technology (BGT) is an innovative degree program whose mission is to educate the next generation of world leaders in research and innovation at the computational/biological interfaces. BGT students are educated and mentored in classes, labs and research projects with faculty from multiple departments and disciplines, spanning the biological and computational disciplines, and medical and non-medical departments.

The BGT program is explicitly designed to be responsive to the breadth, newness and rapidly evolving nature of the BGT arena, and so does not have a heavy emphasis on required courses. All students directly admitted to the BGT Graduate Program must complete the following four core courses:

BGT 200. Statistical Methods for Computational Biology

BGT 203. Genome Informatics and Sequence Analysis

BGT 204. Algorithms in Bioinformatics

BGT 206. Genome Technologies

The BGT core curriculum emphasises the integration of biology and computation. This integration will be reflected in the syllabus of each core course, which will include lectures on biological applications of the informatics and computational principles being discussed, presented by lecturers with expertise in those biological areas. In addition to the core courses, all BGT graduate students will receive formal exposure to ethical and legal issues related to genomics, bioinformatics and genome technology through a series of workshops in conjunction with the IGSP Center for Genome Ethics, Law and Policy.

Elective courses: Additional BGT courses are offered as electives. Most students take a broad set of BGT courses as they define their own paths through the program. The Advisory Committee (in the first year) and the Thesis Committee work with the student to design a series of elective courses to be taken beyond the core courses. Acceptable electives are not limited to genomics, statistics, genome technology or computer science courses, but can entail course offerings, particularly in the biological sciences, that advance the educational ends of the student's specific graduate program. Key electives for the BGT program are:

- BGT 201. Statistical Genetics
- BGT 202. Comparative and Evolutionary Genomics
- BGT 207. Computational Methods for Macromolecular Structure
- BGT 208. Gene Expression Analysis
- BGT 209. Computational Genetics of Complex Traits
- BGT 210. Bioinformatics/Genome Technology Seminars
- BGT 211. Computational Functional Genomics

CERTIFICATE IN BIOINFORMATICS AND GENOME TECHNOLOGY

The Certificate Program in Bioinformatics and Genome Technology is intended for Duke students enrolled in departmental Ph.D. programs who wish to expand their current studies to apply to or include the fields of bioinformatics and genomics. A student may qualify for the Certificate program after completing the following course of study:

- Two Bioinformatics & Genome Technology (BGT) core courses, BGT 201 and BGT 203;
- Either two elective BGT courses or one BGT course and an approved independent study;
- Certified attendance at a minimum of ten seminars in the IGSP Center for Bioinformatics & Computational Biology (CB2) Seminar Series, which results in credit for BGT 210.

Students may petition to substitute courses that are judged equivalent to the BGT core courses.

For more information, visit the web site: <http://www.genomics.duke.edu> or email Professor Terry Oas at oas@duke.edu.

200. Statistical Methods for Computational Biology. Methods of statistical inference and stochastic modeling with application to functional genomics and computational molecular biology. Topics include: statistical theory underlying sequence analysis and database searching; Markov models; elements of Bayesian and likelihood inference; discrete data models; applied linear regression analysis; multivariate data decomposition methods (PCA, clustering); software tools for statistical computing. This course presupposes previous exposure to mathematics and statistics at the level of the BGT program prerequisites. Instructor: Staff. 3 units. C-L: Statistics and Decision Sciences 270

201. Statistical Genetics. Mechanisms, probability models and statistical analysis in examples of classical and population genetics, aimed at covering the basic quantitative concepts and tools for biological scientists. This module will serve as a primer in basic statistics for genomics, also involving computing and computation using standard languages. Instructor: Staff. 3 units. C-L: Statistics and Decision Sciences 271

202. Comparative & Evolutionary Genomics. This course will deal with structure of

genes and genomes, and with genomic diversity and genomic evolution. It will also address methods of analyzing the evolutionary relationships among genes. All genes have evolved from pre-existing genes and their structure preserves information about their evolutionary history as well as their function. This module will focus on the rationale and methods for reconstructing the relationships among gene families and on the techniques for reconstructing the evolutionary relationships among them. It will give the students an understanding of the causes of genomic structure and mechanisms of genomic diversification. Instructor: Staff. 1.5 units.

203. Genome Informatics and Sequence Analysis. This course covers the key concepts, methods and computational aspects of modern functional sequence analysis in genomics. Instructor: Staff. 3 units. C-L: Statistics and Decision Sciences 273

204. Algorithms in Computational Biology. 3 units. C-L: see Computer Science 260

206. Genome Technologies. This course introduces the laboratory and computational methodologies for genetic and protein sequencing, mapping and expression measurement. Instructor: Staff. 3 units.

207. Computational Methods for Macromolecular Structure. This course covers concepts of modeling and computation in approaches to structure prediction in modern proteomics. It introduces advanced probabilistic models and associated inference tools and will involve custom computer programming in standard languages. Instructor: Staff. 3 units. C-L: Statistics and Decision Sciences 277

208. Gene Expression Analysis. This course covers topics spanning the technological and computational areas of modern gene expression analysis, developing computational methods in important and current problems of clinical and physiological phenotyping, including custom computation and algorithmic development. Instructor: Staff. 3 units. C-L: Statistics and Decision Sciences 278

209. Computational Genetics of Complex Traits. This module is intended to give students an understanding of the genetic architecture of complex traits. Complex traits are traits whose structure and function depend on the interaction of many genes. Since these interactions are typically non-linear, this leads to a variable, context-dependent, association of genetic variation and trait variation. Here we address methods for studying the casual association between genetic/genomic variation and trait variation by developing dynamic models of the ontogeny and function of complex traits. Instructor: Staff. 3 units.

211. Computational Functional Genomics. 3 units. C-L: see Computer Science 262

213S. Computational Immunology and Immunogenomics. Course will integrate empirical and computational perspectives on immunology and host defense. Students are expected to have significant preparation in either biomedicine or a quantitative science. Topics covered are intended to provide an entree into the use of computational methods for research and practice in immunology and infectious disease, from basic science to medical applications. Consent of instructor required. Instructors: Kepler and Cowell. 3 units. C-L: Immunology 213S

214S. The Biophysics of Cell Signaling. Cells must constantly sense their environment and respond. The macromolecules (ligands) that cells detect, and the concentrations at which they detect them, are determined by the cell surface receptors they express. Once a particular ligand binds to a receptor this information must be transmitted across the cell membrane if the cell is to respond. When the information transfer is successful, a complex set of events is initiated (a signaling cascade) that culminates in the activation or suppression of one or more cellular responses. In many cases the binding of a ligand to a receptor is not sufficient to initiate signaling. Rather, for these ligands signaling is initiated by inducing receptors to aggregate with additional membrane proteins or among themselves. We will focus on receptor families that work in this way, including the growth factors receptors, the immune recognition receptors and the cytokine receptors. We will discuss models for ligand-receptor binding, ligand-induced receptor aggregation and ligand-initiated cell signaling. Two basic

types of cell signaling models can be distinguished: simple cell signaling models which ignore details of the signaling cascade, but give insight into how ligand-receptor binding properties affect signaling outcomes; and detailed models, which include specific molecular components and interactions beyond the ligand and receptor, and that are required to gain a mechanistic understanding of cell signaling cascades. Both types of models will be considered. Instructor: Staff. 3 units.

225. Special Topics: Comparative Genomics. This module will deal with the structure of genes and genomes, and with genomic diversity and genomic evolution. It will give students an understanding of the origins of genomic structure and the mechanisms of genomic diversification. Instructor: Staff. 1.5 units.

Biological Anthropology and Anatomy (BAA)

Associate Professor Churchill, Chair (04 Bio Sci); Associate Professor Schmitt, Director of Graduate Studies (246 Sands); Professors Cartmill, Glander, Hylander, Simons, and Terborgh; Associate Professor Roth; Associate Research Professor Pope; Assistant Professors Bassett and Drea; 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 daniel.schmitt@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*. Prerequisite: Biological Anthropology and Anatomy 172L and consent of instructor. Instructors: 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) and 132. Instructor: Staff. 3 units.

244L. Methods in Primate Field Ecology. Survey of field methods used in the study of primate ecology, including the habitat assessment, mapping, and behavioral observations using computer technology. Laboratory includes observations of primates at the Duke University Primate Center. Prerequisite: Biological Anthropology and Anatomy 93;

Biological Anthropology and Anatomy 143 recommended. Instructor: Glander or staff. 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 and 143 or 144L or 146; or consent of instructor. Instructor: Staff. 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: Staff. 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 and 132, or consent of instructor. Instructor: Staff. 3 units.

248S. Evolution of Mammals. The origin, adaptive radiation, and phylogenetic relationships of mammals, as inferred from the fossil record. Consent of instructor required. Instructor: Staff. 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: 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. 3 units. C-L: see 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.

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. 1 to 3 units. Instructor: Staff. Variable credit.

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. Variable credit.

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. Variable credit.

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. Variable credit.

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

COURSES CURRENTLY UNSCHEDULED

233S. Nature and Nurture in Animal and Human Development

250. Biometry

292S. Topics in Morphology and Evolution

293. Evolutionary Theory

294. Evolutionary Theory

Biological and Biologically Inspired Materials

Rob Clark, Ph.D. *Director*

The ultimate vision of the Center for Biologically Inspired Materials and Material Systems is to map traditional engineering onto biology. Through this revolutionary approach, this program established a new curriculum for graduate education in Biological and Biologically Inspired Materials. The curriculum serves as an integration of natural science, life science, and engineering. This new graduate training program uses biologically inspired approaches to bridge a gap in current biomedical and bioengineering programs. The Center's vision is to bring "nature's engineering" into the engineering curriculum and engineering principles into the study of nature's materials, revolutionizing the way engineering and life sciences are taught at the graduate student level. Thus, this program presents a new paradigm for education and research, using nature as an example for engineering, while explaining nature using engineering principles and rigor. Because of the potential enormity of the "Engineering of Biology," this program focuses on three specific areas: 1) Bio-NanoScience and Engineering (single molecules and self-assembly), 2) Encapsulation, Coatings, and Surface Patterning (materials at the cellular scale where the lipid bilayer serves as the defining basis of all life), and 3) Hierarchical Systems (larger, more macroscopic, functional organisms). This focused approach will allow students and faculty to develop mapping concepts to the leading edge of knowledge and to explore the intellectual and practical aspects of creating a new curriculum in this burgeoning new area at the interfaces of biology, medicine, engineering and basic physical and chemical sciences. This is the first step towards establishing a new paradigm in science and engineering education that explores life's mechanisms at the molecular level and translates these findings up through hierarchical scales of structure and organization to bring greater understanding of mechanism to the biological organism

University Program in Biological Chemistry (BLC)

Eric Toone, Ph.D., Director; Johannes Rudolph, Ph.D., Director of Graduate Studies

The Program in Biological Chemistry is undergoing evaluation, and admission to the Ph.D. program has been suspended at this time.

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.

COURSES CURRENTLY UNSCHEDULED

300. Case Studies in Drug Discovery

301S. Seminar in Biological Chemistry

Teaching College Biology

See listing for "Teaching College Biology" alphabetized in this chapter under "Teaching".

Biology (BIOLOGY)

Professors Barber, Benfey, Brandon, Christensen, Clark, Crowder, Dong, Forward, Jackson, Kiehart, Kirby, McClay, F. Nijhout, Nowicki, Ramus, Rausher, Reynolds, Rosenberg, Schlesinger, Shaw, Siedow, Simons, Smith, Staddon, Terborgh, Uyenoyama, Van Schaik, Vilgalys, Vogel, Wilbur, and Wray; Associate Professors Alberts, Bejsovec, Cunningham, Lutzoni, Manos, McShea, Morris, Pryer, Rittschof, Roth, Sun, Willis, and Wilson; Assistant Professors Bernhardt, Haase, Drea, Johnsen, Magwene, Pei, and Sherwood; Professors Emeriti Anderson, Boynton, Fluke, Gillham, Gregg, Hellmers, Klopfer, Knoerr, Schmidt-Nielsen, Searles, Stone, Strain, Wainwright, Ward, and White; Research Professors Nicklas, Livingstone, and Tucker; Senior Research Scientist Culberson; Adjunct Professors Antonovics, Funk, Hartshorn, Kirby, Kress, Peet, Rogers, and Willard; Adjunct Associate Professors DePriest, Lacey, M. Nijhout, and Zimmer; Associate Professor of the Practice Motten; Assistant Professors of the Practice Armaleo and Mercer

The Department of Biology offers a variety of training opportunities leading to the Ph.D. degree. 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; genomics; and systematics.

There is a high level of interaction among the various areas of biology and other programs. Faculty members participate in the University Programs in Developmental Biology, Ecology, Genetics and Genomics, Cellular and Molecular 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 School of Engineering (biomechanics); and the N.S.E.E.S. (ecology).

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 and Earth Sciences.

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. 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

204LS. Field Ecology. Ecosystem, community, and physiological ecology of temperate plants and animals through hands-on experimentation. How biological processes are affected by biotic interactions, Theory and methods reviewed through discussions; hypothesis formulation, experimental design, data acquisition and processing, and data analysis learned through field investigation. Includes several field trips, including two weekends. Prerequisites: Biology 25L, Mathematics 31. Biology 110L or other course in ecology, or consent of instructor. Instructor: Reid. 4 units. C-L: Environment 204LS

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.

214. Biophysics in Cellular and Developmental Biology. 3 units. C-L: see Physics 214

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

217. Ecology and Global Change. Feedbacks between ecological processes and global environmental change; physiological and ecosystem ecology using a variety of sources, including the primary scientific literature. Topics include global warming, biodiversity, land-use change, ozone depletion, and the application of ecological research to policy. Prerequisite: Biology 25L or equivalent; recommended: Biology 110L or equivalent. Instructor: Jackson. 3 units.

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.

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

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

238. Phylogenetics. Phylogenetic analysis including sequence alignments and comparative methods. Empirical and simulation studies. Intended for advanced graduate studies. Projects, presentation, and a mini-symposium at the end of the semester. Discussions based on primary literature. Instructor: Lutzoni. 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. 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: Environment 237L

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

251L. Advanced Laboratory Investigations in Animal Physiology. Discussions on research design. Review of relevant scientific literature. Student development of research topic in animal physiology, and independent design of research project. Written proposal and scientific paper, oral presentation required. Peer review of all work. Prerequisite: Biology 151L. Instructors: Eason and Johnsen. 4 units.

251S. Topics in Advanced Animal Physiology. Journal review of physiology research topics; discussion of research-design considerations. Development of research topic in animal physiology, and independent design of research project. Written proposal and scientific paper, oral presentation required. Peer review of all work. Prerequisite: Biology 151L. Instructors: Eason and Johnsen. 3 units.

253L. Physiology of Marine Animals. Variable credit. C-L: see Environment 228L

254. Vertebrate and Invertebrate Endocrinology. Comparative study of the major pathways of hormonal regulation from the organismal to the molecular level in vertebrate and invertebrate models. Applications of endocrinology in pharmaceuticals, cosmetics, and environmental issues. Prerequisites: Biology 25L and Chemistry 152L. A biochemistry course recommended. (Given at Beaufort.) Instructor: Rittschof. 3 units. C-L: Marine Sciences

255L. Biochemistry of Marine Animals. 6 units. C-L: see Environment 229L

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 or Willis. 3 units.

258S. The Making of the Modern Evolutionary Synthesis. An examination of the intellectual and historical development of the modern evolutionary synthesis. Topics will include: the state of evolutionary theory and the debate between the "Mendelians" and "Darwinians" in the early part of the 20th century, the development of modern population genetics and its synthesis with ecology, systematics and paleontology. Contributions of Fisher, Wright, Dobzhansky, Mayr, and Simpson will be highlighted with focus on original literature. What was and was not part of the synthesis, and why, and the current state of evolutionary theory will also be discussed. Enrollment limited to graduate students. Instructors: K. Smith and J. Willis. 3 units.

259S. The Life and Work of Darwin. Readings by and about Darwin and his contemporaries, especially Wallace. Darwin's "Autobiography" and Janet Browne's biography as context for readings of some of his major works and works of his contemporaries. Instructor: Alberts and McShea. 3 units.

264S. Advanced Topics in Marine Ecology. 2 units. C-L: see Environment 269S

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

266. Statistical Analysis of Ecological Data. Methods of statistical analysis, including experimental design, ANOVA, regression, longitudinal data, intervention studies, survival analysis. Lectures supplemented by student projects that involve application of techniques to data. Prerequisite: 1 year of undergraduate statistics. Instructors: Clark and Lavine. 3 units. C-L: Environment 241, Statistics and Decision Sciences 232

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: Clark. 3 units.

268L. Models for Environmental Data. Formulation of environmental models and applications to data. Topics include physiology, population growth, species interactions, disturbance, and ecosystem dynamics. Model development, analysis, and interpretation. Discussions focus on classical and current primary literature. Lab focuses on analysis of data using R, making use of likelihood models, bootstrapping, and Bayesian approaches. Instructor: Clark. 3 units. C-L: Environment 231L

269. Advanced Cell & Molecular Biology. Mechanisms that regulate events during the cell division cycle, with a focus on DNA replication control and cell cycle machinery. Analysis of experimental approaches addressing fundamental questions. Prerequisites: Biology 118/119. Instructor: Haase. 3 units.

271. Genomics. Introduction to the field of genomics. Genomic techniques including genome sequencing, microarray analysis, proteomics, and bioinformatics; applications of genomics to understanding biological problems including biological networks, human origins, evolution; applications to medicine and agriculture. Lecture and discussion. Prerequisites: Biology 118 or consent of instructor. Instructor: Benfey. 3 units.

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

273S. Current Topics in Environmental Biology. The biology and societal implications of technological and environmental problems. Impact on human and animal biology of chemical pollution, including food additives, manufacturing and food production by-products. Evaluation of observations and claims in the popular press, and research in primary scientific literature. (Given at Beaufort.) Prerequisite: Introductory Biology. Instructor: Rittschof. 3 units. C-L: Marine Sciences

274L. Marine Invertebrate Zoology. Variable credit. C-L: see Environment 295L

275S. Sensory Signal Transduction. Recent progress in sensory signal transduction mediated by calcium channels and receptors. Topics include history and techniques in the study of ion channels, such as electrophysiology, calcium imaging, and cell and molecular biology; cell surface perception for external signals, including light receptors, olfactory receptors, taste receptors, hot and cold receptors, and mechanical receptors; heart and brain pacemakers; sensory channel receptor-related human diseases; and plan sensory signaling network. Instructor: Pei. 3 units.

276S. Animal Communication and Social Behavior. Current topics in animal social behavior, with emphasis on form and function of animal signals, based on reading and analysis of current papers in the primary literature. Co-taught with a parallel Biology course

offered at UNC-CH, "Animal Societies and Communication." Prerequisite: Biology 166 or equivalent. Instructor: Nowicki. 3 units.

277S. Foundations of Behavioral Ecology. Readings on behavioral ecology, both historical papers and papers from the current literature that represent the most vital areas of research in the discipline. Instructors: Alberts and Nowicki. 3 units.

278S. Genetic Basis of Behavior. The relationship between genotype and behavioral phenotype. Readings from the primary literature, including papers on humans, lab mice, and wild animal populations. Exploration of two philosophical topics: the question of causality in the natural world and the question of determinism in biology. Short research paper required. Instructor: Alberts. 3 units.

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.

282. Mechanisms of Development/Developmental Genetics. 2 units. C-L: see Cell Biology 282

283. Developmental Genetics. 2 units. C-L: see Cell Biology 283

284. Molecular Population Genetics. Genetic mechanisms of evolutionary change at the DNA sequence level. Models of nucleotide and amino acid substitution; linkage disequilibrium and joint evolution of multiple loci; analysis of evolutionary processes, including neutrality, adaptive selection, and hitchhiking; hypothesis testing in molecular evolution; estimation of evolutionary parameters; case histories of molecular evolution. For graduate students and undergraduates with interests in genetics, evolution, or mathematics. Instructor: Uyenoyama. 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. Prerequisites: Biology 25L and 120 or equivalents. Instructors: Rausher and Uyenoyama. 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, 26L, or other course in plant or animal diversity; recommended, Biology 120 or equivalent. Instructor: Roth. 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. Prerequisites: calculus; statistics and linear algebra recommended. Instructor: Uyenoyama. 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. Prerequisites: Biology 110L or 112 and consent of instructor. Instructors: 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.

295S. Special Topics Seminar. Seminar on a selected topic. Offerings vary each semester. Consent of instructor required. Instructor: Staff. 3 units. C-L: Marine Sciences

296S. Special Topics Seminar. Seminar on a selected topic. Offerings vary each semester. Consent of instructor required. Instructor: Staff. Variable credit.

297. Research Independent Study. Individual research and reading of the primary literature in a field of special interest, under the supervision of a faculty member, the major product of which is a substantive paper or written report containing significant analysis and interpretation of a previously approved topic. Open to juniors and seniors only with consent of supervising instructor. A maximum of three courses of 190, 191, 192, 193T, 297, and 298 may count toward the biology major. Continued in Biology 298. Instructor: Staff. 3 units.

298. Research Independent Study. Continuation of Biology 297. Open to juniors and seniors only with consent of supervising instructor. A maximum of three courses of 190, 191, 192, 193T, 297, and 298 may count toward the biology major. Instructor: Staff. 3 units.

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." 6 to 8 units. Instructor: Staff. 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. Prerequisites: Biology 110L or equivalent and introductory applied statistics or equivalent. Instructors: Reynolds and Urban. 3 units. C-L: Environment 303

304. Modeling Plant and Ecosystem Response to Global Change. Examination of current models used to evaluate potential effects of global change, e.g., land use, atmospheric composition, biological diversity and climate, on terrestrial ecosystems. Ecosystem responses considered in terms of changes in function and vegetation composition/structure. Design, analysis and interpretation of models of plant and ecosystem biogeochemical cycles. Concepts of hierarchy and scaling emphasized in context of regional and global predictions using Dynamic Global Vegetation Models. Combination of lectures, student-moderated discussions and seminars and computer lab exercises. Prerequisites: Ecology (BIO 110) or equivalent. Recommended: Physiological Plant Ecology (BIO 265). Instructor: Reynolds. One Course. 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.

309. Ecological Forecasting Workshop. 3 units. C-L: University Program in Ecology 309

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.

322S. Behavioral, Population, and Community Ecology Discussion Group. An informal discussion group. Topics vary from semester to semester. Instructor: Staff. 1 unit. 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. Tutorial. Carried out under the direction of the appropriate staff members. Consent of instructor required. Hours and credit to be arranged. Instructor: Staff. Variable credit. C-L: Marine Sciences

352. Tutorial. Carried out under the direction of the appropriate staff members. Consent of instructor required. Hours and credit to be arranged. Instructor: Staff. Variable credit. C-L: Marine Sciences

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. C-L: Marine Sciences

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. C-L: Marine Sciences

378. Genetic Approaches to the Solution of Biological Problems. 4 units. C-L: see University Program in Genetics 378; also C-L: Cell and Molecular Biology 378, Molecular Genetics and Microbiology 378

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: Lemons. 1 unit.

COURSES CURRENTLY UNSCHEDULED

213L. Behavioral Ecology

218L. Barrier Island Ecology

219L. Coastal Ecosystem Processes

232. Microclimatology

268. Ecological Models and Data

285S. Ecological Genetics

289L. Methods in Morphometrics

The University Program in Biomolecular and Tissue Engineering

W. M. Reichert, Ph.D., Director

The University Program in Biomolecular and Tissue Engineering is a multidisciplinary certificate program that integrates activities in engineering, the life sciences and medicine.

Faculty are from the Departments of Biochemistry, Biomedical Engineering, Cell Biology, Chemistry, Mechanical Engineering and Materials Science, Medicine, Neurobiology, Ophthalmology, Radiation Oncology and Surgery.

The program emphasizes research, education (both undergraduate and graduate) and interactions with industry. The research focus of the program is upon the action of proteins, 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. 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 Biomolecular and Tissue Engineering offers a certificate of graduate study. The requirements for the certificate include completion of two core courses: Protein Engineering (BME 220) and Seminars in Biomolecular and Tissue Engineering (BME 301/302); approved BTE Engineering electives; and, two approved Basic Science classes. A NIGMS biotechnology training grant offers stipends, tuition and fees to a number of BTE predoctoral fellows.

For more information contact The University Program for Biomolecular and Tissue Engineering, Duke University, Box 90281, Durham, North Carolina 27708-0281 or visit the web site at: <http://bte.egr.duke.edu>.

Business Administration (BA)

Professor Breeden, Dean (219W Fuqua School of Business); Professor Bettman, Director of Graduate Studies (A312 Fuqua School of Business); Professors R. Ashton, Bansal, Boulding, Bradley, Burton, W. Cohen, Coleman, Desai, DeSanctis, Fischer, Francis, Gallant, Graham, Harvey, Hsieh, Huber, Kamakura, Kyle, Laughhunn, Lewin, Lewis, Lind, Luce, Lynch, Mela, Mitchell, Moorman, Payne, Purohit, Sheppard, J. Smith, Song, Staelin, Viswanathan, Whaley, Winkler, and Zipkin; Associate Professors Amaldoss, Anton, A. Ashton, Bercovitz, Bernstein, Brandt, Brav, Edell Britton, Chartrand, Chen, Clemen, DeCroix, de Vericort, Fitzsimons, Gervais, Larrick, Lenox, Linville, Lopomo, Marx, Mikhail, Nanda, Nau, Olsson, Ou-Yang, Pekec, Puri, Rottenstreich, Sitkin, Venkatachalam, Wade-Benzoni, and Wynne; Assistant Professors Banks, Bareket, Carlson, DasVarma, Hogan, Jennings, Kaniel, Khwaja, Kim, Kok, Kyle, Lobo, Majumder, Mathews, Rigotti, Robinson, Rockart, Severinov, Shang, Stowe, Sun, Zarutskie, and Zhang; Professors Emeriti Baligh, K. Cohen, Forsyth, Keller, McCann, and Moore; Research Professor Keeney

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 accounting, 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 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>.

501. Game Theory. Basic topics in noncooperative game theory: representations of games in normal and extensive form and solution concepts, including Nash equilibrium, subgame perfect Nash equilibrium, perfect Bayesian equilibrium, sequential equilibrium, perfect

equilibrium, proper equilibrium, correlated equilibrium, iterated dominance, and rationalization. Discussion of the relation between the normal and extensive form and the relations among the various solution concepts. Application of interest to the students covered as time permits. Instructor: Marx. 3 units.

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. Accounting Seminar: Empirical. This course focuses on empirical-archival research in accounting, emphasizing the framing of research questions, the research design and the research methods. Topics covered include: the value of relevance and stewardship roles of accounting information; valuation models; voluntary disclosure and accounting choice; earnings management; tax considerations. Prerequisites: PhD. level course in microeconomics recommended; basic mathematics background in calculus, statistics and algebra. Instructor: Staff. 3 units.

532. Accounting Seminar: Analytical. This course focuses on the economic models underlying information economics-based theories of the usefulness of accounting information. Topics covered include: adverse selection, moral hazard, signaling, incentive contracting and disclosure. Prerequisites: PhD. level course in microeconomics recommended; basic mathematics background in calculus, statistics and algebra. 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: Staff. 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, nonparametric 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: Staff. 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: Staff. 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 Britton. 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. 3 units.

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)

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.

Cell Biology (CELLBIO)

Professor Hogan, Chair; Professor Wright, Chief, Division of Physiology and Cellular Biophysics; Associate Professor Capel, Director of Graduate Studies; Professors Bennett, C. Bonaventura, J. Bonaventura, Caron, Endow, Erickson, Goldschmidt, Kiehart, McIntosh, Nicklas, Reedy, and Siedow; Associate Professors Corless, Lin, Nicchitta, Schachat, Schomberg, and Vigna; Assistant Professors Anderson, Ehlers, Fehon, Klingensmith, Kraus, McKay, Meyers, Rockey, Saling, and Stamler; Associate Research Professors Jakoi, and Le Furgey; Assistant Research Professor Gainetdinov

The Department of Cell Biology offers graduate training in cell biology, development, and physiology leading to the Ph.D. degree. Classic cell biology research interests include transmembrane receptors, molecular mechanisms of signal transduction, cytoskeleton, cell motility and cell polarity, mechanisms of contraction and vesicle transport, protein secretion and trafficking mechanisms, and biophysics of cell membrane bilayers. A significant portion

of the department addresses cell biology in the context of developing organisms such as *Drosophila*, mouse, and zebrafish. Developmental interests include germ cells and stem cells, neuronal specification and pathfinding, sex determination, development of the gonad, lung, heart, head and neural tube, and appendage and heart regeneration. Specific interests in cellular, organ, and systemic physiology include neuro-muscular junctions, the cellular basis of addiction and innate immunity, as well as heart, lung, gut, muscle, and reproductive organ function. The department has excellent facilities of state-of-the-art micromanipulation, mouse genetics and confocal and live-cell timelapse imaging.

The Department of Cell Biology participates in several university-wide interdisciplinary training programs, including genetics, cell and molecular biology, developmental biology, neurobiology, pharmacology, cancer biology, biomedical engineering, and toxicology. Admission to graduate training in cell biology is through one of these interdisciplinary programs. For more 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.

206. Physiology and Medicine of Extreme Environments. Advanced topics in the physiology and medicine of ambient pressure, immersion, gravity, temperature, and gas composition. Environments include diving and hyperbaric medicine; hot/cold terrestrial and water operations; microgravity and high-g acceleration; high altitude. Examines basic mechanisms and medical management of associated diseases including decompression sickness; altitude sickness; hypothermia and hyperthermia; hypoxia; carbon monoxide poisoning; oxygen toxicity. Laboratory optional. Prerequisites: human anatomy and physiology; diving techniques, equipment, and procedures; diving physiology, dysbaric diseases, and treatments. Instructor: Staff. Variable credit.

208. Stem Cell Biology Minicourse. 2 units. C-L: Molecular Cancer Biology 208

210. Research Independent Study. Consent of director of graduate studies required. 3 to 9 units. Instructor: Staff. Variable credit.

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

- 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 signaling; cell cycle. Instructor: Bennett and staff. 4 units. C-L: Cell and Molecular Biology 251
- 258. Structural Biochemistry I.** 2 units. C-L: see Biochemistry 258; also C-L: Cell and Molecular Biology 258, University Program in Genetics 258, Immunology 258, Molecular Biophysics 258
- 259. Structural Biochemistry II.** 2 units. C-L: see Biochemistry 259; also C-L: Immunology 259, Molecular Biophysics 259, University Program in Genetics 259
- 268. Biochemical Genetics II: From RNA to Protein.** 2 units. C-L: see Biochemistry 268; also C-L: Immunology 268, University Program in Genetics 268
- 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.
- 282. Mechanisms of Development/Developmental Genetics.** Half-semester minicourse targeted to first-year graduate students in the Biological Sciences. Taught sequentially in the Fall semester with Biology 283. Introduces basic concepts of cell specification, morphogenesis, induction, and other mechanisms that enable cells, tissues and organs to assemble the animal. Emphasis is on model organisms, mainly *Drosophila*, *C. elegans*, mouse, and zebrafish, where genomics, mutations, gene modifiers, epistasis analyses, gene knockouts, and transgenesis, plus many other genetic approaches have yielded important insights into the differentiation of cells and the development of complex organisms. Cross-listed with Biology 282. Instructors: Fehon, Kirby, Klingensmith, McClay, and Wharton. 2 units. C-L: Biology 282
- 283. Developmental Genetics.** Half-semester mini-course targeted to first year graduate students in the Biological Sciences. Taught sequentially in the Fall semester with Biology 282. Focuses on genetic approaches to solve mechanistic problems of development. Emphasis is on model organisms, mainly *Drosophila*, *C. elegans*, mouse and zebrafish, where genomics, mutations, gene modifiers, epistasis analysis, gene knockouts, and transgenesis, plus many other genetic approaches have yielded important insights into the differentiation of cell and the development of complex organisms. Cross-listed with Biology 283. Instructors: Fehon, Kirby, Klingensmith, McClay and Wharton. 2 units. C-L: Biology 283
- 296. Developmental Biology Colloquium.** Instructor: Staff. 3 units.
- 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. Variable credit.
- 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. Instructor: 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. Instructor: Caron, Casey, Means, and invited lecturers. 3 units. C-L: Biochemistry 417, Molecular Cancer Biology 417, Pharmacology and Cancer Biology 417

COURSES CURRENTLY UNSCHEDULED

204. Cell and Molecular Physiology

217. Selected Membrane Transport

223. Cellular and Integrative Cardiovascular Physiology and Biophysics

232. Extracellular Matrix and Cell Adhesion

244L. Molecular and Cellular Processes in Marine Organisms

293. Membrane Biophysics

The University Program in Cell and Molecular Biology (CMB)

Kenneth Kreuzer, Director (Department of Biochemistry); Christopher Counter, Director of Graduate Studies (Department of Pharmacology and Cancer Biology); 133 participating faculty

Research training in cell, developmental and molecular biology is found in one of eight departments/programs at Duke University: Biochemistry, Biology, Cell Biology, Immunology, Molecular Genetics and 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 133 faculty. The program offers a certificate of graduate studies, with the doctoral degree awarded by the chosen Department. Students admitted to CMB have up to one academic year to affiliate with a degree program. During the first and second years students typically take a selection of courses providing a broad-based approach to key areas of cell and molecular biology, with the specific course selection tailored to the individual student. 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 e-mail 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. Second half of fall semester. Instructor: Kornbluth and Zhuang. 2 units. C-L: University Program in Genetics 247

251. Molecular Cell Biology. 4 units. C-L: Cell Biology 251

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

264. Cell and Molecular Biology Colloquium. Required of all CMB students. Each Tuesday evening, presentations by upper-year students: one student talks about ongoing dissertation research and another introduces a research paper relevant to that week's seminar. Students attend the Thursday seminar (Cell Structure and Function) and can have lunch with the speaker. Instructor: Counter. 2 units.

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. Instructor: Thiele. 2 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. Instructor: Hammes and Spicer. 2 units.

378. Genetic Approaches to the Solution of Biological Problems. 4 units. C-L: see University Program in Genetics 378; also C-L: Molecular Genetics and Microbiology 378, Biology 378

Chemistry (CHEM)

Professor Beratan, Chair (101 Gross Chemical Laboratory); Assistant Professor Jie Liu, Director of Graduate Studies (221 Gross Chemical Laboratory); Professors Baldwin, Bonk, Crumbliss, Lochmüller, Palmer, Reichert, Shaw, Simon, Toone, and Yang; Associate Professors Fitzgerald, MacPhail, Oas, and Widenhoefer; Assistant Professors Akhremitchev, Coltart, Craig, Franz, Liu, Rudolf, and Zhou; Professors Emeriti Arnett, Chesnut, Hobbs, McPhail, Quin, Smith, Strobel, Wells, and Wilder; Adjunct Professors Chao, Feldman, and Kiserow

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 (CHEM 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.

For Graduates

301. Analytical Chemistry. Fundamental considerations of chemical measurements, optical spectroscopy, mass spectrometry, and separation methods. Instructors: Fitzgerald and Lochmüller. 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: Staff. 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: 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: 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: Shaw and Toone. Variable credit.

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. Instructor: Palmer. 2 units.

321. Inorganic Chemistry. Bonding and spectroscopy, reactions, transition metal chemistry, main group chemistry, organometallics/catalysis, and solid state. Instructors: Crumbliss, Franz, and Palmer. 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 Franz. 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. Instructor: Crumbliss. 2 units.

328. Synthesis and Synthetic Methods in Inorganic/Organometallic Chemistry. A discussion of inorganic synthetic methods including supramolecular chemistry and organometallic reactions. Instructor: 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, Coltart, Craig, Toone, and Widenhoefer. 4 units.

- 332. Organic Synthesis.** Synthetic design, retrosynthetic analysis, synthetic methods, total syntheses. Instructors: Baldwin, Coltart, 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: Craig, and Toone. 4 units.
- 336. Bioorganic 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: Toone and Rudolph. 4 units. C-L: Biochemistry 336
- 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: 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: Akhremitchev, Beratan, Liu, MacPhail, 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: Akhremitchev, Beratan, 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: Beratan, 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: Beratan, MacPhail, and Yang. 4 units.
- 345. Kinetics.** The phenomenology and theory of chemical dynamics and reaction rates. Instructors: Beratan, 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: Akhremitchev, Beratan, Oas, Shaw, and Simon. 4 units.
- 348. Solid-State and Materials Chemistry.** Introduction to the structure, physical, and electronic properties of solid-state materials. Instructor: Liu. 2 units.
- 349. Special Topics in Physical Chemistry.** Advanced topics and recent development in physical chemistry. 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 Burian, Chair (239A Allen); Professor Boatwright, Director of Graduate Studies (231 Allen); Professors Antonaccio, Rigsby, Clay, Davis, and Stanley; Associate Professor Janan; Assistant Professors Parker, Sosin, and Woods; Professors Emeriti Newton, Oates, and Richardson; Adjunct Assistant Professor Dillon (Art History)

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 study collection of Greek and Roman art.

CLASSICAL STUDIES (CLST)

For Seniors and Graduates

211S. Plato. 3 units. C-L: see Philosophy 211S

217S. Aristotle. 3 units. C-L: see Philosophy 217S

220S. Topics in Greek Art. 3 units. C-L: see Art History 201S

222. Fifth- and Fourth-Century Greece. From the Persian Wars to the dominance of Philip of Macedon. Instructor: Rigsby. 3 units. C-L: History 260

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: Boatwright, Parker, or Rigsby. 3 units. C-L: History 266

227S. Topics in Roman Art. 3 units. C-L: see Art History 202S

230S. Topics in Early Christian and Byzantine Art. 3 units. C-L: see Art History 233S; also C-L: Medieval and Renaissance Studies 233S, Religion 275S

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: Dillon. 3 units. C-L: Art History 238S

232S. Greek Painting. From the Late Bronze Age to the fourth century B.C. with emphasis on archaic and classical Athenian vase painters. Instructor: Stanley. 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: Staff. 3 units. C-L: Art History 205S

235S. Roman Architecture. Development of design and engineering in the architecture of ancient Rome; major building forms, public and private, and the principal styles focusing on the late Republic through the empire. Instructor: Boatwright or Richardson. 3 units. C-L: Art History 206S

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.

For Graduates

301. Proseminar: Introduction to Classical Studies. Credit/no credit grading only. 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 or Rigsby. 3 units.

322. Seminar in Ancient History II. Selected topics. Instructor: Boatwright or Rigsby. 3 units.

399. Directed Reading and Research. Credit to be arranged. Instructor: Staff. Variable credit.

COURSES CURRENTLY UNSCHEDULED

203. Ancient Political Philosophy

221. Archaic Greece

223. The Hellenistic World

234S. Roman Sculpture

258. The Hellenistic and Roman East

260. The Byzantine Empire

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.

205. Greek Lyric Poets. Fragments of the early lyric poets; selected odes of Pindar and Bacchylides. Instructor: Burian or Stanley. 3 units.

210. Alexandrian Poetry. Emphasis on the *Argonautica* of Apollonius of Rhodes, and attention to the shorter poems of Theocritus and Callimachus. Instructor: Stanley. 3 units.

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

226. The Orators. Selections from the principal Attic orators, with emphasis on Lysias and Demosthenes. Instructor: Sosin. 3 units.

For Graduates

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

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

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

321. Seminar in Papyrology. Instructor: Sosin. 3 units.

399. Directed Reading and Research. Credit to be arranged. Instructor: Staff. Variable credit.

COURSES CURRENTLY UNSCHEDULED

207. The Dramatists

209. Introduction to Hellenistic Literature

211. Greek Literature in the Roman Empire

220. The Presocratic Philosophers

221. Early Greek Prose

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.

206S. Cicero. Instructor: Richardson. 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.

214S. The Historians. Investigation of the Roman concept and practice of writing history, from Cato to Ammianus Marcellinus. Readings include Sallust, Livy, and Tacitus, and comparative Greek historians (in translation). Instructor: Boatwright 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: Richardson. 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: Woods. 3 units.

314. Seminar in Latin Epigraphy. Instructor: Rigsby. 3 units.

399. Directed Reading and Research. Credit to be arranged. Instructor: Staff. Variable credit.

COURSES CURRENTLY UNSCHEDULED

204. Epic of the Silver Age

205. The Roman Novel

207S. Vergil's *Aeneid*

240. Medieval and Renaissance Astrology

Cognitive Neuroscience

The Center for Cognitive Neuroscience (CCN) offers two main options for graduate training in cognitive neuroscience: an Interdisciplinary Training Program for Graduate Study in Cognitive Neuroscience and a Graduate Certificate Program in Cognitive Neuroscience.

The interdisciplinary training program is designed for students interested in an approach to cognitive neuroscience that integrates ideas and techniques across different aspects of this rapidly growing field. The key feature of the training program is that after two years of course work and laboratory rotations that provide a general training in cognitive neuroscience, students select two advisors for their thesis research who have expertise in the different subdisciplines that best define their interests (e.g., cognition and perception, the neurobiological bases of behavior, brain imaging techniques, electrical recording methods, psychology and psychophysics, philosophy of mind, neuroengineering approaches, computational and theoretical modeling or other relevant fields). Students enrolled in the program will gain a thorough understanding of the intellectual issues that drive this rapidly growing field, as well as expertise in the major methods used in cognitive brain research.

The certificate program is designed for students interested in working primarily within a subdiscipline of cognitive neuroscience that is represented by a particular department. In addition to the curricular requirements of their home department, students in the certificate program complete a year-long core course in cognitive neuroscience, as well as participating in relevant seminars and journal clubs. To participate in the certificate program, students must first be admitted to one of the participating departments. Information regarding application to each of the relevant departments can be found on their respective websites: Psychological and Brain Sciences, Neurobiology, Philosophy, Computer Science, and Biomedical Engineering.

For additional information and updated instructions, please visit our website at <http://www.mind.duke.edu>, or send an email to darcylew@duke.edu.

Computational Science, Engineering and Medicine (CSEM)

Professor Harer, Director

The graduate certificate program in Computational Science, Engineering and Medicine (CSEM) facilitates interdisciplinary training in the use of modern computational techniques in the conduct of research. This broad charter encompasses algorithmic, numerical, and implementation issues. 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 considered. Students will be expected to take credit for three CSEM 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 CSEM-affiliated faculty should serve on the student's dissertation or thesis committee. For more information, see the CSEM Web site at <http://www.csem.duke.edu>

Computer Science (COMPSCI)

Professor Agarwal, Chair (315 Levine Science Research Center); Associate Professor of the Practice Lucic, Associate Chair (D310 LSRC); Associate Professor Chase, Director of Graduate Studies (D306 LSRC); Professors Behringer, Edelsbrunner, Ellis, Harer, Marinos, Palmer, Reif, Rose, Tomasi, and Trivedi; Associate Professors Arge, Board, Henriquez, Kedem, Lebeck, Sun, and Wagner; Assistant Professors Dwyer, Hartemink, Munagala, Ohler, Parr, Sorin, and Yang; Professors Emeriti Biermann, Gallie, Loveland, Patrick, and Starmer; Professor of the Practice Astrachan; Associate Professors of the Practice Ramm and Rodger; Assistant Professor of the Practice Forbes; Associate Research Professor LaBean; Assistant Research Professor Furey; Adjunct Professors Gentzsch, Reed, and

Vitter; Adjunct Associate Professors Brady and Vahdat; Adjunct Assistant Professors Rodriguez and Pitsianis; Lecturer Duvall

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 “quals pass” in four of 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, non-computer science field. To satisfy the research requirement, students complete a two-semester project under faculty supervision, which demonstrates

The student’s ability to dissect problems, propose solutions, and analyze critically. All first-year Ph.D. students participate in a special seminar course (COMPSCI 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 the graduate study 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

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 (e.g., 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. Prerequisites: Computer Science 110 or 210 and Computer Science 214, or consent of the 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. Advanced Database Systems. Advanced database management system design principles and techniques. Materials drawn from both classic and recent research literature.

Possible topics include access methods, query processing and optimization, transaction processing distributed databases, object-oriented and object relational databases, data warehousing, data mining, web and semistructured data, search engines. Programming projects required. Prerequisites: An introductory database course or consent of instructor. Instructor: Yang. 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. Topics include processor design, pipelining, superscalar, out-of-order execution, caches (memory hierarchies), virtual memory, storage systems, simulation techniques, technology trends and future challenges. Prerequisite: Computer Science 104 or Electrical and Computer Engineering 152 or equivalent. Instructors: Board, Kedem, Lebeck, or Sorin. 3 units. C-L: Electrical and Computer Engineering 252

221. Advanced Computer Architecture II. Parallel computer architecture design and evaluation. Design topics include parallel programming, message passing, shared memory, cache coherence, cache coherence, memory consistency models, symmetric multiprocessors, distributed shared memory, interconnection networks, and synchronization. Evaluation topics include modeling, simulation, and benchmarking. Prerequisite: Computer Science 220 or Electrical and Computer Engineering 252 or consent of instructor. Instructor: Lebeck or Sorin. 3 units. C-L: Electrical and Computer Engineering 259

225. Fault-Tolerant and Testable Computer Systems. 3 units. C-L: Electrical and Computer 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. Also taught as Electrical Engineering 255. Prerequisite: four semesters of college mathematics. Instructor: Trivedi. 3 units.

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.

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, Edelsbrunner, 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. Prerequisites: Computer Science 130 and 208 or Computer Science 254 or Electrical Engineering 282. Instructor: Markas or staff. 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. Instructors: Agarwal and staff. 3 units.

238. I/O-Efficient Algorithms. Design and analysis of I/O-Efficient (or external memory) algorithms for problems involving massive datasets. Memory models and algorithm design paradigms. External memory algorithms for sorting and searching, graph problems, geometric problems, string problems and scientific computing problems. Implementation of I/O-Efficient algorithms. Prerequisites: Computer Science 230 or equivalent. Instructor: Arge. 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. Prerequisites: 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 250

260. Algorithms in Computational Biology. Provides a systematic introduction to the algorithms behind the most commonly-used tools in computational biology. Surveys a wide range of methods in the field and provides a significant amount of exposure to actual tools, but primary emphasis is on understanding and analyzing the algorithms behind these tools. Introduction to common techniques in algorithmic design and analysis, including design of data structures and analysis of running time. Covers dynamic programming, string matching, probabilistic techniques, geometric algorithms, hidden Markov models, data mining, and complexity analysis. Topics explored in the context of applications of genome sequence assembly, protein and DNA homology detection, gene and promoter finding, protein structure prediction, motif identification, analysis of gene expression data, functional genomics, and phylogenetic trees. Instructor: Agarwal or Hartemink. 3 units. C-L: Bioinformatics & Genome Technology 204

262. Computational Functional Genomics. Provides a perspective on current issues in the field of computational functional genomics, focusing on computational and statistical methods for elucidating the functional roles of genes. Topics include technologies for generating genomic data (sequence, expression, and binding location), clustering and classification of genomic data, functional annotation of genes and diagnosis of tissue types, modeling genetic regulatory networks, and applications of machine learning and graphical models to the automatic elucidation of these networks. No previous biological training assumed; all necessary biological background provided. Opportunity to read seminal papers in the field and engage a specific subtopic through an independent research project. Instructor: Hartemink. 3 units. C-L: Bioinformatics & Genome Technology 211

264. Nonlinear Dynamics. 3 units. C-L: see 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 Parr. 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: Parr. 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. C-L: Linguistics 274S

296. Advanced Topics in Computer Science. Instructor: Staff. 3 units.

296S. Advanced Topics in Computer Science. Same as Computer Science 296, except taught as a seminar. Instructor: Staff. 3 units.

297. Advanced Topics in Computer Science. Advanced topics from various areas of computer science, changing each year. Includes research intensive work exposing the student to computer science research methodology and resulting in a major document or project. Instructor: Staff. 3 units.

For Graduates

300. Introduction for Graduate Students in Computer Science. Introduction for graduate students in computer science. Topics for discussion include: computer science as a research discipline, views of what constitutes a research contribution, approaches to research in different subfields, tools and methodologies, publishing and presenting research results, the role of computer science as an "amplifier" in other sciences, ethical and policy issues, the information technology industry, grants and funding, and guidelines for success as a graduate student and as a scientist. Instructor: Staff. 1 unit.

310. Topics in Operating Systems. Not open to students who have taken Computer Science 332. Instructor: Staff. 3 units.

320. Advanced Topics in Digital Systems. 3 units. C-L: Electrical and Computer Engineering 352

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 and Computer 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. 1 to 3 units. Instructor: Trivedi. Variable credit.

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: Greenside, 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. 3 units. C-L: see 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. Variable credit.

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. Variable credit.

399. Special Readings. Instructor: Staff. Variable credit.

COURSES CURRENTLY UNSCHEDULED

206. Programming Languages

222. Introduction to VLSI Systems

223. Application Specific VLSI Design

232. Mathematical Analysis of Algorithms

236. Parallel Algorithms

242. Logic for Computer Science

248. Philosophy of Computing

252. Numerical Methods for Partial Differential Equations

254. Numerical Linear Algebra

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

Cultural Anthropology (CULANTH)

Professor Allison, Chair; Professor Starn, Director of Graduate Studies; Professors Andrews (Slavic languages), Butters (English), Mignolo (Romance studies), O'Barr, and Reddy (history); Associate Professors Baker, Ewing, Litzinger, Meintjes (music), Nelson, Piot, Silverblatt, Starn, and Tetel (English); Assistant Professors Jackson, Stein, and Thomas; Professors Emeriti Apte, Friedl, and Quinn

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 in the 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. Preliminary 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 to both the Ph.D. and J.D./M.A. programs are accepted every year. Please contact the departmental web site at <http://culturalanthropology.duke.edu> or send email to duca_grad@duke.edu for further information.

For Seniors and Graduates

200. Duke-Administered Study Abroad: Advanced Special Topics in Cultural Anthropology. Topics differ by section. Instructor: Staff. 3 units.

203S. African Modernities. 3 units. C-L: see African and African American Studies 213S

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

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. C-L: Documentary Studies 253S

262S. Culture, Power, History. Debates in cultural theory and anthropology: identity and nationalism, memory and tradition, globalization, and poststructuralist, feminist and postcolonial theory. Some previous coursework in anthropology and or cultural theory recommended. Instructor: Starn. 3 units.

264S. Millennial Capitalisms: Global Perspectives. Critical examination of the problematic of capital from the late nineteenth century until the present moment. Anthropological frameworks and related disciplinary approaches to the multiple cultural productions and lived experiences under divergent forms of capitalism in the new millennium. Focus on East Asia. Theories of capitalism, globalization and anti-globalization movements, "imaginaries" and fantasies, nature and the virtual, consumption, and disciplinary practices of the body. Instructors: Allison and Litzinger. 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.

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. Instructor: Piot or Thomas. 3 units.

285S. Space, Place, and Power. Examines relationship between space and power by studying how communities make and negotiate spaces, how identities are forged out of

space, and the relationship between cultural and spatial practices. Spatial components of globalization, sexuality and sexual identity, race and gender, and the geographic and cartographic histories of imperialism. Interdisciplinary readings from disciplines of geography, anthropology, cultural studies, women's studies, urban studies and others. Readings in the work of Lefebvre, Foucault, Harvey, Stoler, Pratt, and others. Aims to develop a critical, theoretical approach to space and spatiality. Instructor: Stein. 3 units. C-L: Asian & African Languages and Literature Studies 230S, Women's Studies 225S, Literature 287S

286S. Development, Modernity, and Social Movements. Modernization and ideologies of progress and nationalism; social movements, revolution, and political protest in the United States and around the world. Some prior background in cultural anthropology or social theory preferred. Consent of instructor required for undergraduate students. Instructor: Starn. 3 units.

287S. Ethnohistory of Latin America. Analysis of what can be known about nonwestern cultures described in texts written by European colonizers. Focus on native peoples whose lives were transformed by Spanish colonialism, with particular attention to post-Inca Andean Societies. Instructor: Silverblatt. 3 units. C-L: History 287BS, Literature 287BS

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.

301S. Foucault and Anthropology. A close examination of the work of Foucault and the impact of his work on cultural anthropology. Traces shifts in Foucault's thinking over the course of his career, examines his work in the context of other major French thinkers, and considers selected works in anthropology that have been particularly influenced by his theories. Instructor: Ewing. 3 units.

302S. Nationalism. Focuses on anthropological approaches to the nation-state, nationalist movements, and state formation. Examines the dynamic relationships between nations and states, colonial and post-colonial policies, and anti-colonial strategies within a changing global context. Addresses the ways belonging and participation are defined within particular states, as well as how these definitions are socialized through a variety of institutional contexts. Finally, explores the relationships between popular culture and state formation, examining these as dialectical struggles for hegemony. Instructor: Thomas. 3 units.

303S. Postcolonialism and Its Cultures. An introduction to colonial and postcolonial cultures, forms of knowledge, and theoretical traditions. Explore the foundational scholarship on colonialism within the Indian, European, and U.S. academies; investigate the central debates and arguments in the field of postcolonial theory; and consider postcolonial theory's relationship to the theoretical traditions of poststructuralism and psychoanalysis. Examine historical and the tropological relationship between colonialism and globalization. Develop a set of critical theoretical tools with which to approach the study of colonial and postcolonial cultures, institutions, discourses, and communities. This course pays particular attention to questions of subjectivity and subject formation, notions of resistance and struggle, and the ways in which colonial power has articulated with race, gender, and sexuality at particular historical moments. Readings in the works of Asad, Fanon, Derrida, Said, Spivak, Stoller and others. Instructor: Stein. 3 units.

304S. Anthropology and the Religious Imagination. An examination of religious movements through the political, racial, gendered, and globalized contours of the contemporary moment. Among other cases to be explored: Jerry Falwell and the religious

right, neo-Pentecostalism in the global south, African derived religions in the Americas, Black Hebrew Israelites, transnational Islamic movements, the occult economies of the neoliberal moment, and popular imaginaries of conspiracy. Instructor: Jackson and Piot. 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, involving pre-dissertation and dissertation research. 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. Studies in Ethnomusicology. 3 units. C-L: see 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

208S. Postcolonial Anthropology

210S. Ideology and the Image in Ethnographic Film

215S. The Anthropology of Gender: Theoretical Issues

216S. Gender, Race, and Class

249S. Anthropology and Psychology

250S. The Cultural Analysis of Discourse

255. Anthropology as Public Discourse

272S. Marxism and Feminism

281S. Seminar in Selected Topics

Program for the Study of Democracy, Institutions, and Political Economy

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.

Developmental Biology

The University Program in Developmental Biology provides broad training in mechanisms of embryonic development, developmental genetics, development and evolution, and specialized training in a number of areas. The Program offers a core curriculum in development and training in technologies that are of importance for research on current questions. Specializations include germ cell and stem cell biology, embryonic patterning, morphogenesis, growth and proliferation control, apoptosis, and signal transduction mechanisms that govern cell-cell communication. Development is studied at many levels of analysis, including molecular structure, genetics, genomics, biochemistry, cell biology, and the evolution of developmental processes. The Program begins with a core course in development and participation in the developmental colloquium. Students rotate between labs in their first year to learn advantages of the different model systems and experimental approaches. Students then choose to work in one of the 36 participating laboratories. A broad range of research resources is available for students including the Duke Marine Laboratory, Vivarium, Shared equipment resources, and excellent Science libraries.

Students may apply and be admitted directly to the University Program of Developmental Biology. Prior to the second year of study at Duke students will identify a participating department in which they will earn their PhD. (Note: For international students in particular, designation on the application form of a department in addition to this program may be helpful in securing funding.)

For more information contact: University Program in Developmental Biology, Box 3565 Duke University Medical Center, Durham, North Carolina, 27710; telephone (919) 684-6229.

Developmental Psychology

The facilities in developmental psychology at Duke University and the University of North Carolina at Chapel Hill (UNC) offer a collaborative approach to graduate training in developmental psychology: the UNC-Duke Collaborative Graduate Certificate Program in Developmental Psychology. Graduate students in the doctoral programs in Psychology at Duke and students in UNC's Department of Psychology can apply to this program that offers training opportunities in addition to those of their home department. Students in the certificate program attend developmental talks at both universities and have opportunities to take developmental seminars or engage in supplemental research training with the faculty of their non-home university. Among the research emphases of the participating faculty are cognitive development, social development, applied development and developmental psychobiology. Students apply to the program by the beginning of their third year of graduate study.

For more information, contact: Director, UNC-Duke Collaborative Program in Developmental Psychology, Duke University, Box 90085, Durham, NC 27708-0085; telephone: (919) 660-5715.

Earth and Ocean Sciences (EOS)

Professor Haff, Chair (103 Old Chemistry); Professor Boudreau, Director of Graduate Studies (305 Old Chemistry); Professors Baker, Barber, Corliss, Crowley, Karson, Kay, Klein, Livingstone, and Schlesinger; Associate Professors Clark, Lozier, Malin, Murray, Pratson, and Rojstaczer; Associate Research Professor Hegerl; Adjunct Associate Professor Spivack; 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.nicholas.duke.edu/eos/>. For further information on the graduate program, send email inquiries to dgs@eos.duke.edu.

For Seniors and Graduates

202. Beach and Island Geological Processes. Field seminar on the evolution of beaches and barrier islands with emphasis on the interactions between nearshore processes and human development. Prerequisite: Earth and Ocean Sciences 115/215 or consent of instructor. Instructor: Murray and Pilkey. 2 units. C-L: Marine Sciences

209S. Paleoclimate. Nature and mechanisms of climate variability throughout Earth history. Topics include general theory of climate, paleoclimate modeling and comparisons with observations, methodologies of reconstructing past climate variations, the observational record of paleoclimate extending from the Precambrian through the Ice Ages and Holocene to present, and the impact paleoclimate on biotic evolution/paleogeography and human cultural history. Consent of instructor required. Instructor: Baker or Crowley. 3 units.

210S. Paleoenvironmental Analysis. Methods of paleoenvironmental and paleoclimatic analysis. Includes radiometric and other methods of dating, stable isotopes, trace elements, paleobiotic and other methods of reconstructing climate, hydrology and environment of the past. Also includes approaches to modeling paleoenvironmental data. Instructor: Baker. 3 units.

211. The Climate System. Components of the climate system: observed climate change, concept of energy balance, basic circulation of the atmosphere and ocean, introduction to climate models, sample applications of climate models, interactions between the atmosphere/ocean/ and biosphere, land surface, cryosphere (snow and ice), and chemistry of the atmosphere. Prerequisite: consent of instructor. Instructor: Crowley. 3 units.

212. Climate Change. Introduction to the greenhouse effect; radiatively important trace gases and their cycles, climate observations and their uncertainties, statistical techniques for evaluating climate data and models, climate variability, projects of future climate change, detection and attribution of climate change due to greenhouse gases, changes in extremes of climate, economic and societal impact, policy options for climate change, technological alternatives for energy usage. Prerequisite: Earth and Ocean Sciences 211 and/or consent of the instructor. Instructor: Staff. 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 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.

220. Introduction to Fluid Dynamics. Conservation equations for mass, momentum and heat, with an emphasis on large temporal and spatial scales; application to the earth, ocean, and environmental sciences. Some background in differential equations highly recommended. Instructor: Lozier. 3 units.

222. The Geology Side of Energy. The elementary geology of Earth's energy resources; how the Earth provides usable energy. Energy exploration. The geology of hydrocarbon, geothermal system, and fissionable element reservoirs. Alternative energy reservoirs such as gas clathrates and peat. The geologic conditions for CO₂ sequestration. Global energy resource assessment. Speakers from industry and government. Optional field trip to active energy exploration and production sites during Fall Break. Prerequisites: upper division or graduate standing. Instructor: Malin. 3 units.

224. Environmental Geology. A case history, field and lab exercise, and quantitative model approach to the role of geological materials and processes in environmental assessment studies. The quantitative and qualitative impact of rock type, faulting, folding, volcanism, weathering, erosion, flooding, and underground fluid flow on the human environment. An introduction to quantitative probabilistic hazard analysis and its application to establishing monetary cost/benefit ratios. The basics of engineering geology in environmental studies. Cases taken from current and past geological studies of environmentally sensitive sites. Consent of instructor required. Instructor: Malin. 1 unit. C-L: Earth and Ocean Sciences 120

225. Water Contamination. Geochemistry of water contamination, focusing on behavior of inorganic constituents dissolved in rainwater. Contaminants produced by human interactions with the environment, such as industry and construction. Salinization and desalinization. Prerequisites: Chemistry 12L or 22L. Instructor: Vengosh. 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 or consent of instructor. Instructor: Karson and Klein. 3 units.

236S. Lithosphere Plate Boundaries. Lithosphere Plate Boundaries. (QID) NS Plate tectonics and the geological and geophysical expression of orogenic belts, spreading centers, transform faults, subduction zones. Prerequisite: Earth and Ocean Sciences 101L 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. Involves mathematical modeling. Prerequisite: Earth and Ocean Sciences 130L or consent of instructor. Instructor: Karson. 3 units.

240. Introduction to Modeling in the Earth Sciences. Introduction to Modeling in the Earth Sciences. (M) NS, QS Elementary methods for quantitatively modeling problems in the earth sciences. Formulation and solution of classical equations that express fundamental behaviors of fluids, sediments, and rocks. Examples from different fields of geology. Simple modeling exercises, including a final project. Instructors: Haff, Murray, and Pratson. 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 geomorphology. Consent of instructor required. Instructor: Murray. 3 units.

243S. Landscape Dynamics. How landscape changes with time. The dynamics and mechanisms of earth surface processes underlying landscape change. Hillslope, fluvial, marine, glacial, volcanic, tectonic and aeolian processes. Reading and discussion of primary literature; several field trips to Duke Forest. Prerequisite: Earth and Ocean Sciences 11 or consent of instructor. Instructor: Haff and Pratson. 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.

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.

251S. Global Environmental Change. Topics in the seminar will include climate change, earth surface alteration, prediction, water and carbon cycling, sea-level rise and coastal erosion, biodiversity, fossil fuels and energy resources, water resources, soil fertility, human impact on coastal zone ecosystems. Prerequisite: consent of instructor. Instructor: Baker. 3 units.

252. Introduction to Geophysics. 3 units. C-L: Physics 252

255. Seismology I. Quantitative review of global to local seismology, seismic waves, the earthquake source, and the relevant structure of the earth. Topics included are basic elasticity, derivation of elastodynamic relationships for seismic waves and basics of wave propagation in layered media. Can be taken after Earth and Ocean Sciences 256. Prerequisite: one upper-division course in physics, mathematics, engineering or geology. Quantitative relations will be used in class and in homework. Instructor: Malin. 3 units.

256. Seismology II. Quantitative review of global to local seismology, seismic waves, the earthquake source, and the relevant structure of the earth. Topics include ray theory, travel time analysis of local and teleseismic arrivals, earthquake location and source problems. Can be taken before Earth and Ocean Sciences 255. Prerequisite: one upper division course in physics, mathematics, engineering, or geology. Instructor: Malin. 3 units.

269. Thermodynamics of Geological Systems. Thermodynamics of Geological Systems. (QID) NS Introductory thermodynamics applied to geologic problems through understand-

ing of phase equilibrium. Prerequisites: Earth and Ocean Sciences 101: and Mathematics 32 or consent of instructor. Instructor: Boudreau. 3 units.

271. Stable and Radioactive Isotopes in Environmental Sciences. Theory and applications of stable and radioactive isotope distributions in nature (including oceanographic, geologic, hydrologic, and biological processes). Prerequisites: Chemistry 12L or 22L, 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 22L or equivalent. Instructor: Schlesinger. 3 units. C-L: Biology 272

278. Tropical Climate and Paleoclimate. Thermodynamics of tropical climate. Nature and mechanisms of climate variability in the tropics on time scales from daily to multi-millennial. Impact of climatic variability on tropical biota. Effects of anthropogenic changes of the environment on future climatic change in the tropics and potential extratropical teleconnections. Prerequisite: Earth and Ocean Sciences 41 or 53. Instructor: Baker. 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. Prerequisites: 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. Variable credit.

For Graduates

371. Advanced Topics in Geology. To meet the individual needs of graduate students for independent study. Instructor: Staff. Variable credit.

372. Advanced Topics in Geology. To meet the individual needs of graduate students for independent study. Instructor: Staff. Variable credit.

COURSES CURRENTLY UNSCHEDULED

201L. Physical Processes in Coastal Environments

203. Physical Oceanography

205. Geological Oceanography

206S. Principles of Geological Oceanography

208S. Paleooceanography

259S. Fieldwork in Geophysics

270. Sedimentary Geochemistry

273S. Analytic Techniques

321L. Methods in Hydrogeology

East Asian Studies

Leo Ching, Associate Professor, Director of Graduate Studies; Professors Allison, Gao, Gereffi, Horowitz, Lin, Liu, Niou, Wong, Zeng and Zhou; Associate Professors Abe, Jaffe,

Litzinger, Mazumdar, McKean, Nickerson, Partner, Yoda, Shi, and Weisenfeld; Assistant Professors Feng, Hong, H. Kim, S. Kim, and Metzger

The Asian/Pacific Studies Institute (APSI) at Duke University administers an innovative and interdisciplinary M.A. Program in East Asian Studies. The Program offers broad choices and can be individually tailored. It meets the needs of students planning to enter professional careers such as the diplomatic corps, international law, education, and business as well as providing academic enhancement for mid-career professionals in these fields. The Program is also designed to prepare students who want to enter doctoral programs in the social sciences and humanities.

The Program encourages the crossing of traditional disciplinary boundaries through thematic seminars while retaining a firm grounding in a disciplinary base. The temporal focus of the Program is on the nineteenth and twentieth centuries, with fields of specialization available in Art and Art History, Cultural Anthropology, History, Modern Literature, Political Science, Psychology, Religion, and Sociology. Although currently limited to Chinese and Japanese Studies, language instruction in Korean is also available. The thematic foci of the Program include cultural and literary studies, development and policy studies, gender, sexuality and ethnicity, institutional transformation, and politics and society.

Degree Requirements

The master's degree in East Asian studies requires ten courses (30 credit hours, including an integrated required core course), of which at least eight (24 credit hours) must be in East Asian studies. These must be drawn from a list of approved courses, with no more than four taken in any one department. Fourth-year college-level East Asian language courses may be counted toward the eight-course requirement. In all, no more than two of the ten required courses may be lower level language (third year or below) or non-East Asian. In lieu of a thesis, the Program requires the completion of a capstone course and a research paper or annotated bibliography in area or topic of specialization. The degree is dependent on the acceptance of the research paper or annotated bibliography by the Graduate Committee and successful completion of an oral examination on this paper or bibliography by an MA advisory committee of three faculty members, two of whom must be APSI core faculty members.

Students are directed in their course of study by the APSI Director of Graduate Studies along with an individual faculty advisor. The capstone course is to be chosen with the help of the advisor, who must be a member of the core faculty of the Asian/Pacific Studies Institute.

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 at Duke. Students who are native speakers an East Asian language are encouraged to take one year (two semesters) of another East Asian language.

Joint JD/MA Degree

The Asian/Pacific Studies Institute also administers a joint JD/MA degree. Admission to this program is contingent upon admission to the Duke Law School. Degree requirements for the MA portion are the same as for the East Asian MA, with the exception that a maximum of two of the eight required East Asian courses may be in Law, pertaining to East Asia.

Certificate in East Asian Studies

The Asian/Pacific Studies Institute offers a Certificate in East Asian Studies to allow graduate students at Duke to demonstrate their training and competence in East Asian Studies. To receive the Certificate, students enrolled in the graduate school or in the professional schools must formally apply for the program and 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 (Chinese, Japanese, or Korean).

COURSES ON EAST ASIAN STUDIES OFFERED BY DEPARTMENTS AND PROFESSIONAL SCHOOLS

Asian and African American Studies

200S. Seminar in Asian and African Cultural Studies. C-L: see Asian & African Languages and Literature Studies 200S; also C-L: Cultural Anthropology 288S, Literature 200S

Art History

272S. Topics in Chinese Art

274S. Topics in Japanese Art

379. Fascism East and West: The Visual Culture of Japan, Germany, and Italy

Asian & African Languages and Literature

200S. Seminar in Asian and African Cultural Studies. African and African American Studies 200S, Cultural Anthropology, 288S, Literature 200S

205/206 Asian and African Languages and Literature

250S. Chinese Modernism in Post-Mao Era

252. Special Topics in Asian and African Literature

253 East Asian Cultural Studies, Cultural Anthropology 254

262. Modern Japanese Literature and Culture C-L: Cultural Anthropology 260

280S. Intellectuals/Culture/History: Modern China in Transition, *Staff*

288S. Seminar on Modern Chinese Cinema

Japanese

205S/206S. Seminar in Japanese, *Yoda*

291. Research Methods in Japanese C-L: Cultural Anthropology 290, History 292, Political Science 291, Sociology 291

Business Administration

400. Business After Communism

439. Cultural Setting of Business

456. Emerging Markets

482. Global Academic Travel Experience

Cultural Anthropology

208S. Postcolonial Anthropology

234S. Political Economy of Development: Theories of Change in the Third World C-L: Political Science 234S, Sociology 234S

254. East Asian Cultural Studies C-L: Asian & African Languages and Literature Studies 253

260. Modern Japanese Literature and Culture C-L Asian & African Languages and Literature Studies 262

288S.Seminar in Asian and African Cultural Studies C-L: Asian & African American Studies 200S, Literature 200S

290. Research Methods in Japanese C-L Japanese 291, History 292, Political Science 291

Sociology 291

300S. Popular Culture, Theories and Practices

Economics

242S. Chinese Economy in Transition C-L: Public Policy Studies 242S

265S. International Trade

268S. Current Issues in International and Development Economics

History

204S. Technology, Economic Development, and Social Change, 1750 to Present

207BS. Geographic Perspectives in History II: Asian and Pacific Worlds

276A. Labor, Immigration, and the Asian American Experience

292. Research Methods in Japanese C-L: Japanese 291, Cultural Anthropology 290, Political Science 291, Sociology 291

299S. Special Topics

343A. Before Modern Japan

343B. Modernity in the Japanese Archipelago

Law

207H* Comparative Intellectual Property

218H* The World Trade Organization: The Adjudication of International Trade Disputes

* Course is taught at Summer Institute, Hong Kong

235H* Comparative Securities Law: China and Japan
 237H* Human Rights: International Hong Kong, and Japanese Perspectives
 242H* Health Care Regulation: Asian and Western Perspectives
 245H* Privatization in Emerging Markets
 260H* Merger and Acquisitions in China and Korea
 270H* Foreign Direct Investment in China
 336. Economic Regulations in Japan
 352. International Business Transactions
 375. International Intellectual Property
 380. Research Methods in International, Foreign and Comparative Law
 507. Chinese Company and Security Law
 508. Chinese Law and Society
 509. Chinese Legal History
 512. Comparative Public Law and Policy: Ethnic Group Relations
 605. Chinese for Legal Studies
 650. Japanese for Legal Studies
 665. Korean for Legal Studies

Political Science

211S. Current Problems and Issues in Japanese Politics
 220S. Problems in International Politics
 234S. Political Economy of Development: Theories of Change in the Third World C-L: Cultural Anthropology
 234S, Sociology 234S
 272. China and the World
 291. Research Methods in Japanese C-L: Japanese 291, Cultural Anthropology 290, History 290, Sociology 291
 351. Comparative Law and Politics: Ethnic Group Relations

Public Policy

242S. Chinese Economy in Transition. C-L: Economics 242S
 284S. Public Policy Process in Developing Countries C-L: Political Science 267S

Sociology

222S. A-G. Proseminars in Comparative and Historical Sociology
 225S. A-H. Proseminars in Organizations, Markets, and Work
 228S. A-F. Proseminars in Stratification, Mobility, and Labor Force Behavior
 234S. Political Economy of Development: Theories of Change in the Third World C-L: Political Science 234S,
 Cultural Anthropology 234S
 291S. Research Methods in Japanese C-L Japanese 291, Cultural Anthropology 290, History 292, Political Science
 291

Courses Currently Unscheduled:

Asian and African Languages and Literature 259. The Best-Seller: Cultural Populism in the 1990's China
 History 245/246. Social and Intellectual History of China
 History 252A. Construction of China in European and American Literature
 History 275S. Asian and Asian-American Women in Comparative Perspective
 History 288S. Germany and Japan in World War II
 Religion 218. Religions of East Asia

University Program in Ecology (UPE)

Professor Jackson (biology), Chair; Professor Richter (environment), Director of Graduate Studies; Professors Christensen (environment), Clark (biology), Crowder (environment), Glander (biological anthropology and anatomy), Katul (environment), Lavine (statistics), Livingstone (biology), Nowicki (biology), Oren (environment), Pimm (environment), Rausher (biology), Reynolds (biology), Richardson (environment), Terborgh (environment), and van Schaik (biological anthropology and anatomy); Associate Professors Morris (biology), Rittschof (environment), Urban (environment), and Willis (biology); Assistant Professors Alberts (biology), Read (environment), and Wilson (biology); Professor of the Practice Hartshorn (environment); Associate Professor of the Practice Kirby-Smith (environment); Assistant Professor of the Practice Halpin (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

* Course is taught at Summer Institute, Hong Kong

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. 4 units.

302. Physiological Ecology and Ecosystem Analysis. 4 units.

303. Ecology Seminar. 1 unit.

309. Ecological Forecasting Workshop. 3 units. C-L: Biology 309

Economics (ECON)

Professor Nechyba, Chair (215A Social Sciences); Professor Taylor, Director of Graduate Studies (315 Social Sciences); Associate Professor Peretto, Director of Graduate Admissions (236 Social Sciences). *Primary Appointments:* Professors Bollerslev, Burnside, De Marchi, Goodwin, Grabowski, Graham, Kelley, Kimbrough, McElroy, Nechyba, Schmitt-Grohe, Sloan, Tauchen, Taylor, Tower, Uribe, Vernon, and Weintraub; Associate Professors Bajari, Hong, Peretto, and Timmons; Assistant Professors Arcidiacono, Beresteanu, Connolly, Ellickson, Eraker, Heim, Rossi, Tarozzi, and Yildirim; Professors Emeriti Blackburn, Davies, Kreps, Treml, Wallace and Yohe; Research Professors Burmeister and Toniolo; Adjunct Professor Gallant; Research Scientist Becker. *Secondary Appointments:* Professors Clotfelter, Conrad, Cook, Darity, Hsieh, Kramer, Ladd, Lewis, Munger, and Viswanathan; Associate Professors Bansal, Conrad, Hamilton and Vettas; Assistant Professors Khwaja and Vigdor

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 August at the beginning of their second year. In addition, a student must obtain certification in two 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, macroeconomics, monetary, and international economics, 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

202. Special Topics in Economics. Instructor: Staff. 3 units.

205. Intermediate Economics II. Lecture only version of Economics 205D. Prerequisites: Economics 2D, 52D, or 55D; and Mathematics 31 or 31L; and successful completion (80%) of EcoTeach Center Math Test or equivalent demonstrated competence in Mathematics 103 or any higher-level Mathematics course with Mathematics 103 as a prerequisite, and consent of instructor. Instructor: Arcidiacono, Becker, Heim, or Taylor. 3 units.

205D. Intermediate Economics II. Calculus-based generalization of the theory of demand and supply developed in Economics 55D. Individual behavior in environments of risk and uncertainty. Introduction to game theory and strategic interaction. Adverse selection, moral hazard, non-competitive market structures, externalities, public goods. Similar to Economics 105 but at a more advanced level. Not open to students who have taken Economics 105 or 149. Intended to replace Economics 249 beginning in Spring 2003. Prerequisites: Economics 2D, 52D or 55D; and Mathematics 31 or 31L; and successful completion (80%) of EcoTeach Center Math Test, or equivalent demonstrated competence in Mathematics 103, or any higher-level Mathematics course with Mathematics 103 as a prerequisite. Instructor: Arcidiacono, Fullenkamp, Heim, Taylor, or Yildirim. 3 units.

206. Advanced Microeconomic Analysis. Topics include consumption, production, investment, uncertainty and information. Not open to students who have taken this course as Economics 201. Instructor: Becker or Graham. 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 105 or 149. Instructor: Graham. 3 units.

207S. Models of Conflict and Cooperation. Cooperative and non-cooperative game theory with applications to trading, imperfect competition, cost allocation, and voting. Extensive use of quantitative models requiring familiarity with multivariate calculus, optimization, and probability theory. Prerequisite: Economics 105. Instructor: Graham. 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 105 or 149; and Statistics 101, 103, 104, 112, 113 or 114 or Mathematics 135 or 136. Instructor: McElroy. 3 units. C-L: Women's Studies 208S

209S. Global Issues in Population and Development. Relationship of population growth to economic development and to natural resource and environmental pressures. Causes and impacts of population change, including economic models of fertility, mortality, marriage, and migration. An overlay of comparative cultural factors that affect decision-making, with particular attention to impacts of gender. Research project required. Prerequisite: Economics 105 or 149; and Economics 110 or 154. Instructor: Kelley. 3 units. C-L: Public Policy Studies 209S

210. Intermediate Economics II. Lecture only version of Economics 210D. Prerequisites: Economics 1, 1A, 1D or 51D. Prerequisite or co-requisite: Economics 105, 149, or 205D, and consent of the instructor. Instructor: Burnside, Connolly, or Peretto. 3 units.

210D. Intermediate Economics III. Intermediate level treatment of macroeconomic models, fiscal and monetary policy, inflation, unemployment, economic growth. Similar in content to Economics 110, but at a more advanced level. Not open to students who have taken Economics 110 or 154. Intended to replace Economics 254 beginning in Fall 2003. Prerequisite: Economics 1, 1A, 1D or 51D. Prerequisite or co-requisite: Economics 105, 149, or 205D. Instructor: Burnside, Connolly, or Schmitt-Grohe. 3 units.

210S. Intermediate Economics III. Seminar Version of Economics 210D. Prerequisites: Economics 1, 1A, 1D, or 51D. Prerequisite or co-requisite: Economics 149 or 205D. Instructor: Peretto. 3 units.

214S. Readings in Economics. Seminar to expose students to economic issues and topics through reading of current literature and weekly iterative writing summaries. Topics will vary by week in order to expose the student to a wide array of current literature and economic debate. (Similar to Economics 114S, but requires additional assignment.) Prerequisites: Economics 1, 1A, 1D or 51D; and Economics 2, 2D, 52D or 55; and Economics 105 or 149; and Economics 110 or 154. Instructor: Hagy, Tower, or staff. 3 units.

215S. Research Seminar. Individual research in a field of special interest that culminates in a substantive research project containing significant analysis and interpretation of a previously approved topic. Students to meet individually and on regular basis with supervising professor and in weekly group seminar to present and discuss research. (Similar to Economics 115S, but requires additional assignment.) Consent of instructor and director of undergraduate studies required. Prerequisites: Economics 1, 1A, 1D, or 51D; and Economics 2, 2D, 52D or 55; and Economics 105 or 149; and Economics 110 or 154. Instructor: Hagy, Tower, or staff. 3 units.

218. Macroeconomic Policy and International Finance. 3 units. C-L: see 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 includes statistical data analysis and quantitative techniques to expose development issues, across countries and over time. Prerequisites: Economics 105 or 149; and Economics 110 or 154; and consent of instructor required. Instructor: Kelley. 3 units.

220. Time Series Economics. Non-seminar version of Economics 220S. Instructor: Rossi. 3 units.

220S. Time Series Econometrics. Empirical research in macroeconomics and international finance, providing students with a series of econometric tools for empirical analysis of time-series and an introduction to the current empirical research in macroeconomics, international finance, and forecasting. Small project and simple empirical research required. Instructor: Rossi. 3 units.

238. History of Globalization in the Twentieth Century. Same as Economics 138, but requires an additional paper; not open to students who have taken Economics 138. Prerequisite: Economics 1, 1A, 1D or 51D; recommended Economics 110 or 154. Instructor: Toniolo. 3 units. C-L: History 224A

239D. Introduction to Econometrics. Data collection, estimation, and hypothesis testing. Use of econometric models for analysis and policy. (Same as Economics 139D but requires additional term paper; not open to students who have taken Economics 139D.) For Economics majors only. Prerequisite: Economics 2, 2D, 52D or 55D; Mathematics 103 (co-requisite); Statistics 101, 103, 104, 112, 113 or 114 or Mathematics 135 or 136. Instructor: Beresteanu, Ellickson, or Tarozzi. 3 units.

241. Applied Econometrics. Covers basic econometric methods useful in empirical economic research and forecasting. Topics include multiple regression analysis under nonstandard conditions; probit, logit, and other limited dependent variables; count data; simultaneous equation systems; and basic models with panel data. (Same as Economics 141, but requires additional paper; not open to students who have taken Economics 141.) Prerequisite: Economics 139D; Mathematics 104; Statistics 101, 103, 104, 112, 113 or 114 or Mathematics 135 or 136. Instructor: Beresteanu or Rossi. 3 units.

243. The Art Market. Same as Economics 143, except additional paper required. Prerequisite: Economics 2, 2D, 52D or 55D; and Art History 70 or consent of instructor. Instructors: De Marchi and Van Miegroet. 3 units.

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, 1A, 1D or 51D; and Economics 2, 2D, 52D or 55D. Instructor: Goodwin. 3 units.

- 251S. Regulation of Vice and Substance Abuse.** 3 units. C-L: see Public Policy Studies 251S
- 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 105 or 149; and Economics 110 or 154. Instructor: Bollerslev, Eraker, 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 105 or 149; and Economics 110 or 154; and Economics 139. Instructor: Burmeister. 3 units.
- 258D. Applied Financial Economics.** Same as Economics 258 but with a discussion section. Prerequisites: Economics 105 or 149; and Economics 110 or 154; and Economics 139. Instructor: Burmeister. 3 units.
- 261. Evaluation of Public Expenditures.** 3 units. C-L: see Public Policy Studies 261; also C-L: Environment 272
- 262S. Seminar in Applied Project Evaluation.** 3 units. C-L: see Public Policy Studies 262S
- 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 110 or 154. Instructor: De Vroey. 3 units.
- 265S. International Trade.** International trade, investment and migration, commercial policy, and the political economy of trade. Prerequisite: Economics 105 or 149; and Economics 110 or 154. Instructor: Kimbrough or 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 55D. 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 105 or 149; and Economics 110 or 154. Instructor: Tower. 3 units.
- 270. Resource and Environmental Economics.** 3 units. C-L: see Environment 270; also C-L: Public Policy Studies 272
- 272. Economic Analysis of Resource and Environmental Policies.** 3 units. C-L: see Environment 271
- 275. Economics of Modern Latin America.** Same as Economics 175, but requires an additional paper; not open to students who have taken Economics 175. Prerequisite: Economics 1, 1A, 1D or 51D; and 2, 2D, 52D or 55D. Instructor: Staff. 3 units.
- 276. Mathematical Economics.** Topics include a review of differential and integral calculus; overview of matrix algebra, comparative statics, constrained optimization; introduction to differential equations and difference equations. Prerequisite: basic knowledge of differential and integral calculus. Instructor: Sharpe. 3 units.
- 277. Game Theory.** An introduction to non-cooperative game theory with emphasis on both games of complete information and games of incomplete information. Application from economics, biology, law, and political science. Offered only in the summer. Prerequisite: Economics 105. Instructor: Taylor. 1.5 units.
- 278. Mathematical Economics II.** Addresses more formal mathematical modeling in economics and provides an introduction to real analysis and mathematical dynamics. Offered only in the summer. Instructor: Staff. 3 units.

- 279. Advanced Microeconomics II.** Formal theory and developing proofs; attention paid to empirical implications of theory. Offered only in the summer. Instructor: Staff. 1.5 units.
- 286S. Economic Growth and Development Policy.** 3 units. C-L: see Public Policy Studies 286S
- 287. Public Finance.** Same as Economics 187, but requires additional graduate-level work; not open to students who have taken Economics 187. Prerequisite: Economics 105 or 149. Instructor: Staff. 3 units.
- 288. Advanced Industrial Organization.** Advanced topics in behavior of firms within industries. Topics include the agency problem, barriers to entry, research and development, collusion, pricing, econometrics of market power, and product differentiation. Analysis conducted within market structure and regulation environment. Prerequisite: Economics 188. Instructor: Bajari, Peretto, or Yildirim. 3 units.
- 289. Applied Econometrics II.** Time series analysis, non-linear and systems modeling, limited dependent variables, and hazard models. Probability and distribution theory, and statistical inference. Issues of functional form, qualitative form, qualitative choice models, pooled time series and cross-sectional data, and more advance time series topics. Offered only in the summer. Instructor: Staff. 3 units.
- 290S. The Development of Modern Economic Thought.** Selective survey of the development of economic thinking in the twentieth century, with emphasis on the construction of economics as a science. Research papers required. (Similar to Economics 190, but requires an additional assignment. Not open to students who have taken Economics 190). Prerequisites: Economics 1, 1A, 1D or 51D; and Economics 2, 2D, 52D or 55D. Instructor: Weintraub. 3 units.
- 291. 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. Prerequisites: Economics 105 or 149; and Economics 110 or 154. Instructor: Toniolo. 3 units.
- 293. Research Independent Study.** Individual research in a field of special interest under the supervision of a faculty member, the central goal of which is a substantive paper or written report containing significant analysis and interpretation of a previously approved topic. Consent of instructor and director of undergraduate studies required. Instructor: Staff. 3 units.
- 294. Independent Study.** Individual non-research, directed reading, or individual project in a field of special interest under the supervision of a faculty member. Consent of instructor and director of undergraduate studies required. Instructor: Staff. 3 units.
- 295. Selected Topics in Economics.** Instructor: Staff. 3 units.
- 295S. Selected Topics in Economics.** Seminar version of Economics 295. 3 units.
- 296. Selected Topics in Economics.** Instructor: Staff. 3 units.
- 296S. Selected Topics in Economics.** Seminar version of Economics 296. Instructor: Staff. 3 units.
- 297S. Economic Science Studies.** Application of techniques of science and technology studies to problems in the history, philosophy, methodology and sociology of economics. Addresses modern economics as an illustrative case of issues arising in Studies of Scientific Knowledge. What counts as "fact" in economics? Who decides, and by what processes of negotiation? Does accepting that knowledge in economics as a construct reduce the usefulness of that knowledge and affect the notion of progress in economic science? Why has mathematical economics enjoyed such success in recent decades? Close readings in texts across the sciences and in modern economics, and the history of mathematics, culminating

in a research project. (Similar in context to Economics 197S, but requires an additional assignment. Not open to students who have taken Economics 197S or Sociology 187S.) Prerequisites: Economics 105 or 149; and Economics 110 or 154; and consent of instructor. Instructor: Weintraub. 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: Staff. 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: Taylor. 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: Lewis. 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: Peretto. 3 units.

305. Monetary Theory and Policy. Same topics as Economics 205S but with additional graduate level work. Prerequisite: Economics 304. Instructor: Schmitt-Grohe. 3 units.

306. Microeconomics: Policy Applications. 3 units. C-L: see 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.

310. Social and Economic Data. Introduction to the acquisition and transformation of raw information into economic and social data. Legal, statistical, computing, and social science aspects of data "manufacturing" process. Emphasis on the formal United States infrastructure and access to confidential data offered through the Census Research Data Cent (RDC) network. Basic statistical principles of populations and sampling frames; acquiring data via samples, censuses administrative records, and transaction logging; the law, economics and statistics of data privacy and confidentiality protection; data linking and integration techniques; analytic methods in the social sciences. Consent of instructor required. Instructor: Chen. 3 units. C-L: Political Science 338, Sociology 310

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.

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.

- 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. 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: Staff. 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: Vigdor. 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: Hong or Rossi. 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: Hong or Tauchen. 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 dependent variables. Prerequisite: Economics 342. Instructor: Beresteanu. 3 units.
- 345. Applied Econometrics.** Applications of current econometric methodology to empirical problems with an emphasis on applied microeconomics. Topics include limited dependent variable, longitudinal and panel data analysis, and duration models. Prerequisites: Economics 341 and 344. Instructor: Tarozzi. 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.
- 351. Empirical Microeconomics.** Covers recent research in empirical microeconomics. Particular attention will be paid to applications that exploit insights from game theory,

information economics, imperfect competition and other recent developments in microeconomics theory. Examples from industrial organization, public finance and labor economics will be discussed. Students will engage in an empirical research project as part of the course requirements. Prerequisite: Economics 303, 341, 342, 343. Instructor: Staff. 3 units.

355. Seminar in Labor Economics. Instructor: Heim. 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: Arcidiacono. 3 units.

365. Seminar in International Trade Theory and Policy. Instructor: Connolly. 3 units.

366. Seminar in International Monetary Theory. Instructor: Uribe. 3 units.

379. Natural Resource Economics. 3 units. C-L: see Environment 379.

380. Graduate Economics Workshops. May be taken for multiple credit. Sections: .01 Industrial Organization and Regulation; .02 Macroeconomics; .03 Applied Micro; .04 International; .05 Public Economics; .06 History of Political Economics; .08 Econometrics; .09 Microeconomic Theory; .10 Economic History. Instructor: Staff. 3 units.

385A. Research Seminar in Applied Microeconomics. For students anticipating working on thesis in area of Applied Microeconomics. Emphasis on reading and critiquing state of the art empirical work in microeconomics and presenting ongoing graduate student research. Students expected to contribute to discussion and present on regular basis. Prerequisite: Econ 380 concurrently. Instructors: Arcidiacono, McElroy, Nechyba, Sloan, and Tarozzi. 1.5 units.

385E. Research Seminar in Microeconometrics. Facilitate research in applied microeconomics. Students and faculty present paper by leading research. Emphasis places on those papers that combine sophisticated techniques from econometrics and that integrate theory and empirical work. Participants encourages to present early version of own research. Prerequisites: Econ 380 taken concurrently. Instructors: Bajari, Beresteanu, Ellickson, and Hong. 1.5 units.

385F. Research Seminar in Financial Econometrics. For students anticipating working on thesis in the area of financial econometrics. Emphasis on research that combines sophisticated statistical and econometric techniques with current ideas and issues in asset pricing finance. Students expected to contribute to discussions and present ongoing research on a regular basis. Prerequisites: Field Examinations in Econometrics and Finance, Econ 380 taken concurrently. Instructors: Bollerslev and Tauchen. 1.5 units.

385M. Research Seminar in Macro and International Finance. Discuss and analyze in detail recent papers on Macroeconomics and International Finance. Serves as formal environment in which students present and evaluate research on a regular basis. Participants required to make presentations as directed by instructor and play active role in discussions. Prerequisite: Econ 380 taken concurrently. Instructors: Abraham, Burnside, Connolly, Kimbrough, Peretto, Schmitt-Grohe, and Uribe. 1.5 units.

385T. Research Seminar in Economics Theory. Student's own field and research papers will be used as basis for developing modeling skills in microeconomic theory including

Contract Theory, Decision Theory, Game Theory, General Equilibrium, Industrial Organization, Mechanism Design, political economy, and Public Economics. Explore and develop methods and techniques for deriving economically interesting implications of assumptions on primitives. Write and refine original research papers, present work, and evaluate fellow students in route to dissertation prospectus. Prerequisite: Econ 380 taken concurrently. Instructors: Besharov, Graham, Taylor, and Yildirim. 1.5 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: Grabowski or Yildirim. 3 units.

389. Empirical Methods in Industrial Organization. Survey of empirical literature in industrial organization. Topics include price discrimination, cartels and collusion, entry and market structure, information and competition, technological change, auctions and firm organization. Discussion of recent empirical papers, focusing on the research questions, identification strategies, estimation techniques and policy implications. Instructor: Ellickson. 3 units.

391. 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.

398. Directed Research. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

212S. Economic Science and Economic Policy

225S. Games and Information

231S. Economic Development in Latin America

236. The International Economy Since 1800

240. Comparative Economic Systems

242S. Chinese Economy in Transition

244. Education, Development, and Growth

252. Mercantile Culture and Art in the Netherlands

253. Econometric Methods

259S. State and Local Public Finance

263. Environmental Economics: Quantitative Methods and Applications

269. Microeconomic Analysis

273. Economics of Organization and Management

281. Corporate Finance

283. Agency and Accounting

293S. Russian Economic History

294S. Soviet Economy in Transition

299. Distributive Justice and the Social Sciences

308. Quantitative Analysis II

321. Theory of Quantitative Economic Policy

324. Economics of the Law

325. Economics of the Law

363. Economics of Natural Resource Damage Assessment

372. Advanced Theory of Environmental and Natural Resource Economics

373. Topics in Environmental and Natural Resource Economics

401. Seminar on the British Commonwealth

402. Interdisciplinary Seminar in the History of the Social Sciences

Education Policy Research

The goal of this interdisciplinary program is to train doctoral students who are already enrolled in a behavioral science discipline at Duke University to conduct research on complex problems in education policy. Problems such as student accountability systems,

minority achievement gaps, teacher labor market distribution, and incentives in education require multiple disciplinary perspectives to solve. Faculty in the fields of economics, sociology, psychology, political science, history, and social work have collaborated to address such problems. Doctoral students are trained to: 1) understand the methods, theories, and body of knowledge from other disciplines; 2) understand the unique contribution that one's own discipline can make to solving complex problems; 3) work in multi-disciplinary teams to conduct research; and 4) write for diverse audiences that include scholars in other disciplines and policymakers.

Program requirements include attendance at a weekly seminar that includes faculty from diverse disciplines; a summer research assistantship with a faculty mentor from outside of one's own discipline; course work that broadens the student's perspective on problems in education policy; and a dissertation in the area. This program is designed for doctoral students who intend to pursue an academic career conducting research on problems related to education.

Program eligibility is restricted to students who have already completed at least two years of a doctoral program in a behavioral science at Duke University.

Engineering (EGR)

Kristina M. Johnson, Ph.D., Dean (305 Teer Engineering Library Building); Tod A. Laursen, Ph.D., Senior Associate Dean for Education (305 Teer Engineering Library Building); Linda P. Franzoni, Associate Dean for Student Affairs (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, 15 units of course work beyond the master's degree are required in core courses, and 21 in related areas; 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.pratt.duke.edu>.

Biomedical Engineering (BME)

Professor Truskey, Chair; Professor Myers, Director of Graduate Studies; Professors Barr, R. Clark, Dewhurst, Floyd, Friedman, Hochmuth, Jaszczak, Johnson, Katz, Needham, Nicoletis, Nolte, Reichert, S. Smith, Trahey, von Ramm, and Zalutsky; Associate Professors Burdick, Chilkoti, Collins, Dobbins, Gauthier, Guilak, Henriquez, Izatt, Krassowska, Laursen, Lobach, MacFall, Setton, Tornai, Wolf, and Yuan; Assistant Professors Bursac, Hsu, Nightingale, Niklason, Samei, Song, and Wax; Professors Emeriti H. Clark, Hammond, McElhaney, Plonsey, and Strohbehn; Assistant Research Professors Klitzman and Lo

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. 3 units; 4 units with laboratory. Instructor: Barr, Bursac, Fellous, Henriquez, or Krassowska. Variable credit.

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. Prerequisites: Biomedical Engineering 101L and 153L or equivalents. Instructor: Wolf. 3 units.

206. Elasticity. Linear elasticity will be emphasized including concepts of stress and strain as second order tensors, equilibrium at the boundary and within the body, and compatibility of strains. Generalized solutions to two and three dimensional problems will be derived and applied to classical problems including torsion of noncircular sections, bending of curved beams, stress concentrations and contact problems. Applications of elasticity solutions to contemporary problem in civil and biomedical engineering will be discussed. Prerequisites: Undergraduate partial differential equations or equivalent math course, Introductory Mechanics of Solids. Instructor: Myers. 3 units. C-L: Civil Engineering 206

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: Friedman, Katz, Truskey, or Yuan. 3 units. C-L: Civil Engineering 207, Mechanical Engineering and Materials Science 207

208. Theoretical and Applied Polymer Science. 3 units. C-L: see Mechanical Engineering and Materials Science 211

210. Molecular Basis of Membrane Transport. Transport of substances through cell membranes examined on a molecular level, with applications of physiology, drug delivery, artificial organs and tissue engineering. Topics include organization of the cell membrane, membrane permeability and transport, active transport and control of transport processes. Assignments based on computer simulations, with emphasis on quantitative behavior and design. Prerequisites: Biology 25L or equivalent, Mathematics 107 or equivalent. Instructors: Friedman or Krassowska. 3 units.

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 Mechanical Engineering 83L or consent of instructor. Instructor: Reichert. 3 units. C-L: Mechanical Engineering and Materials Science 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 or Yuan. 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. Prerequisites: Mathematics 107 or 111 and Physics 62L. 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.

230. Tissue Biomechanics. Introduction to the mechanical behaviors of biological solids and fluids with application to tissues, cells and molecules of the musculoskeletal and cardiovascular systems. Topics to be covered include static force analysis and optimization theory, biomechanics of linearly elastic solids and fluids, anisotropic behaviors of bone and fibrous tissues, blood vessel mechanics, cell mechanics and behaviors of single molecules. Emphasis will be placed on modeling stress-strain relations in these tissues, and experimental devices used to measure stress and strain. Student seminars on topics in applied biomechanics will be included. Prerequisites: Biomedical Engineering 110L or Engineering 75L or equivalent. Instructor: Myers or Setton. 3 units.

231. Intermediate Biomechanics. Introduction to solid and orthopaedic biomechanical analyses of complex tissues and structures. Topics to be covered include: spine biomechanics, elastic modeling of bone, linear and quasi-linear viscoelastic properties of soft tissue (for example, tendon and ligament), and active tissue responses (for example, muscle). Emphasis will be placed on experimental techniques used to evaluate these tissues. Student seminars on topics in applied biomechanics will be included. Prerequisites: Biomedical Engineering 110L or Engineering 75L or equivalent. Instructor: Myers or Setton. 3 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: Smith or 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. Prerequisites: Mathematics 107 or 111 and Physics 62L or equivalents. Instructor: Collins or Trahey. 3 units. C-L: Electrical and Computer Engineering 284

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. Prerequisites: 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: Staff. 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: Staff. 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 107 or 111 or equivalent, or consent of instructor. Instructor: Henriquez. 3 units.

248. Tissue Engineering. This course will serve as an overview of selected topics and problems in the emerging field of tissue engineering. General topics include cell sourcing and maintenance of differentiated state, culture scaffolds, cell-biomaterials interactions, bioreactor design, and surgical implantation considerations. Specific tissue types to be reviewed include cartilage, skin equivalents, blood vessels, myocardium and heart valves, and bioartificial livers. Consent of instructor required. Instructor: Bursac or Niklason. 3 units.

251. Seminars in Medical Physics. Medical physics is the application of the concepts and methods of physics and engineering to the diagnosis and treatment of human disease. This course consists of weekly lectures covering broad topics in medical physics including diagnostic imaging, radiation oncology, radiation safety, and nuclear medicine. Lectures will be given by invited speakers drawn from many university and medical center departments including BME, radiology, physics, radiation safety, and radiation oncology. Prerequisites: background in engineering or physics. 1 CC (0.5 ES/0.5 ED). Instructors: Lo and Samei. 1 unit.

260. Devices for People with Disabilities. 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 assistive technologies, patent issues, engineering ethics. Oral and written reports will be required. Selected projects may be continued as independent study. Prerequisite: Biomedical Engineering 154L or equivalent, or consent of instructor. Instructor: Bohs or Goldberg. 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 154L or equivalent or senior standing. Instructor: Malkin, 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. 3 units.

265L. Advanced Topics with Lab. To be used as a "generic" course number for any advanced topics course with lab sections. Instructor: Staff. 1 unit.

270. Introduction to Biomedical Optics. This introductory class examines the basic theory of laser light interaction with tissue, and the diagnostic and therapeutic uses of lasers in medicine. The class is divided into three parts: (I) Tissue Optics; (II) Laser-Tissue Interactions; and (III) Medical Applications of Lasers. Prerequisites: Biomedical Engineering 170, or consent of instructor. Instructor: Staff. 3 units.

For Graduates

301. Biological Engineering Seminar Series (CBIMMS and CBTE). 1 unit. C-L: see Mechanical Engineering and Materials Science 301

302. Biological Engineering Seminar Series (CBIMMS and CBTE). 1 unit. C-L: see Mechanical Engineering and Materials Science 302

311. BME Graduate Seminars. Two semester, weekly seminars series required of all BME graduate students. Students are exposed to the breadth of research topics in BME via seminars given by BME faculty, advanced graduate students, and invited speakers. At the end of each semester students are required to write a synopsis of the seminars attended. More than three unexcused absences will result in a failing grade. Instructor: Staff. 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.

321. Advanced Ultrasonic Imaging. This course provides students with a mathematical basis of ultrasonic imaging methods. Topics include K-space, descriptions of ultrasonic imaging, ultrasonic beam-former design, tissue motion and blood flow imaging methods, and novel ultrasonic imaging methods. Students conduct extensive simulations of ultrasonic imaging methods. Prerequisite: BME 233. Instructor: Trahey. 3 units.

329. Continuum Biomechanics. Introduction to conservation laws and thermodynamic principles of continuum mechanics with application to tissues of the musculoskeletal and cardiovascular systems. Topics cover nonlinear and anisotropic behaviors of solids and fluids. Emphasis on the application of hyperelastic constitutive formulations to determination of stress and strain fields in 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. Prerequisites: Biomedical Engineering 110L or Engineering 75L or equivalent, and Mathematics 111 or equivalent. Instructor: Setton. 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.

334. Radiology in Practice. Designed to complement BME 233 Modern Diagnostic Imaging Systems. Review and real-life exercises on principles of modern medical imaging systems with emphasis on the engineering aspects of image acquisition, reconstruction and visualization, observations of imaging procedures in near clinical settings, and hands-on experience with the instruments. Modalities covered include ultrasound, CT, MRI, nuclear medicine and optical imaging. Prerequisite: BME 233 or equivalent. Instructor: Hsu or Trahey. 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 inviscid 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.

360. Leading Medical Devices: Innovation to Market. Interdisciplinary examination of the medical device landscape for business, engineering, and medicine. Provides core tools for individuals interested in product design and development. Includes market definition and modeling, financing, reimbursement, business plan modeling, and the global marketplace. Case-based and team-based learning including developing a business plan and 510K approval will augment core instruction and guest lecturers. Consent of instructor required. Instructor: Chopra. 3 units.

365. Advanced Topics for Graduate Students 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. 3 units.

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. Variable credit.

COURSES CURRENTLY UNSCHEDULED

202. Biomedical Transfer Processes

209. Kinetics and Reactor Design

223. Cellular and Integrative Cardiovascular Physiology and Biophysics

232L. Biomedical Instrumentation

244. Mathematical Models of Physiological Systems

250. Cardiovascular Mechanics

Civil and Environmental Engineering (CE)

Professor Avissar, Chair (121 Engineering); Associate Professor Kabala, Director of Graduate Studies; Professors Barros, Haff, Katul, Laursen, Malin, Medina, Petroski, and Virgin; Associate Professors Albertson, Boadu, Gavin, Hueckel, Kasibhatla, Peirce, and Porporato; Assistant Professors Dolbow, Khlystov, Linden, Nadeau, and Schuler; Assistant Research Professors Ormeci and Sharpless; Professor Emeriti Wilson

The Department of Civil and Environmental Engineering (CEE) at Duke University offers programs of study and research leading to the M.S. and Ph.D. degrees with a major in Civil and Environmental Engineering. Students may specialize in one of the following tracks: (1) materials, structures and geo-systems; (2) hydrology and environmental fluid dynamics; and (3) pollution and remediation.

Current research in these areas focuses on: new computational paradigms for complex mechanical systems, including contact, fracture and damage problems; environmental geomechanics and geophysics; adaptive materials and structures and their use in structural dynamics; microstructured materials; deterministic and stochastic water resources and contaminant hydrology; global and regional water cycle; ocean-land-atmosphere interactions; biological and chemical aspects of pollution and its remediation in water, air and soil.

Additionally, students may explore interdisciplinary research topics within a new strategic initiative undertaken by CEE in the area of "Extreme Environments." Research in this field will ensure a safer response of the environment and structures to various extreme conditions, occurring spontaneously, incidentally or by design. The Department also supports two new multi-disciplinary research thrusts in (1) instrument and sensor technology applied to measurements in and monitoring of environmental, structural and geo-environmental systems and (2) mathematical and experimental simulators, all broadly related to the natural and engineered environments. With the latter initiatives the Department plans to lead the profession in developing a new physical models aimed at simulating the chemical, biological, physical, and mechanical aspects of the environment and structures. That includes scaling laws to extrapolate processes from the model scale to the local, regional and global scales, or from the micro-structural to macro-structural scale. These new physical models will also provide a means of studying the fundamental processes necessary to develop self-sustained environmental systems to be used for long-term space exploration missions.

200. Engineering Data Analysis. Introduction to the statistical error analysis of imprecise data and the estimation of physical parameters from data with uncertainty. Interpolation and filtering. Data and parameter covariance. Emphasis on time series analysis in the time- and frequency-domains. Linear and nonlinear least squares. Confidence intervals and belts. Hypothesis testing. Introduction to parameter estimation in linear and nonlinear dynamic systems. Prerequisite: graduate standing or instructor consent. Instructors: Gavin or Boadu. 3 units.

201. Continuum Mechanics. 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. Instructors: Hueckel, Laursen, or Nadeau. 3 units.

202. Applied Mathematics for Engineers. Advanced analytical methods of applied mathematics useful in solving a wide spectrum of engineering problems. Applications of linear algebra, calculus of variations, the Frobenius method, ordinary differential equations, partial differential equations, and boundary value problems. Prerequisites: Math 108 or

equivalent and undergraduate courses in solid and/or fluid mechanics. Instructor: Staff. 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. Prerequisites: Engineering 75L or 135 and Mathematics 108 and 111. Instructor: Staff. 3 units. C-L: Mechanical Engineering and Materials Science 204

205. Mechanics of Composite Materials. Theory and application of effective medium, or homogenization, theories to predict macroscopic properties of composite materials based on microstructural characterizations. Effective elasticity, thermal expansion, moisture swelling, and transport properties, among others, are presented along with associated bounds such as Voigt/Reuss and Hashin-Shtrikman. Specific theories include Eshelby, Mori-Tanaka, Kuster-Toksoz, self-consistent, generalized self-consistent, differential method, and composite sphere and cylinder assemblages. Tensor-to-matrix mappings, orientational averaging, and texture analysis. Composite laminated plates, environmentally induced stresses, and failure theories. Prerequisite: Civil Engineering 201 or consent of instructor. Instructor: Nadeau. 3 units.

206. Elasticity. 3 units. C-L: see Biomedical Engineering 206

207. Transport Phenomena in Biological Systems. 3 units. C-L: see Biomedical Engineering 207; also C-L: Mechanical Engineering and Materials Science 207

208. Environmental Transport Phenomena. Conservation principles in the atmosphere and bodies of water, fundamental equations for transport in the atmosphere and bodies of water, scaling principles, simplification, turbulence, turbulent transport, Lagrangian transport, applications to transport of particles from volcanoes and stacks, case studies: volcanic eruption, Chernobyl accident, forest fires and Toms River power plant emission. Instructor: Avissar. 3 units.

210. Intermediate Dynamics. 3 units. C-L: see Mechanical Engineering and Materials Science 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, distortion), 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 107 or 111 or consent of instructor. Instructor: Franzoni. 3 units. C-L: Mechanical Engineering and Materials Science 234

212. Fracture Mechanics. Theoretical concepts concerning the fracture and failure of brittle and ductile materials. Orowan and Griffith approaches to strength. Determination of stress intensity factors using compliance method, weight function method, and numerical methods with conservation laws. Cohesive zone models, fracture toughness, crack growth stability, and plasticity. Prerequisites: CE 201 or instructor consent. Instructor: Dolbow. 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.

238. Environmental Geomechanics. The course addresses engineered and natural situations, where mechanical and hydraulic properties of soils and rocks depend on environmental (thermal chemical, biological) processes. Experimental findings are reviewed, and modeling of coupled thermo-mechanical, chemo-mechanical technologies are reviewed. Instructor: Hueckel. 3 units.

240. Chemical Fate of Organic Compounds. 3 units. C-L: see Environment 240

241. Physical and Chemical Treatment Processes In Environmental Engineering. Theory and design of fundamental and alternative physical and chemical treatment processes for pollution remediation. Reactor kinetics and hydraulics, gas transfer, adsorption, sedimentation, precipitation, coagulation/flocculation, chemical oxidation, disinfection. Prerequisites: introductory environmental engineering, chemistry, graduate standing, or permission of instructor. Instructor: Linden. 3 units.

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. Biological Processes in Environmental Engineering. Biological processes as they relate to environmental systems, including wastewater treatment and bioremediation. Concepts of microbiology, chemical engineering, stoichiometry, and kinetics of complex microbial metabolism, and process analyses. Specific processes discussed include carbon oxidation, nitrification/denitrification, phosphorus removal, methane production, and fermentation. Consent of instructor required. Instructor: Schuler. 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. Prerequisites: 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: Staff. 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: Staff. 3 units. C-L: 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. Engineering Analysis and Computational Mechanics. 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: Dolbow and Laursen. 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: Mechanical Engineering and Materials Science 252

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. Prerequisites: a working knowledge of ordinary and partial differential equations, numerical methods, and programming in FORTRAN. Instructor: Dolbow and 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.

256. Computational Methods for Evolving Discontinuities. Presents an overview of advanced nomenclature methods for the treatment of engineering problems such as brittle and ductile failure and solid-liquid phase transformations in pure substances. Analytical methods for arbitrary discontinuities and interfaces are reviewed, with particular attention to the derivation of jump conditions. Partition of unity and level set methods. Prerequisites: CE 254, CE 255, or instructor consent. Instructor: Dolbow. 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. Prerequisites: 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 108 and 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, or Gavin. 3 units. C-L: Electrical and Computer Engineering 263, Mechanical Engineering and Materials Science 263

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. Variable credit.

269. Fundamentals and Applications of UV Processes in Environmental Systems. Ultraviolet light based processes as they relate to treatment of contaminants in water and air. Concepts in photochemistry and photobiology, fluence determination, UV disinfection, photodegradation processes for chemical containments, advanced oxidation processes, mathematical modeling and design of UV systems. Includes laboratory exercises. Prerequisites: CE 241 or consent or instructor. Instructor: Linden. 3 units.

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 108 or 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 108 or 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 displacement, 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.

292. Structural Engineering Project Management. Apply project management tools and skills to a structural engineering design project. Implement changes in schedule, budget, and

changing client and/or regulatory climate. Work with a design team of undergraduate students. Prerequisites: not open to students who have had CE 192. Consent of instructor required. Instructor: Nadeau. 3 units.

293. Environmental Engineering Project Management. Apply project management tools and skills to an environmental engineering design project. Implement changes in schedule, budget, and changing client and/or regulatory climate. Work with a design team of undergraduate students. Consent of instructor required. Prerequisites: not open to students who have had CE 193. Instructor: Schadd. 3 units.

For Graduates

301. Graduate Colloquium. Current topics in civil and environmental engineering theory and practice. Weekly seminar series. Instructor: Albertson. 0 units.

302. Graduate Colloquium. Current topics in civil and environmental engineering theory and practice. Weekly seminar series. Instructor: Albertson. 0 units.

391. Internship. Student gains practical experience in civil and environmental engineering 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. Instructor: Staff. 1 unit.

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. Variable credit.

COURSES CURRENTLY UNSCHEDULED

209. Kinetics and Reactor Design

215. Engineering Systems Analysis

217. Transportation Systems Analysis

218. Engineering Management and Project Evaluation

220. Water Resources Systems Planning and Management

221. Engineering Systems Reliability, Safety, and Risk Assessment

222. Open Channel Flow

223. Flow Through Porous Media

226. Operational Hydrology

227. Groundwater Hydrology and Contaminant Transport

228L. Sludge Management and Disposal

231. Theory of Adaptive Structures

232. Reinforced Concrete Design

233. Prestressed Concrete Design

234. Advanced Structural Design in Metals

235. Foundation Engineering

236. Earth Structures

237. Advanced Soil Mechanics

242. Environmental Aquatic Chemistry

257. Structural Optimization

258. Analysis of Dynamic and Nonlinear Behavior of Structures

261. Stochastic Subsurface Hydrology

264. Physico-Bio-Chemical Transformations

337. Elements of Soil Dynamics

350. Advanced Engineering Analysis

Electrical and Computer Engineering (ECE)

Professor Brown, Chair; Professor Marinos, Assistant Chair; Professor Krolik, Director of Graduate Studies (2473 CIEMAS); Professors Brady, Carin, Fair, Johnson, Joines, Jokerst, Liu, Massoud, Nolte, Trivedi, and Wang; Associate Professors Board, Brooke, Chakrabarty,

Collins, Kedem, Smith, and Teitworth; Assistant Professors Cummer, George, Lebeck, Ozev, and Sorin; Professors Emeriti Casey, Owen, and Wilson; Associate Professor of the Practice Ybarra; Assistant Research Professors Huettel, Morizio, and Tantum; Adjunct Associate Professor Derby; Adjunct Assistant Professors Bollapragada, Cramer, Guenther, Gustafson, Janet, Rankin, Retana, and Richards.; Visiting Professors Kaiser and McCumber

Graduate study in the Department of Electrical and Computer Engineering (ECE) is intended to prepare students for leadership roles in academia, industry, and government that require creative technical problem solving skills. The department offers both Ph.D. and M.S. degree programs with options for study in a broad spectrum of areas within electrical and computer engineering. Research and course offerings in the department are organized into five areas of specialization: computer engineering, sensing and waves, micro/nano systems, photonics, and signal processing and communications. Detailed descriptions of course offerings, faculty research interests, and degree requirements may be found on the department's website (www.ee.duke.edu). Interdisciplinary programs are also available that connect the above areas with those in other engineering departments and computer science, the natural sciences, and the Medical School. Students in the department may also be involved in research conducted in one of Duke's Centers (e.g. the Fitzpatrick Center for Photonics and Communications). Recommended prerequisites for graduate study in electrical engineering include knowledge of basic mathematics, statistics, and physics, electrical networks, electromagnetics, and system theory. Students with non-electrical and/or computer engineering undergraduate degrees are welcome to apply but should discuss their enrollment and course requirement options with the Director of Graduate Studies. The M.S. degree program includes thesis, project, or courses-only options. A qualifying examination is required for the Ph.D. degree program and must be taken by the beginning of the third semester of enrollment. The exam is intended to assess the student's potential for success as a researcher in their chosen sub-discipline. To ensure breadth of study, Ph.D. students are required to take at least three courses in two areas outside their area of specialization. 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: Brady, Brown, or Stiff-Roberts. 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: Teitworth. 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. Semiconductor Devices for Integrated Circuits. Basic semiconductor properties (energy-band structure, effective density of states, effective masses, carrier statistics, and carrier concentrations). Electron and hole behavior in semiconductors (generation, recombination, drift, diffusion, tunneling, and basic semiconductor equations). Current-voltage, capacitance-voltage, and static and dynamic models of PN Junctions, Schottky barriers, Metal/Semiconductor Contacts, Bipolar-Junction Transistors, MOS Capacitors, MOS-Gated Diodes, and MOS Field-Effect Transistors. SPICE models and model parameters. Instructor: Massoud. 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. Prerequisites: Electrical Engineering 151L and 216. Instructor: Massoud. 3 units.

226. Optoelectronic Devices. Devices for conversion of electrons to photons and photons to electrons. Optical processes in semiconductors: absorption, spontaneous emission and stimulated emission. Light-emitting diodes (LEDs), semiconductor lasers, quantum-well emitters, photodetectors, modulators and optical fiber networks. Prerequisite: Electrical Engineering 216 or equivalent. Instructor: Stiff-Roberts. 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: P. Wang. 3 units.

243. Pattern Classification and Recognition Technology. Theory and practice of recognition technology: pattern classification, pattern recognition, automatic computer decision-making algorithms. Applications covered include medical diseases, severe weather, industrial parts, biometrics, bioinformation, animal behavior patterns, image processing, and human visual systems. Perception as an integral component of intelligent systems. This course prepares students for advanced study of data fusion, data mining, knowledge base construction, problem-solving methodologies of "intelligent agents" and the design of intelligent control systems. Prerequisites: Mathematics 104, Statistics 113 or Mathematics 135, Computer Science 6, or consent of instructor. 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 costatic 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: Staff. 3 units. C-L: Mechanical Engineering and Materials Science 232

251. Advanced Digital System Design. This course covers the fundamentals of advanced digital system design, and the use of a hardware description language, VHDL, for their synthesis and simulation. Examples of systems considered include the arithmetic/logic unit, memory, and microcontrollers. The course includes an appropriate capstone design project that incorporates engineering standards and realistic constraints in the outcome of the design process. Additionally, the designer must consider most of the following: Cost, environmental impact, manufacturability, health and safety, ethics, social and political impact. Each design project is executed by a team of 4 or 5 students who are responsible for generating a final written project report and making an appropriate presentation of their results to the class. Prerequisite: Electrical Engineering 151L and Senior/graduate student standing. Instructor: Marinos. 3 units.

- 252. Advanced Computer Architecture I.** 3 units. C-L: see Computer Science 220
- 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. Prerequisites: 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. C-L: 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. Also taught as Computer Science 226. Prerequisite: four semesters of college mathematics. Instructor: Trivedi. 3 units.
- 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. Prerequisites: 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. Instructor: Cramer. 3 units.
- 259. Advanced Computer Architecture II.** 3 units. C-L: see Computer Science 221
- 261. CMOS VLSI Design Methodologies.** Emphasis on full-custom chip design. Extensive use of CAD tools for IC design, simulation, and layout verification. Techniques for designing high-speed, low-power, and easily-testable circuits. Semester design project: Groups of four students design and simulate a simple custom IC using Mentor Graphics CAD tools. Teams and project scope are multidisciplinary; each team includes students with interests in several of the following areas: analog design, digital design, computer science, computer engineering, signal processing, biomedical engineering, electronics, photonics. A formal project proposal, a written project report, and a formal project presentation are also required. The chip design incorporates considerations such as cost, economic viability, environmental impact, ethical issues, manufacturability, and social and political impact. Prerequisites: ECE 151 and ECE 163. Some background in computer organization is helpful but not required. Instructor: Chakrabarty. 3 units.
- 262. Analog Integrated Circuit Design.** Design and layout of CMOS analog integrated circuits. Qualitative review of the theory of pn junctions, bipolar and MOS devices, and large and small signal models. Emphasis on MOS technology. Continuous time operational amplifiers. Frequency response, stability and compensation. Complex analog subsystems including phase-locked loops, A/D and D/A converters, switched capacitor simulation, layout, extraction, verification, and MATLAB modeling. Projects make extensive use of full custom VLSI CAD software. Prerequisite: Electrical Engineering 261. Instructor: Morizio. 3 units.

263. Multivariable Control. 3 units. C-L: see Civil Engineering 263; also C-L: Mechanical Engineering and Materials Science 263

264. CAD For Mixed-Signal Circuits. The course focuses on various aspects of design automation for mixed-signal circuits. Circuit simulation methods including graph-based circuit representation, automated derivation and solving of nodal equations, and DC analysis, test automation approaches including test equipments, test generation, fault simulation, and built-in-self-test, and automated circuit synthesis including architecture generation, circuit synthesis, tack generation, placement and routing are the major topics. The course will have one major project, 4-6 homework assignments, one midterm, and one final. Prerequisites: ECE 163. Permission of instructor required. Instructor: Ozev. 3 units.

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. Prerequisite: Electrical Engineering 170. Instructor: Carin, Joines, Liu, or Smith. 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, waveguides, 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. Also taught as Physics 185. 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.

277. Computational Electromagnetics. Systematic discussion of useful numerical methods in computational electromagnetics including integral equation techniques and differential equation techniques, both in the frequency and time domains. Hands-on experience with numerical techniques, including the method of moments, finite element and finite-difference time-domain methods, and modern high order and spectral domain methods. Prerequisite: Electrical and Computer Engineering 271 or consent of instructor. Instructor: Carin or Liu. 3 units.

278. Inverse Problems in Electromagnetics and Acoustics. Systematic discussion of practical inverse problems in electromagnetics and acoustics. Hands-on experience with numerical solution of inverse problems, both linear and nonlinear in nature. Comprehensive study includes: discrete linear and nonlinear inverse methods, origin and solution of nonuniqueness, tomography, wave-equation based linear inverse methods, and nonlinear inverse scattering methods. Assignments are project oriented using MATLAB. Prerequisites: Graduate level acoustics or electromagnetics (EE 271), or consent of instructor. Instructor: Liu. 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 Nolte. 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 or Tatum. 3 units.

283. Digital Communication Systems. Digital modulation techniques. Coding theory. Transmission over bandwidth 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: see 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 transmission, 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: 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, beamforming, 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. Prerequisites: 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. Instructor: Staff. 3 units.

For Graduates

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 resistance 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. C-L: Computer Science 320

361. Advanced VLSI Design. 3 units. C-L: see Computer Science 322

371. Advanced Electromagnetic Theory. Instructor: Staff. 3 units.

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. Variable credit.

COURSES CURRENTLY UNSCHEDULED

217. Analog Integrated Circuits

276. Laser Physics

311. Quantum Electronics

382. Advanced Topics in Signal Processing

383. Applied Information Theory and Statistical Estimation

Mechanical Engineering and Materials Science (ME)

Professor Hall, Chair (142A Engineering); Professor Virgin, Director of Graduate Studies (145 Engineering); Professors Bejan, Clark, Cocks, Dowell, Garg, Needham, Shaughnessy, and Tan; Associate Professors Bliss, Franzoni, Howle, Jones, Knight, and Marszalek; Assistant Professors Curtarolo, Ferrari, Lazarides, Protz, Zauscher, Zhelev, and Zhong; Assistant Research Professors Cole and Thomas; Senior Research Scientists Kielb; Adjunct Assistant Professors Stepp and Watkins; Professor Emeriti Harman, Hochmuth, and Pearsall

The department offers programs of study and research leading to the M.S. and Ph.D. degrees in both mechanical engineering and materials science. The department's broad areas of concentration include nonlinear dynamics and control, unsteady aerodynamics and fluid mechanics including aeroelasticity (fluid/structure interfaces), biomaterials and biomechanics, and thermal sciences and engineering. Additional areas of concentration include atomic force microscopy, biomaterials, electronic materials, material characteristics/properties and thin films.

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 of this degree and to obtain it during completion of their program. Programs of study are highly flexible to meet individual needs.

Current research areas include: aeroelasticity; atomic force microscopy; bearing design and lubrication; biorheology; cell, membrane, and surface engineering; chaotic systems; computational fluid dynamics; computational materials science; convection; diffusion and kinetics on Si, GaAs, and other electronic materials; feed-back and feed-forward control systems; fluid dynamics of biological systems; heat transfer in heterogeneous media;

magnetic bearings; mechanical properties of kidney stones; nano-tribology; oxide heterostructures; positron annihilation spectroscopy; robotics; shock-wave lithotripsy; sound propagation and absorbing materials; thermal design by entropy generation minimization; turbomachinery; ultrasound contrast enhancement; unsteady aerodynamics; and vibrations and acoustics of dynamic systems;

For additional information, visit the departmental web site at <http://www.mems.duke.edu/>.

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.

204. Plates and Shells. 3 units. C-L: Civil Engineering 204

207. Transport Phenomena in Biological Systems. 3 units. C-L: see Biomedical Engineering 207; also C-L: 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. C-L: Civil Engineering 210

211. Theoretical and Applied Polymer Science. An advanced course in materials science and engineering dealing specifically with the structure and properties of polymers. Particular attention paid to recent developments in the processing and use of modern plastics and fibers. Product design considered in terms of polymer structures, processing techniques, and properties. Instructor: Zauscher. 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: Mechanical 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. Prerequisites: Mechanical Engineering 83L and 101L. Instructor: Staff. 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: Mechanical Engineering 83L. Instructor: Jones. 3 units.

215. Biomedical Materials and Artificial Organs. 3 units. C-L: see 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. Prerequisites: Engineering 75L and Mechanical Engineering 83L. 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. Prerequisites: Mechanical Engineering 83L and 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: Staff. 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. 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. Prerequisites: Mathematics 107 or 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 and Computer Engineering 246

234. 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, distortion), 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 107 or 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 Kielb. 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. Prerequisites: 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: Staff. 3 units.

252. Buckling of Engineering Structures. 3 units. C-L: see Civil Engineering 252

263. Multivariable Control. 3 units. C-L: see Civil Engineering 263; also C-L: Electrical and Computer 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. 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. Prerequisites: 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: Staff. 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: Staff. 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: Staff. 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.

For Graduates

301. Biological Engineering Seminar Series (CBIMMS and CBTE). Seminar series featuring in alternate weeks invited speakers and pre-seminar discussions. Research topics in biological engineering, with emphasis on bioinspired materials and materials systems, biomolecular, and tissue engineering. Enrollment is required of all BIMMS and BTE certificate program students in their first and second year. Open to others for credit or audit. Instructor consent required. Instructors: Zauscher, Craig, and Reichert. 1 unit. C-L: Biomedical Engineering 301

302. Biological Engineering Seminar Series (CBIMMS and CBTE). Seminar series featuring in alternate weeks invited speakers and pre-seminar discussions. Research topics in biological engineering, with emphasis on bioinspired materials and materials systems, biomolecular, and tissue engineering. Enrollment is required of all BIMMS and BTE certificate program students in their first and second year. Open to others for credit or audit. Instructor consent required. Instructors: Zauscher, Craig, and Reichert. 1 unit. C-L: Biomedical Engineering 302

303. CBIMMS Adv Materials Lab. Mechanical Engineering & Materials Science. Advanced Topics: Advanced Materials Lab. This course will give a hands-on introduction to characterization and clean room based processing methods that play an important role in the fabrication and characterization of materials. Clean-room based processing methods to be covered include: basic photolithography, evaporation, electron beam lithography, and wet and dry etching. Characterization methods to be covered include: atomic force microscopy, scanning electron microscopy, transmission electron microscopy and X-Ray photoelectron spectroscopy. Credit/No Credit. Permission Required. Instructor: Walters. 3 units.

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. Variable credit.

COURSES CURRENTLY UNSCHEDULED

208. Introduction to Colloid and Surface Science

224. An Introduction to Turbulence

290. Physical Oceanography

322. Mechanics of Viscous Fluids

English (ENGLISH)

Professor Butters, Interim Chair (312 Allen); Associate Professor Somerset, Director of Graduate Studies (316 Allen); Professors Aers, Applewhite, Baker, Beckwith, Butters, Clum, Davidson, DeNeef, Ferraro, Gaines, Holloway, Pfau, Pope, Porter, Price, Smith, Strandberg, and Torgovnick; Associate Professors Aravamudan, Baucom, Harris, Jones, Khanna, Moses, Psomiades, Shannon, Somerset, Tetel, Wald, and Wallace; Associate Professor of the Practice Malouf; Assistant Professors Cohen and Mitchell; Adjunct Professors Andrews and O’Barr; Senior Lecturing Fellow Gopen; Lecturing Fellow Hillard; Lecturer Metzger

The department only admits students seeking a Ph.D. (though see below on J.D./M.A.). The Ph.D. in English requires completion of a minimum of eleven courses, a reading proficiency in 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. A J.D./M.A. degree is offered by the department in cooperation with the Law School. J.D./M.A. students must apply for admission to the Law School, and must combine relevant course work in English with full-time work toward a law degree.

Particular faculty interests currently cutting across the chronological and geographical categorizations of literature include examples such as the cultural work of memory; orientalism; mourning, history and reconciliation; literatures and discourses of the Atlantic; diasporic literatures; religion; and science and technology. Students are encouraged to read broadly in English and American literatures (including four-nations British literature, English and America in the Black Atlantic, the Irish Atlantic and other Atlanticist literatures, Anglo-diasporic literatures, and postcolonial literatures). They are also encouraged to interrogate the constitution and writing of literary and cultural history, and to develop the specific range of linguistic, philosophical, and historical skills relevant to their chosen field and their chosen intervention therein.

For additional information, visit our web site at <http://www.duke.edu/web/english/graduate/index.htm>.

For Seniors and Graduates

201S. Writing Poetry: Formal and Dramatic Approaches. A workshop comparing meter, stanza, and rhyme with free verse, to illuminate the freedom and form of all poetry. Narrative and conceptual content considered within the poem’s emotive, musical dynamic. Group discussion of technique, personal aesthetic and creative process; revisions of poems. Consent of instructor required. Instructor: Applewhite, Pope. 3 units.

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.

204S. Psycholinguistics. 3 units. C-L: see Psychology 220S

205. Semiotics and Linguistics. 3 units. C-L: see Russian 205; also C-L: Linguistics 205

207A. Introduction to Old English. An introduction to the language of the Anglo-Saxon period (700-1100), with readings in representative prose and poetry. Not open to students who have taken 113A or the equivalent. Instructor: Somerset. 3 units.

212S. Middle English Literature: 1100 to 1500. Selected topics. Instructor: Aers, Beckwith, or Somerset. 3 units. C-L: Medieval and Renaissance Studies 209S

213S. Chaucer and His Contexts. The first two-thirds of his career, especially *Troilus and Criseyde*. Instructor: Aers, Beckwith, or Somerset. 3 units. C-L: Medieval and Renaissance Studies 213S

220S. Shakespeare: Selected Topics. Instructor: Porter or Shannon. 3 units. C-L: Medieval and Renaissance Studies 220S

221S. Renaissance Prose and Poetry: 1500 to 1660. Selected topics. Instructor: DeNeef, Quilligan, or Shannon. 3 units. C-L: Medieval and Renaissance Studies 221BS

235. Restoration and Eighteenth-Century Literature: 1660 to 1800. Selected topics. Instructor: Aravamudan or Mitchell. 3 units.

235S. Restoration and Eighteenth-Century Literature: 1660 to 1800. Seminar version of English 235. Instructor: Staff. 3 units.

241S. Romantic Literature: 1790 to 1830. Selected topics. Instructor: Applewhite or Pfau. 3 units.

245. Victorian Literature: 1830 to 1900. Selected topics. Instructor: Psomiades. 3 units.

245S. Victorian Literature: 1830 to 1900. Seminar version of English 245. Instructor: Staff. 3 units.

250S. Music in Literature and Philosophy: 1800-1945. 3 units. C-L: see German 280S

251. British Literature since 1900. Selected topics. Instructor: Baucom, Moses, or Torgovnick. 3 units.

262. American Literature to 1820. Selected topics. Instructor: Cohen, Davidson, Jones, or Wald. 3 units.

263. American Literature 1820 to 1865. Selected topics. Instructor: C. Davidson, or Jones. 3 units.

267. American Literature: 1865 to 1915. Selected topics. Instructor: C. Davidson, Wald or Wallace. 3 units.

269. American Women Writers. Selected topics. Instructor: C. Davidson or Pope. 3 units.

271AS. Special Topics Seminar I. Seminar version of 288. Subjects, area, or themes that cut across historical eras, several national literatures, or genres. Can be counted as a pre-1500 course for the diversified study requirement. Instructor: Staff. 3 units.

271BS. Special Topics Seminar II. Seminar version of 288. Subjects, areas or themes that cut across historical eras, several national literatures, or genres. Can be counted as a 1500-1660 course for the diversified study requirement. Instructor: Staff. 3 units.

271C. Selected Topics in Feminist Studies. Instructor: Staff. 3 units.

271CS. Special Topics Seminar III. Seminar version of 288. Subjects, areas or themes that cut across historical eras, several national literatures, or genres. Can be counted as a 1660-1860 course for the diversified study requirement. Instructor: Staff. 3 units.

271ES. Special Topics Seminar IV. Seminar version of 288. Subjects, areas or themes that cut across historical eras, several national literatures, or genres. Can be counted as a 1860-Present course for the diversified study requirement. Instructor: Staff. 3 units.

- 271FS. Special Topics Seminar in Criticism, Theory, or Methodology.** Seminar version of 288. Instructor: Staff. 3 units.
- 272S. Remembrance and Reconciliation: Geographies of Memory.** Exploration, drawing on a variety of texts, of the complex dynamics of remembering and forgetting as they bear on difficult pasts and the possibility for reconciliation. Particular attention given to racial reconciliation in South Africa and the United States. Consent of instructor required. Also taught as Christian Theology 270 and Distinguished Professor Course 202S. Instructors: Holloway and Jones. 3 units.
- 275. American Literature since 1915.** Selected topics. Instructor: Baker, Ferraro, Pope, Strandberg, or Torgovnick. 3 units.
- 280. Twentieth-Century Reconceptions of Knowledge and Science.** 3 units. C-L: see 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.
- 284. Contemporary Film Theory.** Post-1968 film theory—Brechtian aesthetics, cinema semiotics, psychoanalytic film theory, technology, feminist theory, and Third World cinema. Instructor: Gaines. 3 units.
- 288A. Special Topics I.** Subjects, areas, or themes that cut across historical eras, several national literatures, or genres. Can be counted as a pre-1500 course for the diversified study requirement. Instructor: Staff. 3 units.
- 288B. Special Topics II.** Subjects, areas or themes that cut across historical eras, several national literatures, or genres. Can be counted as a 1500-1660 course for the diversified study requirement. Instructor: Staff. 3 units.
- 288C. Special Topics III.** Subjects, areas or themes that cut across historical eras, several national literatures, or genres. Can be counted as a 1660-1860 course for the diversified study requirement. Instructor: Staff. 3 units.
- 288E. Special Topics IV.** Subjects, areas or themes that cut across historical eras, several national literatures, or genres. Can be counted as a 1860-Present course for the diversified study requirement. Instructor: Staff. 3 units.
- 288F. Special Topics in Criticism.** Instructor: Staff. 3 units.
- 289. The Theory of the Novel.** Major issues in the history and theory of the novel. Instructor: Moses or Torgovnick. 3 units.
- 299S. Special Topics in Linguistics.** Instructor: Staff. 3 units.
- 312. Studies in Middle English Literature.** Instructor: Aers, Beckwith, or Somerset. 3 units.
- 315. Studies in Chaucer.** Instructor: Aers, Beckwith, or Somerset. 3 units.
- 321. Studies in Renaissance Literature.** Instructor: DeNeef, Porter, or Shannon. 3 units.
- 324. Studies in Shakespeare.** Instructor: Porter. 3 units.
- 329. Studies in Milton.** Instructor: DeNeef. 3 units.
- 337. Studies in Augustanism.** Instructor: Staff. 3 units.
- 338. Studies in a Major Augustan Author.** Instructor: Staff. 3 units.
- 341. Studies in Romanticism.** Instructor: Applewhite or Pfau. 3 units.
- 347. Studies in Victorianism.** Instructor: Psomiades. 3 units.
- 348. Studies in a Major Nineteenth-Century British Author.** Instructor: Pfau. 3 units.
- 353. Studies in Modern British Literature.** Instructor: Baucom, Moses, or Torgovnick. 3 units.
- 361. Studies in American Literature before 1915.** Instructor: Cohen, Holloway, or Jones. 3 units.

- 368. Studies in a Major American Author before 1915.** Instructor: Cohen, C. Davidson, Holloway, or Jones. 3 units.
- 375. Studies in Modern American Literature.** Instructor: Applewhite, Ferraro, Holloway, Strandberg, or Wald. 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.** 3 units. C-L: see Literature 300; also C-L: 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. Variable credit.

COURSES CURRENTLY UNSCHEDULED

203S. Advanced Narrative Writing

207B. Old English Literature

208. History of the English Language

209. Present-Day English

290. Methods of Composition Pedagogy

310. Studies in Old English Literature

383. Studies in Textual Criticism

393. Professionalism, Theory, and Power in Legal and Literary Studies

Environment (ENVIRON)

William Schlesinger, Dean; Professor Knoerr, Director of Graduate Studies (A309A Levine Science Research Center); Professors Barber, C. Bonaventura, Christensen, Clark, Corliss, Crowder, DiGiulio, Forward, Healy, Hinton, Jackson, Katul, Keohane, Kramer, Lavine, Levin, Linney, Lozier, McClay, Medina, Oren, Peirce, Pimm, Reckhow, Reckhow, Reynolds, Richardson, Richter, Schlesinger, Schwartz, Terborgh, Wiener, and Wolpert; Associate Professors Albertson, Freedman, Kasibhatla, McKean, Pratson, Read, Rittschof, and Urban; Assistant Professors Campbell, Johnsen, Murray, and Smith; Professor of the Practice: Orbach; Associate Professors of the Practice: Kirby-Smith, Maguire, and Miranda; Assistant Professor of the Practice Halpin; Research Professors J. Bonaventura and Ramus; Associate Research Professor LeFurgey; Assistant Research Professor Kullman. *Extended Faculty:* Anderson, Angle, Chao, Coates, Cooper, Craig, Hartshorn, Heppell, Holmes, Hyrenbach, Lipshultz, Lomas, McClellan-Green, Mercer, Myers, Pattanayak, Pearsall, Saterson, Smith, Snook, Sunda, Vandenberg, and Vasudevan

Major and minor work for the Environment Graduate Program is offered through the Environmental Sciences and Policy Division and the Coastal Systems Science and Policy Division of the Nicholas School of the Environment and Earth Sciences. The research emphasis of the Environmental Sciences and Policy Division is in the areas of Ecosystem Science and Management, Environmental Chemistry and Toxicology, Aquatic and Atmospheric Sciences, and Environmental Social Sciences. The research emphasis of the Coastal Systems Science and Policy Division is in Coastal and Estuarine Processes, Marine Biology and Biochemistry, and Endangered and Threatened Species and Related Policy. Information about the interdepartmental graduate program in Marine Sciences may be found under that name in this chapter. 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 Nicholas School of the Environment and Earth Sciences. For more complete program descriptions and information on professional training in forestry or environmental studies, the *Bulletin of Duke University: Nicholas School of the Environment and Earth Sciences* 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 and Earth Sciences' 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.

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: Pimm. 3 units.

204LS. Field Ecology. 4 units. C-L: see Biology 204LS

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: Doggett. 3 units.

207L. Forest Pest Management. Same as 207 with laboratory which is largely field oriented to focus on diagnostics and impact analysis. Instructor: Doggett. 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/Orbach (Beaufort) or Read. 3 units. C-L: Marine Sciences

210. 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, may be introduced. Instructor: Staff. 3 units. C-L: Statistics and Decision Sciences 240

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. Prerequisites: 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, introductory applied statistics, and Environment 351, or consent of instructor. Instructor: Urban. 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. Prerequisites: introductory statistics, calculus, and computer programming or consent of instructor. Instructor: Pimm. 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

219L. Marine Ecology. 4 units. C-L: see Biology 203L; also C-L: Marine Sciences

220. Introduction to Geographic Information Systems. Introduction to Geographic Information Systems, software and analysis methods. Based on series of self-paced modules with all content provided over the Internet. Basic structure of vector and raster geographic data and spatial analysis methods. Intended to provide self-paced alternative for students interested in gaining an overview of current software and applications. Consent of instructor required. Instructor: Halpin. 2 units.

221L. 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.

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.) Prerequisites: introductory chemistry and biology. Instructor: Staff. 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, Reynolds, and staff. 4 units. C-L: Marine Sciences

227. Biology and Conservation of Sea Turtles. Essential biology of sea turtles (evolution, anatomy, physiology, behavior, life history, population dynamics) and their conservation needs, emphasizing their role in marine ecosystem structure and function. Will integrate basic ecological concepts with related topics including conservation and management of endangered species, contributions of technology to management of migratory marine species, role of research in national and international law and policy, and veterinary aspects of conservation. (Given at Beaufort.) Prerequisite: Introductory Biology. Instructors: S. Eckert, K. Eckert. 3 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. Instructor: K. Eckert, S. Eckert, and Crowder. 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.) Prerequisites: 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.) Prerequisites: Biology 25L; and Chemistry 11L, 12L. Instructor: McClellan-Green (spring); Rittschof (fall and summer). 6 units. C-L: Biology 255L, Marine Sciences

231L. Models for Environmental Data. 3 units. C-L: see Biology 268L

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: Reckhow. 3 units.

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

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. Instructor: Staff. 3 units. C-L: Civil Engineering 240

241. Statistical Analysis of Ecological Data. Methods of statistical analysis, including experimental design, ANOVA, regression, longitudinal data, intervention studies, survival analysis. Lectures supplemented by student projects that involve application of techniques to data. Prerequisite: 1 year of undergraduate statistics. Instructors: Clark and Lavine. 3 units. C-L: Biology 266, Statistics and Decision Sciences 232

243. Environmental Biochemistry. 3 units. C-L: see Cell Biology 243

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: Thomann. 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: Thomann. 3 units.

248. Solid Waste Engineering. 3 units. C-L: see Civil Engineering 248

252. Sustainability and Renewable Resource Economics. Economic theories of sustainability, contrasted with other scientific views. Focus on renewable resource economics, modeling, and management. Prerequisite: Environment 270. Instructor: Smith. 3 units.

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: introductory biology and chemistry. Instructors: Forward and Rittschof. 4 units. C-L: Marine Sciences

254. Qualitative Research Design in Marine Studies. Examination of the concept of research (philosophy, epistemology, practice) along with methods used widely in the social sciences. Focus is on qualitative methods, and related research ethics, objectives, design, data collection, analysis, and presentation. Consideration of utility of qualitative methods for understanding activities and policy in the marine and coastal environment. (Given at Beaufort.) Instructor: Campbell. 3 units. 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

259. Fundamentals of Geographic Information Systems and Geospatial Analysis. Fundamental aspects of geographic information systems and satellite remote sensing for environmental applications. Covers concepts of geographic data development, cartography, image processing, and spatial analysis. Gateway into more advanced training in geospatial analysis curriculum. Consent of instructor required. Instructor: Halpin. 4 units.

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.

261. Geospatial Analysis for Conservation Management. Application course focusing on spatial analysis and image processing applications to support conservation management. Habitat mapping, spatial analysis of animal movements, habitat modeling, and the optimization of nature reserve selection. Requires a fundamental knowledge of geospatial analysis theory and analysis tools. Consent of instructor required. Prerequisite: Environment 259. Instructor: Halpin. 4 units.

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.

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.

265. Geospatial Analysis for Coastal and Marine Management. Application course focusing on spatial analysis and image processing applications to support coastal and marine management. Covers benthic habitat mapping, spatial analysis of marine animal movements, habitat modeling, optimization of marine protected areas. Requires fundamental knowledge of geospatial analysis theory and analysis tools. Consent of instructor required. Prerequisite: Environment 259. Instructor: Halpin. 4 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.

267S. Conservation Biology of Marine Mammals. Examination of issues affecting the conservation of marine mammal populations, including: habitat loss and degradation, interactions with commercial fisheries, and direct harvests. Consent of instructor required. (Given at Beaufort.) Instructor: Read. 2 units. C-L: Marine Sciences

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: Benbear. 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: Kramer. 3 units. C-L: Economics 272

272. Evaluation of Public Expenditures. 3 units. C-L: see Public Policy Studies 261; also C-L: 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: Public Policy Studies 297, Political Science 264, Marine Sciences

277. Professional Ethics for Environmental Practitioners. Give students training and experience in applying moral reasoning to the types of ethical problems likely to be encountered by environmental practitioners. Instructor: Maguire. 1 unit.

279. Introduction to Atmospheric Chemistry. A broad overview of the science of oxidant chemistry in the atmosphere. Basic physical and chemical concepts relevant to the understanding of atmospheric chemistry; several contemporary topics 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. Prerequisites: one college-level course each in chemistry and calculus. Instructor: Kasibhatla. 3 units. C-L: Civil Engineering 279

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.

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. Half or one course for undergraduates. 1 to 3 units for graduate students. 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

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. Instructors: Ramus or staff (Beaufort); Lomas (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

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, 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, spring, and summer or at Bermuda, spring.) Prerequisite: Biology 25L. Instructors: Dimock (Beaufort) or Kirby-Smith (Beaufort); de Putron and Wood (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, science-intensive disputes, and negotiation analysis. In-class time will be spent conducting negotiation role plays of increasing complexity and then debriefing them. Outside of class, students will prepare for the role plays and read background material to aid in debriefing. Students will keep a journal of their experiences. Instructor: Maguire. 2 units.

298. Special Topics. Content to be determined each semester. May be repeated. Instructor: Staff. Variable credit. C-L: Marine Sciences

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. Variable credit. C-L: Marine Sciences

303. Principles of Ecological Modeling. 3 units. C-L: see Biology 303.

309. Wetland Restoration Ecology. Restoration of wetlands requires understanding of wetland hydrology, biogeochemical processes, decomposition, community habitat requirements and soil processes. Factors are discussed in an ecosystem context along with current restoration techniques. Course utilizes newly constructed wetlands in Duke Forest to explore wetland restoration principles. Students teamed together to develop restoration plan for a restored wetland. Final report and oral presentation required. Instructor: Richardson. 3 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 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 and Cancer Biology 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. Prerequisites: Pharmacology 233 and 347. Instructor: Levin. 1 unit. C-L: Pharmacology and Cancer Biology 315

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. Prerequisites: one course in biochemistry and one course in toxicology. Instructors: Di Giulio and Freedman. 3 units.

320. Ecosystem Management. Principles of environmental management in the context of arbitrary temporal and spatial boundaries, complexity, dynamic processes, uncertainty and varied and changing human values. Topics to include adaptive management, decision making in the content of uncertainty, conflict resolution, strategic planning, evaluation and accountability. Case studies will cover terrestrial, aquatic and marine ecosystems and an array of social and institutional settings. Instructor: Christensen. 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.

322. Coastal Watershed and Policy. Examine hydrology of coastal watersheds and how watersheds modifications impact estuaries and near shore coastal ecosystems. Hydrologic functioning of natural unaltered watersheds is contrasted with changes caused by man's modification of those systems. Include discussion of efforts to remedy impacts through installation of Best Management Practices and wetlands restoration. Emphasis on gaining understanding of what the impacts of hydrologic change are on biology of coastal waters as watershed development alters the physics, chemistry, and geology of coastal waters. Includes field trips to watersheds in coastal NC. Instructor: Kirby-Smith. 3 units. C-L: Marine Sciences

324. Marine Conservation Biology. Focus on the ecological effects of fishing, the major threat to marine biodiversity, by examining selected case studies, discussing conservation strategies, and learning how science and policy can be integrated to solve real-world problems. We will use the recent report of the Pew Oceans Commission as the starting point of our discussion. (Taught at Beaufort). Instructor: Read. 3 units. C-L: Marine Sciences

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.

355. International Environmental Law. This seminar will focus on the process of international law as it relates to the environment, and on the implications for international law generally that follow from the legal political advances of environmental lawmaking. The seminar will examine samples of the environmental issues that have provoked international lawmaking regarding freshwater oceans, the atmosphere, and biodiversity (including endangered species and habitats). Attention will be paid to the interplay of international law including human rights, law of war and international trade law. Instructor: Salzman. 2 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.

359. Advanced Geospatial Analysis. Provide training in more advanced skills such as: GIS database programming, modeling applications, spatial decision support systems and Internet map server technologies. The course requires a fundamental knowledge of geospatial analysis theory, analysis tools, and applications. Consent of instructor required. Prerequisites: Environment 259 and Environment 282 or 286. Instructor: Halpin. 3 units.

360S. Political Ecology. Seminar to examine concept of political ecology as means of conceptualizing conservation and development conflicts and solutions. Intended to engage students with political ecology to strengthen usefulness, enrich possibilities, and improve participants ongoing research, collaborations and critical inquiries. Enrollment limited to graduate students. Taught at Beaufort. Instructor: Campbell. 3 units.

379. Natural Resource Economics. Addresses questions about natural resource scarcity using modern capital theory and optimal control theory to derive core results. Two

objectives: provide students with a solid foundation in theory of natural resource economics, emphasizing tools and theoretical breadth to enhance research and teaching. Second objective to highlight contemporary themes in theoretical and empirical resource economics. Designed for PhD students in economics, finance, agriculture and resource economics, or public policy (with economics concentration). Prerequisites: one year PhD-level microeconomic theory and econometrics; review of differential equations recommended. Consent of instructor required. Instructor: Smith. 3 units. C-L: Economics 379

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.

398. Program Area Symposium. Required symposium in each program area. Students present master's project research. Pass/fail grading only. Instructor: Staff. 1 unit. C-L: Marine Sciences

399. Master's Project. An applied study of a forestry or environmental management problem or a theoretical research effort. A seminar presentation of the objectives, methodology, and preliminary findings is required. A written (or other medium) report at the conclusion of the project is also required. Undertaken with the guidance of the student's adviser. Consent of instructor required. Pass/fail grading only. Instructor: Staff. Variable credit. C-L: Marine Sciences

405. Environmental Communication for Behavior Change - Online Course. Course provides environmental professionals with a practical introduction to the strategies, methods, and tools of environmental communication that effectively lead to changes in behavior. Emphasis on practical, field-based tools. Intensive online course. Consent of instructor required. Instructor: Day. 1 unit.

463. Program Management for Environmental Professionals. In the private and public sectors, as well as not-for-profit organizations, managerial effectiveness is central to environmental leadership. This course will focus on the development of management skills including decision-making, motivation, working in teams, organizational cultures, organizational design, learning organizations and change management. For DEL-MEM students only. Consent of instructor required. Instructor: Christensen. 3 units.

470. A Landscape Perspective on Environmental Management. Environmental management is pursued at increasingly larger spatial scales. As a direct consequence, we encounter more spatial heterogeneity and logistical constraints on empirical approaches. The field of landscape ecology specifically addresses issues of spatial scale and heterogeneity as these influence our ecological understanding and management of natural and seminatural systems. This course is an applications-driven survey of common tasks in landscape management, including inventory and monitoring programs and prioritizing sites according to various criteria (e.g., diversity hotspots, environmental impacts). Specific applications emphasize ecosystem processes (productivity, hydrology) and conservation planning at large scales. To address the uncertainty that naturally attends these applications, the course is developed in the framework of adaptive management. For DEL-MEM students only. Consent of instructor required. Instructor: Urban. 3 units.

COURSES CURRENTLY UNSCHEDULED

202. Microbial Ecology

218L. Barrier Island Ecology

222L. Physical Processes in Coastal Environments

223L. Behavioral Ecology

224L. Coastal Ecosystem Processes

230L. Weather and Climate

231. Ecological Models and Data

- 232. Microclimatology
- 242. Environmental Aquatic Chemistry
- 244L. Molecular and Cellular Processes in Marine Organisms
- 245. Ecology of Microorganisms
- 252L. Statistics and Data Analysis in Earth and Ocean Science
- 257. Environmental Experimental Design
- 263. Environmental Economics: Quantitative Methods and Applications
- 268. Advanced Topics in Nearshore Processes
- 290. Physical Oceanography
- 291. Geological Oceanography
- 294. Water Quality Skills
- 303. Principles of Ecological Modeling
- 316. Case Studies in Environmental and Forest Management
- 330L. Environmental Monitoring and Instrumentation
- 335. Water Quality Modeling
- 340. Biohazard Science
- 341L. Methods in Biohazard Science
- 342. Bioaerosols
- 343. Hazard Management, Law, and Ethics
- 363. Economics of Natural Resource Damage Assessment
- 372. Advanced Theory of Environmental and Natural Resource Economics
- 373. Topics in Environmental and Natural Resource Economics
- 389. Seminar in Conservation and Environmental History

Genetics

See "University Program in Genetics" (immediately below), and also "Molecular Genetics and Microbiology"

The University Program in Genetics and Genomics (UPG)

The Duke University Program in Genetics and Genomics is an umbrella graduate training program that spans several basic science and clinical departments and bridges the medical center and the college of arts and sciences. There are currently 79 faculty and 80 students in the program, which was founded in 1967 and has been continuously supported by a training grant from the NIH for the past 25 years. Over the past several decades, the program has served as an important forum for training and education in genetics, including model systems (bacteria, yeast, fungi, drosophila, zebrafish, mouse), population genetics, and human genetics. We hope to also forge a close link between the program and the emerging Institute of Genome Sciences and Policy (IGSP) at Duke.

The Duke UPGG program is unique in that it is degree granting. Thus students can either receive their degree via the University Program in Genetics and Genomics, or via their host department that students affiliate with upon joining a laboratory for graduate training. The requirements for the two are different, since students who choose to earn their degree from the host department satisfy both UPGG and departmental requirements. In many cases, the requirements for the UPGG program satisfy the departmental requirements.

The relationship between the University Program in Genetics and Genomics and the Department of Genetics is evolving as a consequence of the merger of the Departments of Genetics and Microbiology to form the Department of Molecular Genetics and Microbiology. In the past, the Department of Genetics administered a graduate program in concert with the University Program in Genetics and Genomics. Now the merged and expanded Department of Molecular Genetics and Microbiology has established a departmental graduate training program, the MGM department, that students from UPGG can choose to adopt if they join an MGM member laboratory. Alternatively, students have the option to seek their degree via the genetics program independent of a departmental affiliation. These mechanisms ensure a great degree of flexibility in serving the needs of

the member labs, 13 different departments, and ensure that students in UPGG have both a common home and can pursue their own unique career paths within the umbrella of the program.

The curriculum requirements for the Duke University Program in Genetics and Genomics are flexible. Students are required to take two full semester courses, Genetic Analysis (UPG 278) and Evolutionary Genetics (UPG 287), one additional full semester course with an emphasis in genetics, and two minicourses selected from a variety of offerings. Courses for first year students are chosen in consultation with the Director of Graduate Studies (Marcy Speer) and a first year advisory committee. Courses are available and encouraged for students past the first year of study, and decisions about additional coursework are made in consultation with the student's faculty advisor and committee to complement the requirements of the student's own research interests.

In addition to courses, students participate in other educational activities. These include an annual student organized retreat at the beach, and a biweekly student research seminar series that alternates with a biweekly student-faculty lunch. There is a fall genetics seminar series that is interspersed with four distinguished lecturer seminars, two in the spring and two in the fall. Students organize and invite the distinguished lecturer series with advice from the program co-director, Doug Marchuk, and students host the dinners with the distinguished lecturers. Students have the opportunity to develop teaching skills as an assistant for one semester. Finally, students complete a preliminary examination at the end of the second year of graduate student and form their thesis committee.

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. 3 units.

225. Critical Readings in Classical Human Statistical Genetics. In-depth readings of classical human statistical genetics papers that shaped the field including Morton's lod score analysis, Penrose's affected sibling pair studies, and the Elston-Stewart algorithm, among others. Student-led discussions of content. Instructors: Speer and Scott. 1 unit.

232. Human Genetics. 3 units. C-L: Molecular Genetics and Microbiology 232

247. Macromolecular Synthesis. 2 units. C-L: see Cell and Molecular Biology 247

258. Structural Biochemistry I. 2 units. C-L: see Biochemistry 258; also C-L: Cell and Molecular Biology 258, Cell Biology 258, Immunology 258, Molecular Biophysics 258

259. Structural Biochemistry II. 2 units. C-L: see Biochemistry 259; also C-L: Cell Biology 259, Immunology 259, Molecular Biophysics 259

268. Biochemical Genetics II: From RNA to Protein. 2 units. C-L: see Biochemistry 268; also C-L: Cell Biology 268, Immunology 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: Capel, Kiehart, Lew, Wharton. 4 units.

281. DNA, Chromosomes, and History. 3 units.

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.

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.

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: Fehon. 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. Instructor: Garcia-Blanco. 1 unit.

378. 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: Capel, Kiehart, Lew, Wharton. 4 units. C-L: Cell and Molecular Biology 378, Molecular Genetics and Microbiology 378, Biology 378

COURSES CURRENTLY UNSCHEDULED

215. Genetic Mechanisms

German Studies Program (GERMAN)

Associate Professor of the Practice Walther, Chair (116J Old Chemistry); Professor Rolleston, Director of Graduate Studies (116L Old Chemistry); Professors Borchardt (German), Gillespie (political science), Gilliam (music), Hillerbrand (religion), Jameson (literature), Kitschelt (political science), Klopfer (biology), Koonz (history), Steinmetz (divinity), Surin (literature), and Todd (music); Associate Professors Berger (divinity), Campt (women's studies), Coles (political science), Hacoheh (history), Morton (German), Pfau (English), Rasmussen (German), Robisheaux (history), Stiles (art and art history), and Van Miegroet (art and art history); Assistant Professor McIsaac (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 allied 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 dissertation chapter review committee consists of the student's faculty advisor and three other faculty members selected by the student.

For additional information, email jroll@duke.edu.

201. German for Academic Research I. Introduction to German for the purpose of developing reading and translation skills necessary for pursuing academic research. Assumes no prior knowledge of German. Foundations of German grammar and syntax; emphasis on vocabulary and translations. Selected readings in theory of translation and techniques. Not open for credit to undergraduate students who have taken Intermediate German (65, 66, 69, or equivalent). Does not count towards the major or minor, or towards the fulfillment of the Foreign Language Requirement. Instructor: Staff. 3 units.

202. German for Academic Research II. Development and refinement of skills needed to read and translate intermediate to advanced academic German. Texts selected by instructor, with regular opportunities to work on materials related to individual fields/research topics. Selected readings in theory of translation and techniques. Prerequisite: German 201. Not open for credit to undergraduate students who have taken Intermediate German (65, 66, 69, or equivalent). Does not count towards the major or minor, or towards the fulfillment of the Foreign Language Requirement. Instructor: McIsaac or staff. 3 units.

204S. German Business / Global Contexts. Current German economic and business debates and events. Germany's position in the global marketplace and on ensuing intercultural business encounters. Topics include state of Germany's industry and energy resources, monetary policies and banking systems, environmental concerns, foreign trade, taxes, and the social safety net. Attention to Germany's self-understanding as a "social market economy" and the compatibility of that model with current trends in globalization. Instructor: Staff. 3 units.

209S. Introduction to Medieval German: The Language of the German Middle Ages and Its Literature. Basic reading skills in the medieval German language (Middle High German) developed by working with literary texts in their original idiom. Canonical texts such as courtly love poetry (Walther von der Vogelweide), Arthurian romance (Hartmann von Aue, Wolfram), and heroic epic (Nibelungenlied). Understanding manuscript culture, philological inquiry, medieval intellectual practices, relationship between learned Latin culture and educated vernacular cultures. Research paper required. Readings and discussion in German. Instructor: Rasmussen. 3 units. C-L: Medieval and Renaissance Studies 201S

210S. 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

215S. Renaissance and Reformation. The development of 'personality' from 'type' to 'individual' in German culture in the great transition from medieval to early modern times, with examples from literature, history, art, architecture, music, science, and religion. Emphasis on the Italian connection, northern mysticism, Prague in the fourteenth century, fifteenth-century poetry and prose, and Luther. Taught in German. Instructor: Borchardt. 3 units. C-L: Medieval and Renaissance Studies 210CS

216S. The Grand Gesture: German Literature of the Seventeenth Century. The poetry of excess, of performance, of the public posture; rhetoric; the prose of the rogue, adventurer, and the Ne'er-do-well; comedy, farce, and the clown in the German literature of the Baroque era. Instructor: Borchardt. 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.

232S. Poetry and Modernity. Modern poetic form as a window into history: Linguistic versions of experience and memory opening into subtle shifts in the ethics and aesthetics of self. A survey of German lyrical voices from Goethe, Schiller, Hölderlin through Rilke and

Expressionism to poets active since 1989. Taught in German, every second year. Instructor: Rolleston. 3 units.

235S. Sex and Gender in 19th-Century German Prose. Developments in German literature from 1795-1914 from the perspective of gender and sexuality in social and historical context. Topics include: the relationship of ghosts, madness, incest, and murder to desire; gendered responses to industrialization; the gendering of nationalism; intersections of race and gender; male and female Bildung, feminine aesthetics; canonicity and gender. Texts in a variety of genres. Instructor: McIsaac. 3 units.

245S. German Literature and Culture 1900-1945. Radical social shifts and their disruption of German culture and literary conventions during the first half of the 20th century. From the poetry, film, manifestoes, and revolutionary theater of Expressionism, to the high modernism of Rilke, Kafka, Hesse, and Mann, to the didactic literary program of Brecht and his circle, including Kurt Weill and Marieluise Fleisser, to the internationalist goals of the Frankfurt School of Social Research. Emphasis on relations between text and history, from WWI to Weimar to the persecutions and systematic destructions of the Nazi era. Instructor: Rolleston. 3 units.

247S. Contested Memories in German Culture since 1945. Major German literary, filmic, and cultural works since 1945. Topics vary: representations of National Socialism and the Holocaust in German culture; "Vergangenheitsbewältigung" (dealing with the past) in German literature and culture; history, memory and national identity in German, Austrian, and Swiss Literature. Instructor: Staff. 3 units.

258S. Special Topics in German Literature and Cultural Studies. Instructor: Staff. 3 units.

260. History of the German Language. Phonology, morphology, and syntax of German from the beginnings to the present. Instructor: Keul or Rasmussen. 3 units. C-L: Medieval and Renaissance Studies 260B, Linguistics 260

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. C-L: Literature 270

276S. Nietzsche's Political Philosophy. 3 units. C-L: see Political Science 226S; also C-L: Philosophy 237S

280S. Music in Literature and Philosophy: 1800-1945. Readings in the philosophy of Nineteenth and early Twentieth Century "classical" music and in literature as a source for and response to musical composition, performance, and listening experience. Taught in English. Instructor: Pfau. 3 units. C-L: English 250S

285S. Science and Technology in Nineteenth-Century German Culture. Literature and science writing by literary figures (such as Goethe, Novalis, Kleist, Stifter, Musil), the social history of technology, the history of science (especially physics, anthropology, and biology), and philosophy (such as Kant, Marx, Nietzsche, Weber). The German historical context as seen from contemporary American and German understandings. Taught in English, with an optional German section for those reading in the original. Instructor: McIsaac. 3 units.

286S. 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. Taught in English. Instructor: McIsaac. 3 units. C-L: Art History 256S

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. Instructor: 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 *Geistesgeschichte*; the politics of *Germanistik*, 1933-45; *Germanistik* 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: 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, folksong, 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

220S. Reason and Imagination: The German Eighteenth Century

227S. Goethe Seminar

230S. German Romanticism

271S. Contemporary Theory and the German Tradition

Graduate Studies (GS)

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.

301. Instructional Uses of Technology. Technology is an increasingly visible part of the academic enterprise. Work with cutting-edge technology and share ideas with graduate students across disciplines about the use of technology to augment pedagogy, and using new tools to address old problems. Completion of four workshops or an electronic teaching portfolio affords free certificate on your transcript. Topics include introduction to using technology in teaching; creating course web pages; effective in-class presentations; and communication and interactivity tools. Workshops offered on various topics for varying skill levels and interests. Instructor: Murphy. 1 unit.

302. Introduction to College Teaching. Classroom teaching skills, like research and writing skills, require time and effort to learn and develop. In this six-part workshop series, you will learn principles and strategies for effective college teaching. Topics include: (1) Planning and designing an effective course, (2) Reflecting on beliefs about students and learning, (3) Writing the syllabus and learning objectives, (4) Selecting teaching methods and learning activities, (5) Evaluating teaching and learning, and (6) Integrating teaching and learning. The series is offered several times each semester. Instructor: Staff. 1 unit.

310A. Responsible Conduct of Research: Campus Workshop. Graduate level training in research and professional ethics is a formal degree requirement for every Ph.D. student at Duke beginning with Fall 2003 matriculation. Topics include history of research ethics, academic integrity, preventive ethics, and Duke resources to assist graduate researchers. Entering Ph.D. students must attend ONE (Humanities and Social Sciences OR Natural Sciences and Engineering) of the full day RCR orientation workshops held each Fall, except basic medical science students who attend GS310B. Instructor: Staff. 6 units.

310B. Responsible Conduct of Research: Beaufort Workshop. Graduate level training in research and professional ethics is a formal degree requirement for every Ph.D. student at Duke beginning with Fall 2003 matriculation. Topics include history of research ethics, academic integrity, preventive ethics, and Duke resources to assist graduate researchers. Entering Ph.D. students in Basic Medical Sciences must attend a weekend retreat at Duke University Marine Laboratory in Beaufort, NC. Instructor: Staff. 12 units.

311. Responsible Conduct of Research: Graduate Forums. Beyond orientation training, Ph.D. students must earn six additional credits of RCR training during their first three years of study. The Graduate and Medical Schools offer a series of RCR forums (two credits each) during the academic year. Topics include copyright and fair use laws, proper use of data, research with human or animal subjects, authorship, and mentoring. Other RCR training when pre-approved by the Graduate School may take a variety of formats including graduate courses, departmental seminars, or workshops. Instructor: Staff. Variable credit.

320A. Academic Writing for Graduate Students I. Focus on developing awareness of and practicing the basic writing skills and text forms of graduate-level writing. Emphasis on making claims and developing supporting argumentation. Also addresses basic organizational patterns, academic grammar, recognizing and avoiding plagiarism, appropriate paraphrasing and source citation, proofreading skills, techniques for academic vocabulary acquisition. Individual conferences with students to provide feedback, training and guidance. Instructor: Staff. 3 units.

320B. Integrated Oral Communication for International Students. Focus on developing students' ability to participate actively in conversations of personal, professional, and general interest. Strategies for lecture comprehension and effective note-taking through guided listening practice using authentic academic sources. Significant focus on pronunciation using in-class, online, and language lab resources; individual coaching through e-voice clip exchanges. Individual conferences, vidoetaping, and peer review throughout the course. Instructor: Staff. 4 units.

321A. Academic Writing for Graduate Students II. Focus on more advanced skills and text forms of academic writing: discipline-specific texts in various genres, including research paper introductions, abstracts, graphs and charts, summaries, critiques, and literature reviews. Techniques for academic vocabulary acquisitions, retention, and retrieval. Extensive writing practice and intensive instructor feedback over multiple revisions of assignments. Individual conferences and revisions of writing exercises to provide personalized guidance. Instructor: Staff. 3 units.

321B. Academic Communication and Presentation Skills for International Students. Focus on developing students' academic discussions, argumentation, and presentation skills. Discussion and videotaped academic presentations in various genres. Addresses cultural expectations affecting successful cross-cultural communication; units on improving pronunciation and fluency incorporated throughout. Individual conferences, conferences, and peer review throughout course. Instructor: Staff. 3 units.

Health Policy

Christopher Conover, Ph.D., Program Director

Duke University, through the Center for Health Policy, Law and Management and Education, a part of the Terry Sanford Institute of Public Policy, offers an interdisciplinary certificate in health policy for graduate students. 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.

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>.

Capstone Course (required)

Health Policy 255/Public Policy 255. Health Policy Analysis. Consent of instructor required.

^{*} 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.

Core Courses (any 2 courses)

Regularly Scheduled Courses

Economics 215S. Applied Cost Benefit Analysis. Prerequisite: Economics 149.
Economics 356. Graduate Health Economics I. Prerequisites: Economics 243 and 301.
Economics 357. Seminar in Health Economics. Prerequisites: Economics 243 and 301.
Health Management 326. Fundamentals of Health Care Markets.
Law 347. Health Care Law and Policy.
Managerial Economics 408. Health Care Systems.
Public Policy Studies 253/Political Science 249. The Politics of Health Care.
Public Policy Studies 263. Public Health Issues: Prevention and Management.
Public Policy Studies 264S.07. Getting Value for Money in Health Care: Rationing in Theory and Practice.

Special Topics Courses, Offered Periodically

Public Policy Studies 263S.01. Health Policy: Prevention and Management.

Elective Courses (any 2 courses)*

African and African-American Studies 299S.01/Psychology 262S. Minority Mental Health.
African and African-American Studies 299S.01/History 299S.05. Race/Medicine: Historical Perspective.
Biometry 217. Clinical Decision Analysis. Prerequisite: BTP 211.
Community and Family Medicine 247B. Medicine in America.
Community and Family Medicine 256C. Ethical Issues in Medicine.
Christian Ethics 266. Ethics and Health Care.
Economics 372. Advanced Theory of Environmental and Natural Resource Economics
Environment 270L. Resource and Environmental Economics. Prerequisite: introductory course in microeconomics.
Environment 271. Economic Analysis of Resource and Environmental Policies. Prerequisite 270L or equivalent. Economics 149 recommended.
Environment 274. Resource and Environmental Policy. Prerequisite: Environment 251 or equivalent.
Environment 343. Hazard Management, Law and Ethics. Consent of instructor required.
Environment 385. Decision Theory and Risk Analysis. Prerequisite: Environment 251 or equivalent.
History 279. Health, Healing and History.
Interdisciplinary Course 300C/Law 580. Interdisciplinary Seminar in Medical-Legal-Ethical Issues.
Interdisciplinary Course 302C. Exploring Medicine: Cross-Cultural Challenges to Medicine in the Twenty-First Century.
Law 235. Environmental Law.
Law 301. AIDS Law.
Law 400.01. AIDS Legal Assistance Project.
Law 529.01. Genetics and the Law.
Law 547. Food and Drug Law (seminar).
Law 550. Health Care Financing and Competition (Seminar).
Law 555. International Environmental Law (Seminar).
Law 590. Risk Assessment and Management.
Law 596. Toxic Substance Regulation (Seminar).
Law 598. Violence, the Media, and the Law (Seminar).
Liberal Studies 270.21. Genes, Medicine, and Money.
Liberal Studies 290.45. Health Care, Narrative, and Social Theory.
Liberal Studies 290.53. Aging and Health.
Nursing 303. Issues in Contemporary Health Care Organizations.
Nursing 362. Ethics in Nursing.
Nursing 480. Social Issues, Health, and Illness in the Aged Years.
Physicians Assistant 250. Health Systems Organization
Political Science 176A,B. Perspectives on Food and Hunger.
Public Policy Studies 264S.32. Matters of Life and Death.
Public Policy Studies 264S.70. Policy Implementation.
Public Policy Studies 266S. Comparative Social Policy.
Religion 388. Ethics and Medicine.
Sociology 171. Comparative Health Care Systems.
Sociology 227S, B. Social Behavior and Health.
Sociology 227S, D. Health and Aging.

History (HISTORY)

Professor Deutsch, Chair (216A Carr); Professors Boatwright, Chafe, Edwards, English, Gaspar, Gavins, Herrup, Humphreys, Kaplan, Koonz, Kuniholm, Mauskopf, Miller, Payne,

* Candidates for the Master's of Public Policy degree or Program for International Development seeking the certificate need only complete one elective course if they write their master's memo on some aspect of health policy.

Petroski, Radway, Reddy, Richards, Roland, Shatzmiller, Thompson, and Wood; Associate Professors Balleisen, Ewald, French, Glymph, Hacoheh, Huston, Korstad, Mazumdar, Nathans, Neuschel, Partner, Peck, Robisheaux, Silverblatt, and Thorne; Assistant Professors Baker, Bonker, Fenn, Kornbluh, Krylova, Olcott, and Parker; Professors Emeriti Cahow, Colton, Davis, Durden, Franklin, Goodwyn, Holley, Lerner, Scott, TePaske, Witt, 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, and 303. 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. C-L: Russian 218S

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.

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: see 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: Staff. 3 units. C-L: Public Policy Studies 270S
- 221BS. Religion and Society in the Age of the Reformation.** The social history of religion in the age of the Protestant Reformation and Catholic Renewal; ritual and community in the fifteenth century; the Protestant Reformation and social change; the urban reformation in Germany and Switzerland; women and reform; Protestant and Catholic marriage, household and kinship; Catholic renewal; the formation of religious confessional identities; religion and violence; interpreting "popular" religious culture; and witchcraft. Instructor: Robisheaux. 3 units. C-L: Medieval and Renaissance Studies 220BS
- 224A. History of Globalization in the Twentieth Century.** 3 units. C-L: see Economics 238
- 224S. The World Wars.** Continuation of History 223S. Instructor: Staff. 3 units.
- 228S. Twentieth Century Social Movements in America.** Focus on the emergence of the women's movement and the civil rights movement, both concerned with issues of equality and justice, in the United States during the post-New Deal period. Instructor: Chafe. 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
- 233AS. Narrative, History, and Historical Fiction.** The use of narrative in history and fiction writing. Theory of narrative in psychology, literature, philosophy, and history. Students write an extended piece of narrative history, historical fiction, or theory. Instructor: Partner. 3 units.
- 235S. The Antebellum South.** The economic, political, and social aspects of life in the South, 1820-1860. Instructor: S. Nathans. 3 units. C-L: African and African American Studies 235S
- 255AS. Courts, Wars, Legacies of Wars.** 3 units. C-L: see Political Science 238S
- 255B. War and the National State.** 3 units. C-L: see Political Science 288
- 256. Modern Literature and History.** 3 units. C-L: see French 256
- 260. Fifth- and Fourth-Century Greece.** 3 units. C-L: see Classical Studies 222
- 262S. Japan Since 1945.** Issues relating to post-War Japan. Topics include: the Occupation; democracy in postwar Japan; the rise of mass consumption; security and the US-Japan alliance; the political system; popular culture; arts and literature; the transformation of the countryside; the creation of an economic superpower; the myth of the kaisha; moments of conflict and crisis. Instructor: Partner. 3 units.
- 263. The Roman Republic.** 3 units. C-L: see Classical Studies 224
- 266. Late Antiquity.** 3 units. C-L: see 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
- 272S. Fin-de-siècle and Interwar Vienna: Politics, Society, and Culture.** The cultural milieu of *fin-de-siècle* and interwar Vienna. Freud, Kraus, the Austro-Marxists, Neurath, the Austrian School of Economics, Wittgenstein, the Logical Positivists, Popper, and Musil; monographs on Viennese culture (Schorske), feminism, and Austrian socialism. Instructor: Hacoen. 3 units.

287A. Popular Religion/Culture. 3 units. C-L: see Religion 287

287BS. Ethnohistory of Latin America. 3 units. C-L: see Cultural Anthropology 287S; also C-L: Literature 287BS

292. Research Methods in Japanese. 3 units. C-L: see Japanese 291; also C-L: Cultural Anthropology 290, Political Science 291, Sociology 291

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.

296S. United States Policy in the Middle East. 3 units. C-L: see Public Policy Studies 257S

297S. Teaching Race, Teaching Gender. 3 units. C-L: see African and African American Studies 297S; also C-L: Women's Studies 297S

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.

303. Focusing on Teaching and Pedagogy. A required course that focuses on a range of pedagogical issues, both to support student's work in the classroom as teaching assistants and to prepare them for teaching in their professional careers. Course work will culminate in the creation of a teaching portfolio. Consent of instructor required. Instructor: Staff. 3 units.

Colloquia and Seminars for Graduates

311. Readings in European History. The department offers a series of rotating courses, covering the history and historiography of various aspects of European History. Written work is confined to methodological, conceptual, or historiographic essays. Topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 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. Instructor: Payne. 3 units.

312. Readings in Latin American History. The department offers a series of rotating courses, covering the history and historiography of various aspects of Latin American History. Written work is confined to methodological, conceptual, or historiographic essays. Topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

313. Readings in African and Asian History. The department offers a series of rotating courses, covering the history and historiography of various aspects of African and Asian History. Written work is confined to methodological, conceptual, or historiographic essays. Topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

315. Readings in Global Connections. The department offers a series of rotating courses, covering the history and historiography of various aspects of Global Connections. Written work is confined to methodological, conceptual, or historiographic essays. Topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

320. Readings in Law and Society. The department offers a series of rotating courses, covering the history and historiography of various aspects of Law and Society. Written work

is confined to methodological, conceptual, or historiographic essays. Topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

325S. Readings in Politics, Public Life, The State. The department offers a series of rotating courses, covering the history and historiography of various aspects of Politics, Public Life, The State. Written work is confined to methodological, conceptual, or historiographic essays. Topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

335S. Readings in Methods, Theory. The department offers a series of rotating courses, covering the history and historiography of various aspects of Methods, Theory. Written work is confined to methodological, conceptual, or historiographic essays. Topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

340. Readings in Racial Formations. The department offers a series of rotating courses, covering the history and historiography of various aspects of Racial Formations. Written work is confined to methodological, conceptual, or historiographic essays. Topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 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: Staff. 3 units.

345. Readings in Empires, Colonial Encounters. The department offers a series of rotating courses, covering the history and historiography of various aspects of Empires, Colonial Encounters. Written work is confined to methodological, conceptual, or historiographic essays. Topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

345A. Spaces, Bodies, & Narratives: Mapping Religion in Colonial India. 3 units. C-L: see Religion 368

350. Readings in Labor Systems, Capitalism, Business Cultures. The department offers a series of rotating courses, covering the history and historiography of various aspects of Labor Systems, Capitalism, Business Cultures. Written work is confined to methodological, conceptual, or historiographic essays. Topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 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. Instructor: Staff. Variable credit.

359. Readings in Military History, Science, Technology. The department offers a series of rotating courses, covering the history and historiography of various aspects of Military, Science, Technology. Written work is confined to methodological, conceptual, or historiographic essays. Topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

360. Research in North American History. The department offers a series of rotating courses that offer students the opportunity to research and write on topics in North American History, with the expectation that students will produce a substantial term paper based on research in primary sources. Specific topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

362. Research in Latin American History. The department offers a series of rotating courses that offer students the opportunity to research and write on topics in Latin American History, with the expectation that students will produce a substantial term paper based on research in primary sources. Specific topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

363. Research in African and Asian History. The department offers a series of rotating courses that offer students the opportunity to research and write on topics in African and Asian History, with the expectation that students will produce a substantial term paper based on research in primary sources. Specific topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

365. Research in Global Connections. The department offers a series of rotating courses that offer students the opportunity to research and write on topics in Global Connections, with the expectation that students will produce a substantial term paper based on research in primary sources. Specific topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

368S. Research in Law and Society. The department offers a series of rotating courses that offer students the opportunity to research and write on topics in Law and Society, with the expectation that students will produce a substantial term paper based on research in primary sources. Specific topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

371. Research in Politics, Public Life, The State. The department offers a series of rotating courses that offer students the opportunity to research and write on topics in Politics, Public Life, The State, with the expectation that students will produce a substantial term paper based on research in primary sources. Specific topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

372S. Research in Gender. The department offers a series of rotating courses that offer students the opportunity to research and write on topics in Gender, with the expectation that students will produce a substantial term paper based on research in primary sources. Specific topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

374S. Research in Methods, Theory. The department offers a series of rotating courses that offer students the opportunity to research and write on topics in Methods, Theory, with the expectation that students will produce a substantial term paper based on research in primary sources. Specific topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

376S. Research in Racial Formations. The department offers a series of rotating courses that offer students the opportunity to research and write on topics in Racial Formations, with the expectation that students will produce a substantial term paper based on research in primary sources. Specific topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

378. Research in Empires, Colonial Encounters. The department offers a series of rotating courses that offer students the opportunity to research and write on topics in Research in Empires, Colonial Encounters, with the expectation that students will produce a substantial term paper based on research in primary sources. Specific topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

380. Research in Labor Systems, Capitalism, Business Cultures. The department offers a series of rotating courses that offer students the opportunity to research and write on topics in Labor Systems, Capitalism, Business Cultures, with the expectation that students will produce a substantial term paper based on research in primary sources. Specific topics vary, as do the instructors. Consent of instructor required. Instructor: Staff. 3 units.

398. Special Reading Topics, Independent Study. These courses allow for independent study on specific topics on an individual basis with instructors. Written work is confined to methodological, conceptual, or historiographic essays. Consent of instructor required. Instructor: Staff. 3 units.

399. Special Reading Topics, Independent Study. These courses allow for independent study on specific topics, on an individual basis with instructors. The expectation is that students will produce a substantial term paper based on research in primary sources. Consent of instructor required. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

- 201T. Russian Intelligentsia
- 204S. Technology, Economic Development, and Social Change, 1750 to the Present
- 214. Class, Public Opinion, and the French Revolution
- 218. Problems in British Imperialism
- 219S. History of Science and Technology
- 220S. History of Science and Technology
- 223S. The World Wars
- 225S. Problems in Comparative Labor History
- 228. Recent United States History: Major Political and Social Movements
- 231S. Readings in Latin American Colonial History
- 236B. Special Topics in Early Medieval History
- 238S. Europe in the High Middle Ages
- 239. History of Socialism and Communism
- 241A. The Origins of Totalitarianism, 1924-1954
- 242B. The Soviet 1920s: The Road to a New Synthesis
- 254S. European Diplomatic History, 1871-1945
- 255C. The Culture of American Capitalism, 1750-1860
- 255ES. Topics in Cold War History
- 257. Comparative Latin America Labor
- 259. Archaic Greece
- 261. The Hellenistic World
- 264. The Roman Empire
- 270S. British History, Seventeenth Century to the Present
- 273S. Topics in the History of Science
- 274S. History of Science
- 275S. Asian and Asian-American Women in Comparative Perspective
- 276A. Labor, Immigration, and the Asian American Experience
- 279. Health, Healing, and History
- 280. Health, Healing, and History
- 282S. Canada
- 288S. Germany and Japan in World War II
- 289S. War, Revolution, and Society in the Caribbean, 1700-1815
- 290S. Theoretical Bases of Social Interpretation
- 293. French Liberalism: An Intellectual History, 1815-1981
- 295S. Slavery and Freedom in Africa, to 1960
- 299. Lectures in Special Topics
- 314. Historical and Social Science Methodology
- 356. History and Culture of Islamic Cairo
- 389. Seminar in Conservation and Environmental History

The Master of Arts Program in Humanities

Professor David Bell, Director (romance studies)

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 an academic advisor. Thirty units of course work are 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 – to maintain an intellectual focus already developed in their undergraduate careers.

Center for Hydrologic Science

Miguel Medina, Ph.D., and Gabriel Katul, Ph.D., Co-Directors, Professors Baker (earth and ocean sciences), Haff (earth and ocean sciences), Katul (environment), Oren (environment), Schlesinger (biology and environment), and Trangenstein (mathematics); Associate Professors Boadu (civil engineering), Kabala (civil engineering), Peirce (civil engineering), 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 for Hydrologic Science represents Duke University as a Member of the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI).

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 (Center for Hydrologic Science, Box 90287, Duke University, Durham, NC 27708-0287), email (Miguel.Medina@duke.edu).

Immunology (IMMUNOL)

Professor Tedder, Chair (353 Jones); Professor Kelsoe, Director of Graduate Studies (117 Jones); Professors Abraham, Burks, Dawson, Frank, Hall, Kepler, Krangel, Lefkowitz, St. Clair, and Weinberg; Associate Professors Gunn and Zhuang; Assistant Professors Alberti, He, Kondo, Rathmell, Yang, Zhang, and Zhong; Research Assistant Professors Poe and Sarzotti-Kelsoe; Professors Emeriti Metzgar and Ward

Immunology is the study of the cells, proteins, and genes that protect against infection and malignancy. Immunology encompasses innate and natural, nonspecific defense mechanisms, as well as specific immune responses that generate immunologic memory. The department’s focus is on lymphocytes, and their cellular biology, physiology, genetics and development. Immunology is by its nature a bridging science. The roots of immunology lie in the study of infectious disease, vaccine development, organ transplantation, immunity to malignancy, and immunotherapy. Modern research in immunology draws on recent advances in cell- and molecular biology, biochemistry, genomics and informatics to determine how the immune system functions. In turn, immunology has contributed to understanding biological structure, eukaryotic gene organization and expression, signal transduction, and intracellular protein transport and assembly.

The Department of Immunology offers graduate work leading to the Ph.D. degree. Research programs are available in many aspects of molecular and cellular immunology, including immunogenetics. The department is a participating member in the following

University Programs: Cell and Molecular Biology, Genetics, the Medical Scientist Training Program, and the Developmental Biology Training Program.

The Department of Immunology has outstanding facilities for carrying out all aspects of immunologic research. A description of the Ph.D. program, prerequisites for admission, and research in the department may be found at <http://immunology.mc.duke.edu> or by emailing dgs-immunology@duke.edu.

209. Independent Study. A laboratory or library project. Consent of director of undergraduate studies and instructor required. Instructor: Staff. Variable credit.

213S. Computational Immunology and Immunogenomics. 3 units. C-L: see Bioinformatics & Genome Technology 213S

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. Prerequisites: Biology 119 and Chemistry 151L or equivalents. Instructors: Dawson and staff. 3 units. C-L: Biology 244

252. Virology. 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. Instructor: Keene and staff. 3 units.

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

259. Structural Biochemistry II. 2 units. C-L: see Biochemistry 259; also C-L: Cell Biology 259, Molecular Biophysics 259, University Program in Genetics 259

268. Biochemical Genetics II: From RNA to Protein. 2 units. C-L: see Biochemistry 268; also C-L: Cell Biology 268, University Program in Genetics 268

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; 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. 3 units.

300. Tumor Immunology. An advanced seminar based on original literature focusing on neoplasia and the immune system. 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. Instructor: Tedder and staff. 2 units.

332. Immunology Seminar. Work in progress seminar in which students and postdoctoral trainees give 30min-1 hour presentations of their research. Considered a showcase of current research in the Department of Immunology. All students enrolled in Immunol programs are required to give a presentation once per year. Informal questions and discussion are encouraged throughout presentation. First- and second-year Immunology graduate students should register for Section 1 for graded credit. Immunology students beyond the second year should register for Section 2 for non-graded credit. Students of non-Immunology majors should register for Section 2 or get permission from course director for Section 1. Attendance is essential for both sections. Director: Zhuang. 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. Instructor: He 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. Instructor: He and staff. 1 unit.

COURSES CURRENTLY UNSCHEDULED

210. Independent Study

246S. Parasitic Diseases

304. Molecular Membrane Biology

The Integrated Toxicology Program

Professor Simon, Director of Graduate Studies

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, Neurobiology, Pathology, Pharmacology, and the Nicholas School of the Environment and Earth Sciences including the Duke Marine Laboratory. Among the principal areas of concentration in the program are neurotoxicology, genetic toxicology, developmental toxicology, environmental toxicology, and toxicogenomics. 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 CIIT Centers for Health Research, and the Environmental Protection Agency (EPA).

Application to the program can be made in two ways. If your primary interest is Toxicology, then you may apply for admission directly through the Integrated Toxicology Program, indicating "Toxicology" as your primary admitting unit on the standard graduate school application. Students admitted directly into the Integrated Toxicology Program affiliate with a department depending upon their choice of research mentor. Students with a primary interest in a departmentally based field may also apply to the Integrated Toxicology Program by indicating "Toxicology" as the secondary field on the graduate school application. The primary field should indicate the specific graduate department in Arts and Sciences, the School of Medicine, or the Nicholas School of the Environment and Earth Sciences. There is no difference in the eventual degree granted through either mechanism; both routes result in a Ph.D granted by a specific department, with certification in Toxicology. 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.

Students are offered admission to the program with fellowship support based on rank among all applicants. Students may be awarded a Toxicology fellowship or may be accepted into the Toxicology Program with support from departmental funds. For each entering year, approximately four full fellowships (tuition, fees and stipend) are awarded to Toxicology graduate school applicants. Please note that Toxicology fellowships are restricted to U.S. citizens or permanent residents. Non-U.S. citizens who are interested in the Integrated Toxicology Program will need to apply and request funding directly through a participating

department. Applicants must have a bachelor's degree with a strong foundation in mathematics and the biological and physical sciences. Applicants must submit scores on the GRE general test, transcripts, and letters of recommendation. It is expected that course work and research experience will vary among applicants but that the applicant's academic credentials will be sufficient to ensure successful completion of the degree.

Further information may be obtained from the Program Manager, Duke University, Box 90328, Durham, North Carolina, 27708; telephone (919) 613-8078; email: toxicology@duke.edu

Interdisciplinary European Studies

Although Duke does not offer an interdisciplinary postgraduate degree in European Studies, graduate students affiliated with any Duke department or professional school are encouraged to document their specialization in the region by earning a Certificate in Interdisciplinary European Studies in conjunction with their master's or doctoral degree.

Requirements for the certificate are the following:

1. Five core courses with at least a 75% European Studies content taken in at least three different departments;
2. Two-year participation in the European Studies Graduate Student Colloquium; ("participation" in this context means that involvement in at least four Graduate Colloquium-sponsored activities per semester must be documented);
3. Attain competency in one European language other than English equivalent to at least four semesters of college level study (advanced proficiency). Certification of language competency will be approved by the Executive Committee.
4. Attain competency in a second European language other than English equivalent to at least two semesters of college level study (intermediate proficiency). Certification of language competency will be approved by the Executive Committee.
5. A significant focus on European Studies-related issues in dissertation work.

It will also be required that a faculty member with European expertise be appointed to the student's dissertation committee from outside the student's home department.

There are numerous European Studies-related courses that are naturally and historically embedded in the Duke curriculum. A list of approved courses is available at the Center for European Studies website (<http://www.jhfc.duke.edu/ces/>). If there is a question as to whether the course meets the 75% European content requirement, such determination will be made by the CES Director in consultation with the Executive Committee. That the requirement for a significant focus on European Studies-related issues in dissertation work is met will be at the determination of the student's thesis advisor. The certificate will be signed by the Director of the Center for European Studies and the Dean of the Graduate School. Appropriate notation is made on the student's transcript. For any questions, contact the Center at (919) 684-6449.

Program in International Development Policy

The Program in International Development Policy (PIDP) is offered through the Duke Center for International Development at the Sanford Institute of Public Policy. The PIDP provides from one semester to two years of graduate education in policy analysis related to sustainable development. The PIDP is a program for mid-career professionals and as such, applicants must have at least three years of work experience to meet the minimum admissions requirements. 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 spend two academic years fulfilling the requirements for the Master of Arts in International

Development Policy. Degree candidates with at least one year of previous graduate-level course work and a strong background in market-based economics may be eligible to complete the A.M. in one calendar year. A non-degree certificate (lasting two academic semesters) is available to those who may not be eligible for the one-year degree or do not have two years available to complete the two-year degree.

All participants are required to take at least two PIDP seminars each semester and two additional graduate-level elective courses in related fields (e.g., public policy, economics, political science, environment, business). Each participant self-designs their own curriculum, with the help of their academic advisor, based on one of the PIDP Areas of Specialization: Development Management, Applied Economics, Social Policy, Environmental Management, and Policy and Peace and Conflict Resolution. All participants are required to take three core seminars during their first year of study: Economic Foundations of Development, Economic Analysis of Development, and Policy Analysis of Development. All degree candidates are required to complete a master's project in their final semester. Two-year degree candidates are required to do an internship during the summer between their first and second year of the program. Limited scholarships in the form of partial tuition waivers are available from PIDP on a competitive basis. For further information, visit our web site at <http://www.pubpol.duke.edu/dcid>; contact the Program in International Development Policy, Duke University, Box 90237, Durham, North Carolina, 27708-0237; telephone (919) 613-7339; fax (919) 684-2861; or e-mail pidpinfo@duke.edu.

Latin American and Caribbean Studies (LATAMER)

Associate Professor French, Director, Center For Latin American and Caribbean Studies, and Director, the Consortium in Latin American Studies at UNC-Chapel Hill and Duke University (2114 Campus Drive); Associate Professor Nelson, Director, University Graduate Program in Latin American Cultural Studies

The Center for Latin American and Caribbean Studies oversees and coordinates graduate education on Latin America and the Caribbean, 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 or the Caribbean. In addition to fulfilling the requirements of their departments, students of Latin American and Caribbean 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 and Caribbean Studies

Requirements include:

1. six graduate courses on Latin America or the Caribbean;
2. an approved thesis prospectus or departmental equivalent on a Latin American or Caribbean topic; and
3. proficiency in 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 and Caribbean American studies, contact the academic coordinator for Latin American and Caribbean Studies, 2114 Campus Drive, Box 90254, Duke University, Durham, NC 27708-0254, telephone (919) 681-3980, email: las@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. fluency in Spanish, Portuguese, or other language of Latin America or the Caribbean, such as Yucatec Maya or Quechua. Such working knowledge must be demonstrated by completing graduate courses taught in the language or 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: las@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 Consortium 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 Consortium, which offers graduate students at Duke an array of intellectually challenging opportunities to broaden their disciplinary training. The single most important initiative of the Consortium 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 and Caribbean 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, the Caribbean, the environment, Andean countries, rethinking the political and citizenship across borders.

Since 1991 the Consortium in Latin American Studies at UNC-Chapel Hill and Duke has been 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 and Caribbean 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: Staff. 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: Staff. 1 unit.

Courses with Latin American Content Offered by Departments

For a current list of course offerings, visit www.duke.edu/web/las/courses.html.

The Master of Arts in Liberal Studies Program (MALS)

Donna Zapf, Ph.D., Director

MALS is a flexible interdisciplinary program that allows individuals to pursue a variety of personal and professional educational interests across disciplinary boundaries. An advisory committee made up of faculty from throughout the University and chaired by the MALS director manages the academic concerns of the program. This committee admits students, selects new courses, approves final project topics and determines academic 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 of 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). 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 Assistant (Box 90095, Duke University, Durham, North Carolina 27708, (919) 684-3222), email: dukemals@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 Radway, Chair (literature); Professor Hardt, Director of Graduate Studies (literature and Italian); Professors Gaines (literature and English), Jameson (literature and French) Kaplan (French and literature), Lenoir (literature), Lentricchia (literature), Mignolo (literature and Spanish), Moi (literature and French), Moreiras (Spanish and literature), Mudimbe (literature), Rolleston (literature and Germanic languages and literature), B. H. Smith (literature), Stewart (French and literature), and Thomas (French and literature); Associate Professors Khanna (English and literature), Lubiano (literature), Wiegman (women's studies and literature) Willis (literature), and Yoda (literature and Asian and African languages and literature); Assistant Professors Mottahedeh (literature), and Viego (literature and Spanish); Research Professor Dorfman (literature and Latin American studies).

The interdepartmental program leading to a Ph.D. in Literature offers 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 Baucom, Davidson, Moses, Pfau, Torgovnick

(English); Abe, Stiles, and Wharton (art history); Burian and Davis (classical studies); Orr (Romance studies); Cooke (AA&LL); 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. More information on the program and a full descriptive brochure is available from Professor Surin, 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: see Asian & African Languages and Literature Studies 200S; also C-L: African and African American Studies 200S, Cultural Anthropology 288S

211. Theory and Practice of Literary Translation. Linguistic foundations and historical role of translation. Practical exercises and translation assignments. Prerequisite: working knowledge of a foreign language and consent of instructor. Instructor: Burian. 3 units.

220. Foundations in Feminist Theory. 3 units. C-L: see Women's Studies 220

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

270. Consciousness and Modern Society. 3 units. C-L: see German 270

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.

283. Modernism. Aspects of the "modern," sometimes with emphasis on the formal analysis of specific literary and nonliterary texts (Joyce, Kafka, Mahler, Eisenstein); sometimes with a focus on theories of modernism (Adorno), or on the modernism/postmodernism debate, or on the sociological and technological dimensions of the modern in its relations to modernization, etc. Instructor: Jameson or Lentricchia. 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: Staff. 3 units.

- 287BS. Ethnohistory of Latin America.** 3 units. C-L: see Cultural Anthropology 287S; also C-L: History 287BS
- 287S. Space, Place, and Power.** 3 units. C-L: see Cultural Anthropology 285S; also C-L: Asian & African Languages and Literature Studies 230S, Women's Studies 225S
- 289. Topics in Feminist Theory.** Instructor: Moi or Radway. 3 units.
- 290. Topics in Psychoanalytic Criticism.** Instructor: Moi. 3 units.
- 291. Topics in Popular Culture and the Media.** Instructor: Radway or Willis. 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: Gaines, Jameson, or Mottahedeh. 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. Special Topics I.** Subjects, areas, or themes that cut across historical eras, several national literatures, or genres. Can be counted as a pre-1500 course for the diversified study requirement. Instructor: Staff. 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. Variable credit.

COURSES CURRENTLY UNSCHEDULED

212. Studies in Narrative

214. Gender, Nationalities, and Russian Literary Traditions

253. Philology, Linguistics, and the Roots of Literature

254. Introduction to Feminism

280. Semiotics for Literature

282. Contemporary Literary Theory

285. Literature and Ideology

287. Problems in Narrative Analysis

288. Basic Issues in the History of Literary Theory

296. Feminist Thought Before 1970

The University Program in Marine Sciences

Assistant Professor Read (environment), Director of Graduate Studies; Professors Barber (environment and biology), C. Bonaventura (environment and cell biology), J. Bonaventura (environment and cell biology), Crowder (environment and biology), Forward (environment and biology), Ramus (environment and biology); Associate Professor Rittschof (environment and biology), Assistant Professor Campbell (environment); Professor in the Practice of Marine Affairs and Policy Orbach (environment); Associate Professor of the Practice of Marine Ecology Kirby-Smith (environment); Adjunct 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 are usually from a department or program represented by faculty who are members of the Coastal Systems Science and Policy Division of the Nicholas School. These are the Departments of Biology, Cell Biology, Environment, University Program in Ecology, and Toxicology Program. 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, the University of North Carolina and North Carolina State University.

Persons interested in graduate work in the marine sciences should apply through Environment or the University Program in Ecology. For more information, contact Duke University Marine Laboratory, 135 Duke Marine Lab Road, Beaufort, North Carolina 28516-9721, <http://www.nicholas.duke.edu/marinelab/>.

The following courses are offered at Beaufort. See the Marine Laboratory bulletin or web for the current schedule of courses.

Biology 203L. Marine Ecology. (Given at Beaufort fall and summer and at Bermuda, spring.) Prerequisite: introductory biology. Instructors: Crowder or Kirby-Smith (Beaufort); de Putron (Bermuda). 4 units. C-L: Environment 219L

Biology 253L. Physiology of Marine Animals. Variable credit. C-L: see Environment 228L

Biology 254. Vertebrate and Invertebrate Endocrinology. Prerequisites: Biology 25L and Chemistry 152L. A biochemistry course recommended. (Given at Beaufort.) Instructor: Rittschof. 3 units.

Biology 255L. Biochemistry of Marine Animals. 6 units. C-L: see Environment 229L

Biology 264S. Advanced Topics in Marine Ecology. 2 units. C-L: see Environment 269S

Biology 273S. Current Topics in Environmental Biology. (Given at Beaufort.) Prerequisite: Introductory Biology. Instructor: Rittschof. 3 units.

Biology 274L. Marine Invertebrate Zoology. Variable credit. C-L: see Environment 295L

Biology 295S. Special Topics Seminar. Consent of instructor required. Instructor: Staff. 3 units.

Biology 351. Tutorial. Consent of instructor required. Hours and credit to be arranged. Instructor: Staff. Variable credit.

Biology 352. Tutorial. Consent of instructor required. Hours and credit to be arranged. Instructor: Staff. Variable credit.

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. Variable credit.

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. Variable credit.

Cell Biology 210. Independent Study. Consent of director of graduate studies required. 3 to 9 units. Instructor: Staff. Variable credit.

Cell Biology 243. Environmental Biochemistry. (Given at Beaufort.) Prerequisite: organic chemistry. Instructor: C. Bonaventura. 3 units. C-L: Environment 243

Earth and Ocean Sciences 202. Beach and Island Geological Processes. Prerequisite: Earth and Ocean Sciences 115/215 or consent of instructor. Instructor: Murray and Pilkey. 2 units.

Earth and Ocean Sciences 371. Advanced Topics in Geology. To meet the individual needs of graduate students for independent study. Instructor: Staff. Variable credit.

Earth and Ocean Sciences 372. Advanced Topics in Geology. To meet the individual needs of graduate students for independent study. Instructor: Staff. Variable credit.

Environment 208. Estuarine Ecosystem Processes. (Given at Beaufort.) Prerequisite: ecology, systematics, or field biology course or consent of instructor. Instructor: Kirby-Smith. 3 units.

Environment 209. Conservation Biology and Policy. (Given at Beaufort.) Prerequisite: introductory biology; suggested: a policy and/or introductory ecology course. Instructor: Crowder/Orbach (Beaufort). 3 units.

Environment 219L. Marine Ecology. 4 units. C-L: see Biology 203L

Environment 225L. Coastal Ecotoxicology and Pollution. (Given at Beaufort.) Prerequisites: introductory chemistry and biology. Instructor: Staff. 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, Reynolds, and staff. 4 units.

Environment 227. Biology and Conservation of Sea Turtles. (Given at Beaufort.) Prerequisite: Introductory Biology. Instructors: S. Eckert, K. Eckert. 3 units.

Environment 227L. Biology and Conservation of Sea Turtles. (Given at Beaufort.) Prerequisite: introductory biology. Instructor: K. Eckert, S. Eckert, and Crowder. 4 units.

Environment 228L. Physiology of Marine Animals. Four units (fall); six units (summer). (Given at Beaufort.) Prerequisites: introductory biology and chemistry. Instructor: Forward. Variable credit. C-L: Biology 253L

Environment 229L. Biochemistry of Marine Animals. Four units (fall and spring); six units (summer). (Given at Beaufort.) Prerequisites: Biology 25L; and Chemistry 11L, 12L. Instructor: Rittschof (fall and summer). Variable credit. C-L: Biology 255L

- Environment 243. Environmental Biochemistry.** 3 units. C-L: see Cell Biology 243
- Environment 253L. Sensory Physiology and Behavior of Marine Animals.** (Given at Beaufort and Bermuda.) Prerequisites: introductory biology and chemistry. Instructors: Rittschof (Beaufort); Wood (Bermuda). 4 units.
- Environment 254. Qualitative Research Design in Marine Studies.** (Given at Beaufort.) Instructor: Campbell. 3 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. C-L: Public Policy Studies 297, Political Science 264
- Environment 292L. Biological Oceanography.** Four units (spring); six units (summer). (Given at Beaufort and Bermuda.) Prerequisite: introductory biology. Instructors: Sstaff (Beaufort); Lomas (Bermuda). Variable credit.
- 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. Four units (fall, spring, and Summer Term II); six units (Summer Term I). (Given at Beaufort fall, spring, and summer or at Bermuda, spring.) Prerequisite: Biology 25L. Instructors: Dimock (Beaufort) or Kirby-Smith (Beaufort); Wood (Bermuda). Variable credit. C-L: Biology 274L
- Environment 298. Special Topics.** Instructor: Staff. Variable credit.
- Environment 299. Independent Studies and Projects.** Consent of instructor required. Units to be arranged. Instructor: Staff. Variable credit.
- Environment 322. Coastal Watershed and Policy.** Instructor: Kirby-Smith. 3 units.
- Environment 324. Marine Conservation Biology.** Instructor: Read. 3 units.
- Environment 360S. Political Ecology.** Instructor: Campbell. 3 units.
- Environment 398. Program Area Symposium.** Instructor: Staff. 1 unit.
- Environment 399. Master's Project.** Consent of instructor required. Pass/fail grading only. Instructor: Staff. Variable credit.
- Political Science 264. Marine Policy.** 3 units. C-L: see Environment 276; also C-L: Public Policy Studies 297
- Public Policy Studies 297. Marine Policy.** 3 units. C-L: see Environment 276; also C-L: Political Science 264

Mathematics (MATH)

Professor Hain, *Chair* (124B Physics); Professor Witelski, *Director of Graduate Studies* (233C Physics); Professors Agarwal, Allard, Beale, H. Bray, Bryant, Edelsbrunner, Hain, Harer, Layton, Morrison, Pardon, Petters, Reed, Rose, Schaeffer, Schoen, Stern, Trangenstein, Venakides, and Zhou; Associate Professors Aspinwall, R. Hodel, Kraines, Plesser, and Saper; Assistant Professors Huber and Mattingly; Assistant Research Professors Degeratu, Hanke, Katz, A. Layton, and R. Yoshida; VIGRE Postdoctoral Fellow Michener; Lecturing Fellows C. Bray, Dong, M. Hodel, and Tomberg; Associate Professors

of the Practice Blake and Bookman; Adjunct Professors Bertozzi, Howard, Shearer and Wahl; Professors Emeriti Kitchen, Moore, Scoville, Smith, Warner, and Weisfeld.

Graduate work in the Department of Mathematics is offered leading to the Ph.D. degree. Admission to this program is based on the applicant's undergraduate academic record, level of preparation for graduate study, the Graduate Record Examination general and subject tests, and letters of recommendation.

The department offers research training in both pure and applied mathematics. Major areas of research specialization include algebra and algebraic geometry, analysis and partial differential equations, applied mathematics and scientific computing, 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, and the Center for Nonlinear and Complex Systems.

All Ph.D. students are required to pass a qualifying examination; most students take this examination shortly after completing their first year of graduate study. While students are normally admitted only to the Ph.D. program, 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. 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. degree.

Further details concerning the department, the graduate program, admissions, facilities, the faculty and their research, and financial support may be obtained from our web site <http://www.math.duke.edu/>. For inquiries, send e-mail to the director of graduate studies at dgs-math@math.duke.edu.

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.

215. Mathematical Finance. An introduction to the basic concepts of mathematical finance. Topics include modeling security price behavior, Brownian and geometric

Brownian motion, mean variance analysis and the efficient frontier, expected utility maximization, Ito's formula and stochastic differential equations, the Black-Scholes equation and option pricing formula. Prerequisites: Mathematics 103, 104, 135 or equivalent, or consent of instructor. Instructor: Staff. 3 units. C-L: Economics 225

216. Applied Stochastic Processes. An introduction to stochastic processes without measure theory. Topics selected from: Markov chains in discrete and continuous time, queuing theory, branching processes, martingales, Brownian motion, stochastic calculus. Prerequisite: Mathematics 135 or equivalent. Instructor: Staff. 3 units. C-L: Statistics and Decision Sciences 253

217. Linear Models. 3 units. C-L: see Statistics and Decision Sciences 244

221. Numerical Analysis. 3 units. C-L: see Computer Science 250; also C-L: Statistics and Decision Sciences 250

224. Scientific Computing I. Structured scientific programming in C/C++ and FORTRAN. Floating point arithmetic and interactive graphics for data visualization. Numerical linear algebra, direct and iterative methods for solving linear systems, matrix factorizations, least squares problems and eigenvalue problems. Iterative methods for nonlinear equations and nonlinear systems, Newton's method. Prerequisite: Mathematics 103 and 104. Instructor: Staff. 3 units.

225. Scientific Computing II. Approximation theory: Fourier series, orthogonal polynomials, interpolating polynomials and splines. Numerical differentiation and integration. Numerical methods for ordinary differential equations: finite difference methods for initial and boundary value problems, and stability analysis. Introduction to finite element methods. Prerequisite: Mathematics 224 and familiarity with ODEs at the level of Mathematics 111 or 131. 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. 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.

236. General Relativity. 3 units. C-L: see Physics 292

241. Real Analysis. Measures; Lebesgue integral; L_p spaces; Daniell integral, differentiation theory, product measures. Prerequisite: Mathematics 204 or equivalent. Instructor: Staff. 3 units.

242. Functional Analysis. Metric spaces, fixed point theorems, Baire category theorem, Banach spaces, fundamental theorems of functional analysis, Fourier transform. Prerequisite: Mathematics 241 or equivalent. Instructor: Staff. 3 units.

245. Complex Analysis. Complex calculus, conformal mapping, Riemann mapping theorem, Riemann surfaces. Prerequisite: Mathematics 204 or equivalent. Instructor: Staff. 3 units.

248. Topics in Analysis. Harmonic analysis, dynamical systems, geometric measure theory, or calculus of variations. Prerequisite: Mathematics 241 and 245 or equivalents. 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. 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. Prerequisite: Mathematics 251 or equivalent. Instructor: Staff. 3 units.

253. Representation Theory. Representation theory of finite groups, Lie algebras and Lie groups, roots, weights, Dynkin diagrams, classification of semisimple Lie algebras and their representations, exceptional groups, examples and applications to geometry and mathematical physics. Prerequisite: Mathematics 200 or equivalent. Instructor: Staff. 3 units. C-L: Physics 293

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. 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.

267. Differential Geometry. Differentiable manifolds, fiber bundles, connections, curvature, characteristic classes, Riemannian geometry including submanifolds and variations of length integral, complex manifolds, homogeneous spaces. 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.

272. Riemann Surfaces. Compact Riemann Surfaces, maps to projective space, Riemann-Roch Theorem, Serre duality, Hurwitz formula, Hodge theory in dimension one, Jacobians, the Abel-Jacobi map, sheaves, Čech cohomology. Prerequisite: Mathematics 245 and Mathematics 261 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.

274. Number Theory. Binary quadratic forms; Orders, Integral closure; Dedekind domains; Fractional ideals; Spectra of rings; Minkowski theory; Fundamental finiteness theorems; Valuations; Ramification; Zeta functions; Density of primes in arithmetic progressions. Prerequisites: Mathematics 201 or 251 or 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.

281. Partial Differential Equations II. Linear wave motion, dispersion, stationary phase, foundations of continuum mechanics, characteristics, linear hyperbolic systems, and nonlinear conservation laws. 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.

287. Probability. Random variables, independence, expectations, laws of large numbers, central limit theorem, martingales, Brownian motion. 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.

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

207. Topics in Mathematical Physics

211. Mathematical Methods in Physics and Engineering I

212. Mathematical Methods in Physics and Engineering II

218. Introduction to Multivariate Statistics

222. Numerical Methods for Partial Differential Equations

223. Numerical Linear Algebra

238. Topics in Applied Mathematics

239. Applied Mathematics

249. Topics in Functional Analysis

257. Mathematical Logic

264. Topics in Topology

279. Topics in Mathematical Physics

284. Topics in Partial Differential Equations

288. Topics in Probability Theory

297. Special Readings

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 Physics

Associate Professor Dobbins, Director; Assistant Professor Samei, Director of Graduate Studies; Professors Floyd, Jaszczak, Johnson, Spider, Trahey, Yin, and Zalutsky; Associate

Professors Dobbins, MacFall, Song, and Tornai; Assistant Professor Samei; Associate Research Professors Bida, Das, Turkington, and Zhou; Assistant research Professors Bowsher and Lo; Associate clinical Professors Oldham and Yoshizumi; Assistant Clinical Professors Craciunescu, Petry, Rieman, Wang, and Whiddon; Consulting Associate Professor Wieland; Adjunct Assistant Professor Vylet

Medical physics is a discipline that applies physics to the needs of medicine, and has been instrumental in the development of the medical fields of radiology, radiation oncology, and nuclear medicine. The Medical Physics Graduate Program, new at Duke in 2005-06, offers M.S. and Ph.D. degrees, and is organized into four academic tracks: diagnostic imaging physics, radiation oncology physics, nuclear medicine physics, and medical health physics. Graduates are trained for employment opportunities in academic, clinical service, industry, or government labs. The medical physics program is a collaborative interdisciplinary program, and the faculty are drawn from the sponsoring departments of radiology, radiation oncology, occupational and environmental safety (health physics), biomedical engineering, and physics. Current research interests of the faculty include magnetic resonance imaging and microscopy, advanced digital imaging instrumentation and algorithms, detector and display characterization, computer-aided diagnosis, ultrasound, monoclonal antibody imaging and therapy, intensity modulated radiation therapy, on-board imaging in radiation therapy, SPECT and PET imaging, neutron-stimulated imaging, and dosimetry. All students take common core courses in the first year, followed by concentration in a major track of study. Because this program is new this year, the courses are under development. A full, multi-year curriculum has been designed, and students are encouraged to consult the program Web site (medicalphysics.duke.edu) for a full list of anticipated future course offerings and an updated listing of program faculty.

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 \$20,772. 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.

MSTP AND M.D./Ph.D. students have the option of pursuing two different routes to graduate from Duke University. The first option is to be awarded the Ph.D. as soon as all requirements for that degree have been completed and before formal completion of the M.D. In order to implement this option students must sit for the final defense, submit to the library the final copies of the dissertation, and file, with the Graduate School, an Intention to Receive Degree form by the announced deadline for the semester in which they wish to receive the degree. (Please note that exercising this option precludes students from participating in a later Ph.D. ceremony.)

The second option is to be awarded both the Ph.D. and the M.D. at the same Commencement. Students exercising this option must, after completing their final defenses, submit the final copies of the dissertation to the library, which will notify the Graduate School of the completion of this requirement. Students will not, however, file an Intention to Receive Degree form with the Graduate School until the semester in which they complete the M.D. degree. (Please note that exercising this option places the burden of remembering to file the Intention to Receive Degree form with the individual student, not with the doctoral program or department or with the Graduate School.)

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)

Associate Professor Shannon (English), Chair and Director of Graduate Studies; Professors Aers (English), Beckwith (English, theater studies), Bland (religion), Borchardt (Germanic languages and literature), Bruzelius (art and art history), Clark (religion), Clay (classical studies), DeNeef (English), Garci-Gómez (romance studies), Greer (romance studies), Herrup (history), Hillerbrand (religion), Keefe (religion), Mahoney (philosophy), Mignolo (romance studies), Porter (English), Price (English), Quilligan (English), Rigsby (classical studies), Shatzmiller (history), Steinmetz (religion), and Wharton (art and art history); Associate Professors Bartlet (music), Brothers (music), Finucci (romance studies), Keefe (religion), Neuschel (history), Longino (romance studies), Rasmussen (Germanic languages and literature), Robisheaux (history), Silverblatt (cultural anthropology), Solterer (romance studies), Somerset (English), Van Miegroet (art and art history); Assistant Professors McCarthy (music), Parker (classical studies), Schachter (romance studies), Woods (classical studies); Professors Emeriti Caserta (romance studies), Newton (classical studies), Randall (English, theater studies), Silbiger (music), Tetel (romance studies), Williams (English), and Witt (history); Adjunct Assistant Professor Keul (Germanic languages and literature)

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, offering courses in art history, history, music, philosophy, religion, and language and literature (classical studies, English, German, and Romance languages). The Program in Medieval and Renaissance Studies seeks to promote cross-departmental and cross-institutional engagement that gives students a network of colleagues beyond their home departments.

Students may earn a formal Graduate Certificate in interdisciplinary Medieval and Renaissance Studies by meeting the following requirements: (1) complete three Medieval and Renaissance courses *outside* of the major department (MEDREN 300 or MEDREN 301 may count as one of these three distributional courses, and students are highly encouraged to take these cross-disciplinary seminars); (2) attend the Medieval-Renaissance Graduate Colloquium for two consecutive years; (3) present a research paper at one of several local Medieval and Renaissance workshops, colloquia, or conferences; and (4) complete a dissertation on a topic in Medieval and Renaissance studies. While students may be affiliated with the Center without having to obtain the Graduate Certificate, the certificate is a valuable complement to degrees in traditional Duke departments. Students planning to obtain the certificate should file an application with the Center for Medieval and Renaissance Studies as early in their careers as possible, but no later than the fall of their graduation year. For an application and more detailed information on the program and its requirements, contact our director of graduate studies and visit our web site at <http://www.duke.edu/~jmems/cmrs>.

For descriptions of cross-listed courses below, see the listings under the specified departments.

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.

201S. Introduction to Medieval German: The Language of the German Middle Ages and Its Literature. 3 units. C-L: see German 209S

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: see German 210S

204. Origen. 3 units. C-L: see 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). Each year offers a special focus, such as: 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) are included. Also offered as a Divinity School course, and as Religion 206. 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. Prerequisites: Medieval and Renaissance Studies 202B and 202C. Instructor: Staff. 3 units.

209S. Middle English Literature: 1100 to 1500. 3 units. C-L: see English 212S

210AS. History of the Spanish Language. 3 units. C-L: see Spanish 210S; also C-L: Linguistics 210S

212. Notation. 3 units. C-L: see Music 212

213S. Chaucer and His Contexts. 3 units. C-L: see English 213S

216. Augustine. 3 units. C-L: see Religion 219

218S. Medieval Philosophy. 3 units. C-L: see Philosophy 218S

219S. Late Medieval and Renaissance Philosophy. 3 units. C-L: see Philosophy 219S

220BS. Religion and Society in the Age of the Reformation. 3 units. C-L: see History 221BS

220S. Shakespeare: Selected Topics. 3 units. C-L: see English 220S

221BS. Renaissance Prose and Poetry: 1500 to 1660. 3 units. C-L: see English 221S

221C. Medieval Latin. 3 units. C-L: see Latin 221

223A. Music in the Middle Ages. 3 units. C-L: see Music 222

223B. Music in the Renaissance. 3 units. C-L: see Music 223

224. Music in the Baroque Era. 3 units. C-L: see Music 224

233S. Topics in Early Christian and Byzantine Art. 3 units. C-L: see Art History 233S; also C-L: Classical Studies 230S, Religion 275S

234A. Early Christian Asceticism. 3 units. C-L: see Religion 234

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.

237S. Topics in Romanesque and Gothic Art and Architecture. 3 units. C-L: see Art History 236S

240. Medieval Narrative. 3 units. C-L: see French 240

241. History of Netherlandish Art and Visual Culture in a European Context. 3 units. C-L: see Art History 241

242. History of Netherlandish Art and Visual Culture in a European Context. 3 units. C-L: see Art History 242

243S. Topics in Netherlandish and German Art. 3 units. C-L: see Art History 243S

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.

247. Readings in Latin Ecclesiastical Literature. Readings in Latin of pastoral, theological, and church-disciplinary literature from the late patristic and medieval period. Also offered as a graduate Religion and Divinity School course. Open to juniors and seniors only. Prerequisite: knowledge of Latin. Instructor: Keefe. 3 units.

249. Early Modern Studies. 3 units. C-L: see French 247

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.

254. Justice, Law, and Commerce in Islam. 3 units. C-L: see Religion 254; also C-L: African and African American Studies 254

260B. History of the German Language. 3 units. C-L: see German 260; also C-L: Linguistics 260

267S. Britain in the Sixteenth Century. 3 units. C-L: see History 267S

268S. England in the Seventeenth Century. 3 units. C-L: see 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.

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

208. History of the English Language

210B. History of the French Language

234B. Heresy: Theological and Social Dimensions of Early Christian Dissent

236B. Special Topics in Early Medieval History

238S. Europe in the High Middle Ages

244. Classical Islamic Theology and Ethics

248S. Topics in Italian Renaissance Art

260A. The Byzantine Empire

261S. Topics in Italian Baroque Art

University Program in Molecular Biophysics

See "University Program in Structural Biology and Biophysics" alphabetized under "Structural"

The University Program in Molecular Cancer Biology (MOLCAN)

Professor Patrick Casey, *Director* (pharmacology and cancer biology) C133 LSRC; Professor Ann Marie Pendergast, *Director of Graduate Studies* (pharmacology and cancer biology) C233 LSRC; Professors Bennett (cell biology), Blackshear (medicine), Caron (cell biology), Casey (pharmacology and cancer biology), Colvin (Medicine), Dewhirst (radiation oncology), Keene (microbiology), Lefkowitz (medicine), McDonnell (pharmacology and cancer biology), Means (pharmacology and cancer biology), Modrich (biochemistry), Nevins (genetics), Pendergast (pharmacology and cancer biology), Slotkin (pharmacology and cancer biology), and Wang (pharmacology and cancer biology);

Associate Professors Daaka (surgery) Garcia-Blanco (genetics), Heitman (genetics), Kornbluth (pharmacology and cancer biology), Lew (pharmacology and cancer biology), Yao (pharmacology and cancer biology), and Zhuang (immunology); Assistant Professors Blobe (medicine), Counter (pharmacology and cancer biology), Kontos (medicine); Reya (pharmacology and cancer biology), Rudolph (biochemistry), Wechsler-Reya (pharmacology and cancer biology), and York (pharmacology and cancer biology).

The molecular cancer biologists at Duke University seek to understand the complex regulatory mechanisms that govern mammalian cell growth and differentiation, discern how these mechanisms are perturbed in malignant cells, and how our knowledge of these regulatory mechanisms might lead to improved anti-cancer therapy. This research covers the boundaries of disciplines such as pharmacology, biochemistry, molecular biology, genetics and cell biology, and has increased our knowledge of the basic mechanisms underlying growth regulation. To understand how and why these mechanisms fail, and how their failure results in the initiation of cancer requires an understanding of the molecules involved in chemically and cellularly precise terms, so as to decipher their ultimate impact on the growth and development of the organism.

The Program in Molecular Cancer Biology includes faculty from nine participating departments. Program scientists are actively engaged in dissecting the regulatory networks that control the processes of growth and development at the cellular and molecular levels, and the defects that lead to oncogenic transformation.

The approaches used by the investigators range from classical genetics to cell and molecular biology and protein biochemistry. An ultimate goal is identifying novel candidates for therapeutic intervention of oncogenesis. Graduate training in this program is greatly enhanced by the interaction between investigators.

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.

208. Stem Cell Biology Minicourse. 2 units. C-L: Cell Biology 208

210. Independent Study in Molecular Cancer Biology. Consent of instructor required. Instructor: Staff. 1 unit.

300. Special Topics in Cancer Biology. Instructor: Wechsler-Reya. 2 units.

301. Molecular Cancer Biology Seminar. Instructor: Yao. 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. Instructor: Caron, Casey, Means, and invited lecturers. 3 units. C-L: Biochemistry 417, Cell Biology 417, Pharmacology and 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: Counter and staff. 2 units. C-L: Pharmacology and Cancer Biology 418

Molecular Genetics and Microbiology (MGM)

Professor Petes, Chair (366 CARL); Assistant Professor Amrein, Director of Graduate Studies (323 CARL); Professors Cullen, Garcia-Blanco, Goldschmidt-Clermont, Heitman, Keene, Linney, Nevins, Pericak-Vance, Petes, Schwartz, and Willard; Associate Professors Lew, Marchuk, McCusker, Mitchell, Pickup, Wharton, and Zhuang; Assistant Professors Aballay, Amalfitano, Amrein, Chi, Dietrich, Gromeier, Matsunami, and Valdivia

The Department of Molecular Genetics & Microbiology offers a range of opportunities for training in the use of molecular and genetic tools to solve biological problems. Current research interests are focused in microbial pathogenesis, RNA biology, virology, and experimental genetics and genomics. Members of the Department use a wide variety of experimental approaches (e.g., classical genetics, generation of transgenic animals, tissue culture models) and study a diversity of organisms (budding yeast, *Cryptococcus*, fruit flies, mice, zebrafish, and humans). The Department is extremely interactive. In addition to course work, students participate in a number of activities that enhance their training and facilitate interaction with each other, as well as with post-doctoral fellows and faculty. Refer to <http://mgm.duke.edu> for more information.

203. Research Independent Study. Independent research in Molecular Genetics and Microbiology. Instructor: Staff. 3 units.

222. Critical Readings in Genetics and Genomics. Classical and molecular genetic approaches to understanding eukaryotic cell function using unicellular organisms such as yeasts. Experimental approaches as well as illustrative studies of secretion, cell cycle, signal transduction, and cytoskeleton. Discussion of current literature and student presentations. Consent of instructors required. Instructors: Heitman, Lew, McCusker. 3 units.

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. Prerequisites: 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

252. Virology. Molecular biology of mammalian viruses, with emphasis on mechanisms of replication, virus-host interactions, viral pathogenicity, and the relationship of virus infection to neoplasia. Instructor: Cullen and staff. 3 units.

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. Instructor: McCusker, Abraham, and staff. 3 units.

300. Gene Regulation. Principles of prokaryotic and eukaryotic gene regulation at transcriptional and post-transcriptional levels. Topics include promoter structure and transcription factor function; processing, transport, and degradation of mRNA; translation. Gene regulatory pathways. Instructor: Nevins and staff. 3 units.

301. Topics in Molecular Genetics and Microbiology. Discussion of current literature related to seminars in the Thursday series. Instructor: Wharton and staff. 2 units.

378. Genetic Approaches to the Solution of Biological Problems. 4 units. C-L: see University Program in Genetics 378; also C-L: Cell and Molecular Biology 378, Biology 378

Music (MUSIC)

Associate Professor Lindroth, Chair (105 Mary Duke Biddle Music Building); Associate Professor Meintjes, Director of Graduate Studies (072 Mary Duke Biddle Music Building); Professors Jaffe, Todd and Gilliam; Associate Professor Brothers; Assistant Professors Kelley and McCarthy; 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 17 courses (51 units) are required; no more than four courses (12 units) may be accepted for transfer from another institution. Two courses may 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 students 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 17 courses (51 units) are required; no more than four courses (12 units) may be accepted for transfer from another institution. Three courses may 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, students 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 11 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: Staff. 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: Staff. 3 units.

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, Lindroth, or Kelley. 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: Staff. 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: Staff. 3 units.

222. Music in the Middle Ages. Selected topics. Instructor: Brothers. 3 units. C-L: Medieval and Renaissance Studies 223A

223. Music in the Renaissance. Selected topics. Instructor: Brothers or McCarthy. 3 units. C-L: Medieval and Renaissance Studies 223B

224. Music in the Baroque Era. Selected topics. Instructor: McCarthy. 3 units. C-L: Medieval and Renaissance Studies 224

225. Music in the Classic Era. Selected topics. Instructor: Todd. 3 units.

226. Music in the Nineteenth Century. Selected topics. Instructor: Gilliam or Todd. 3 units.

227. Music in the Twentieth Century. Selected topics. Instructor: Brothers, Gilliam, or Todd. 3 units.

228. Collegium Musicum. An opportunity to study and perform vocal and instrumental music from the Middle Ages through the Baroque. Weekly rehearsals; one or two concerts per semester. Audition and consent of instructor required. Instructor: McCarthy or staff. 1.5 units.

259. Introduction to Audition, or Why We Hear What We Do. 2 units. C-L: see Neurobiology 259; also C-L: Philosophy 259, Psychology 265

295S. Composition Seminar. Selected topics in composition. Instructor: Jaffe, Lindroth, or Kelley. 3 units.

297. Composition. Weekly independent study sessions at an advanced level with a member of the graduate faculty in composition. Instructor: Jaffe, Lindroth, or Kelley. 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, Lindroth, or Kelley. 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, Lindroth, or Kelley. 3 units.

317S. Seminar in the History of Music. Selected topics. Instructor: Staff. 3 units.

330. 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. 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, Lindroth, or Kelley. 3 units.

398. Composition. Weekly independent studies at the doctoral level with a member of the graduate faculty in composition. Instructor: Jaffe, Lindroth, or Kelley. 3 units.

399. Composition. Weekly independent studies at the doctoral level with a member of the graduate faculty in composition. Instructor: Jaffe, Lindroth, or Kelley. 3 units.

COURSES CURRENTLY UNSCHEDULED

218. Advanced Counterpoint

228A. Collegium Musicum

229. Collegium Musicum
229A. Collegium Musicum
236. Nineteenth-Century Piano Music
318S. Seminar in Performance Practice

Nanoscience

The mission of the graduate *Certificate Program in Nanoscience (CPN)* is to educate students in nanoscience disciplines and applications. This graduate certificate program is designed to address the need for an interdisciplinary graduate education in nanoscience that extends beyond the traditional disciplines and skills that are taught within existing departments. In this program, graduate students are educated and mentored in classes, labs and research projects by faculty from many disciplines. Current focus areas within nanoscience that are currently represented at Duke include: i) synthesis of nanostructured materials, ii) fundamental properties of nanostructured materials, iii) nanodevice fabrication and applications, and iv) advanced characterization of nanostructured materials and devices. The disciplines span the physical sciences, engineering, and basic biological-science disciplines that are relevant to nanoscience; the program includes faculty from departments within Arts and Sciences, the Pratt School of Engineering, and the Medical School. Member departments include: Biology, Biochemistry, Biomedical Engineering, Cell Biology, Chemistry, Computer Science, Electrical and Computer Engineering, Mechanical Engineering and Materials Science, and Physics.

For additional information, visit the web site: <http://www.cs.duke.edu/nano/>, or contact Professor John Reif (reif@cs.duke.edu) or Professor Stephen Teitworth (teitso@phy.duke.edu).

Requirements

To be awarded a Certificate in Nanoscience, a student must:

- 1) be enrolled in the Certificate Program in Nanoscience for at least two years; have a Nanoscience Advisory Committee appointed and approved by the Nanoscience DGS; complete the requirements for a PhD in their department, with a PhD thesis committee containing at least one member of the core Nanoscience faculty;
- 2) take the following required courses:
 - (a) the single semester course NANO200 Foundations of Nanoscience or approved substitution elective course,
 - (b) the single semester course NANO201 Nanoscience Laboratory or approved substitution elective course,
 - (c) take the single semester course NANO202 Nanoscience Graduate Seminar and have regular attendance at the Nanoscience Graduate Seminar throughout the period of the student's enrollment in the Certificate Program in Nanoscience;
 - (d) take a one semester elective course or three one-month short courses chosen from an approved list of Nanoscience elective courses at Duke University; and
- 3) complete a project of duration approximately one to two months (the project and its duration must be pre-approved by the student's Advisory Committee) in association with a research group in Nanoscience outside the student's dissertation group, to be described by a written report or poster presentation (for example, an experimental student in physics may take a rotation in another laboratory at Duke University, while a theoretical student in physics may do a project in a software laboratory).

Elective courses in Nanoscience:

Biochemistry

222. Structure of Biological Macromolecules

Biology

295S. Physical Approaches to the Living Cell

Biomedical Engineering

207. Transport Phenomena in Biological Systems

220L. Introduction to Biomedical Engineering

247. Drug Delivery

Cell Biology

251. Molecular Cell Biology

Chemistry

304. Separation Science

311. Biological Chemistry

321. Inorganic Chemistry

326. Transition Metal Ion Reactivity and Mechanisms

328. Synthesis and Synthetic Methods in Inorganic/Organometallic Chemistry

331. Organic Chemistry

334. Physical Organic Chemistry

336. Bioorganic Chemistry

348. Solid State Chemistry

Computer Science

222. Nanocomputers

230. Design and Analysis of Algorithms

250. Numerical Analysis

260. Algorithms in Computational Biology

296. Molecular Computing, Biomolecular Nanotechnology

Mathematics

224. Scientific Computing I

225. Scientific Computing II

226. Numerical Partial Differential Equations I

229. Mathematical Modeling

Mechanical Engineering and Materials Science

208. Introduction to Colloid and Surface Science

209. Soft Wet Materials and Interfaces

211. Theoretical and Applied Polymer Science

265.2 Interaction of radiation with nanostructured matter

310. Nanomechanics: From Molecules to Materials

Physics

246S. Physical Approaches to the Living Cell

307. Introduction to Condensed Matter Physics

310. Advanced Solid State Physics

346. Introduction to Electronic Nanophysics

Neurobiology (NEUROBIO)

Professor McNamara, Chair (101I Bryan Research Building); Professor Chikaraishi, Director of Graduate Studies (427G Bryan Research Building); Professors Abou-Donia, Augustine, Bennett, Boustany, Fitzpatrick, Flanagan, W. C. Hall, W. G. Hall, Katz, McCarthy, McClay, Nadler, Nicoletis, Purves, Schwartz-Bloom, Simon, Slotkin, Staddon, Strittmatter, Turner, Tyrey, Warner, and Wong; Associate Professors Cant, Corless, Ehlers, Guzeldere, Haglund, Jarvis, Lewis, Lo, Mooney, Nowicki, Schmechel, Skene, and Vandongen; Assistant Professors Feng, George, Huettel, Lascola, Laskowitz, Liedtke, Matsunami, Platt, Raghavachari, Rich, Tracey, Wang, Wechsler-Reya, West, Yasuda, and White; Associate Research Professors Madison, Vitek, and Woldorff; Assistant Research Professors Alzate, Peng, Rickman, and Voyvodic; Assistant Adjunct Professors Xiong, Yakel, and Williams

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, in both biology and medicine, broad and important questions about this complex organ remain to be answered. 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.

The ways in which 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.

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 Arts and Sciences campus also participate in the work. There are now more than sixty faculty members associated with the graduate program in neurobiology at Duke. A large and diverse body of students and other professionals are also engaged in neurobiological research.

Students in the graduate program take a core curriculum that covers the major subfields of contemporary neurobiology, but students 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 *Basic Neurobiology* (Neurobio 202), *Student Seminar* (Neurobio 280), *Readings in Neuroscience* (Neurobio 322), *Concepts in Neuroscience* (Neurobio 323), and *Frontiers in Neuroscience* (Neurobio 325).

For additional information, please visit our web site at <http://neurobiology.mc.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: Mooney and Williams. 4 units.

210. Independent Study. Directed reading and research in neurobiology. Course intended primarily for upper-level undergraduate students. Consent of instructor required. Instructor: Staff. Variable credit.

212. Research Independent Study. Individual research and reading of the primary literature in a field of special interest, under the supervision of a faculty member, the major product of which is a substantive paper or written report containing significant analysis and interpretation of a previously approved topic. Consent of instructor required. Instructor: Staff. 3 units.

259. Introduction to Audition, or Why We Hear What We Do. The purpose of this course is to consider broadly audition in relation to the end of the auditory system, namely the sounds we hear for a variety of purposes ranging from navigation in the auditory environment to communication and music. The course will consider these functions primarily in humans, but will also deal with their analogues, homologues, and precedents in a range of other animals. An additional theme will be a comparison of the operating principles of the auditory system with what is presently known about vision. Instructor: Purves. 2 units. C-L: Philosophy 259, Psychology 265, Music 259

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: Staff. 1 unit.

322. Readings in Neuroscience. The goal of this course is to introduce beginning graduate students to the neurobiological literature and to the techniques used to analyze this literature. For each class, students will read some of the classic papers in the field. During the class

meeting, faculty will lead the students in detailed discussions and analyses of these papers. Concurrent enrollment in Neurobiology 323 is a requirement for enrollment in Neurobiology 322. Instructor: Chikaraishi. 3 units.

323. Concepts in Neuroscience. The goal of this course is to introduce trainees to the basic principles of neuroscience that all neurobiology graduate students are expected to know before embarking on their specialized research programs. Each week a different topic will be discussed, ranging from cellular aspects of neuronal signaling to cortical mechanisms of perception and motor control. An interactive discussion-based format with focus on original papers will allow students to immerse themselves in the fundamental issues that lie at the heart of contemporary neuroscience. There will be weekly review and discussion sessions in small groups. Note: Concurrent enrollment in Neurobiology 322 is not a prerequisite for this course. Instructor: Chikaraishi. 3 units. C-L: Psychology 361

325. Frontiers in Neuroscience. This course is designed to give first-year graduate students in Neurobiology an opportunity to discuss neuroscience topics that are the focus of investigations in the laboratories of primary faculty members. Each faculty member gives a department seminar that provides a glimpse of his or her latest accomplishments and future directions. Prior to their seminars faculty members meet with the first-year students for one-hour sessions to review the background and significance of the research, ongoing in their labs, which will be the focus of the upcoming seminar. Instructor: Staff. 1 unit.

333. Statistics for Basic Biomedical Scientists. 2 units. C-L: see Pharmacology and Cancer Biology 333

349S. Cognitive Neuroscience I. 3 units. C-L: see Psychology 359S; also C-L: Philosophy 359S

350S. Cognitive Neuroscience II. 3 units. C-L: see Psychology 360S; also C-L: Philosophy 360S

351. Molecular Neurobiology. This is a reading/tutorial course for graduate students covering primary literature in selected areas of molecular neurobiology. Topics include aspects of gene expression in the nervous system with particular emphasis on the induction of gene expression by neuronal signals and the mechanisms by which neuronal identity is acquired. Topics will be modified to suit the interests of students. Half-semester. Instructor: Chikaraishi. 2 units.

353. Neurobiology of Olfaction. Based on critical readings from the original literature, this advanced seminar course will explore cellular, molecular, and systems level approaches to olfactory signal transduction, the encoding and representation of olfactory information, and the role of olfaction in animal behavior. Examples will be drawn from invertebrate and vertebrate systems, and additional readings will include comparisons with other chemosensory systems, such as pheromone sensing. Instructor: Katz. 3 units.

357. Vision: Why We See What We Do. This course will cover the major aspects of visual perception (brightness, color, form, motion, and depth) and present understanding of the underlying neurobiological machinery. Particular attention will be paid to links between perception and its generation by visual system circuitry. The course will be about equally divided between lecture and discussion; grades will be based on class participation and weekly papers critiquing/commenting on the relevant literature. Instructor: Purves. 2 units.

361. Neurobiology of Disease. Series of weekly two-hour sessions, each centered on a given disease of the nervous system. One or two students working with a designated faculty member are responsible for an introduction (20-25 minutes) followed by a discussion of key primary papers on the subject. Two or three articles provided at least a week in advance provide a framework for discussion. Diseases to be covered currently include: ALS, Alzheimer's, CNS neoplasms, Epilepsy, multiple sclerosis, Parkinson's disease, retinitis pigmentosa, and stroke. The idea is to describe the key features of the disease, current insight into etiology and pathogenetic mechanisms of the disease, models available and the evidence (if any) establishing the validity of the models, therapies available and envisioned.

The topic "Neuroengineering: Approach to Restorative Neurology" will be addressed. Instructor: McNamara. 2 units.

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 and Cancer Biology 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. Credit: 1-16. Staff. Variable credit.

381. Functional Magnetic Resonance Imaging. The course covers all aspects of functional magnetic resonance imaging, from its basic principles in physics, engineering, biophysics, and physiology; through computational, analytic, and signal processing issues; to its applications in neurobiology and cognitive neuroscience. The course will consist of weekly lectures and integrated laboratory sessions. Lectures will be given by BIAC faculty, and will incorporate primary readings in the field to encourage discussion. The laboratory sessions will involve analysis of fMRI data sets that illustrate issues discussed in the lectures. Students will gain experience both in the theoretical principles of fMRI and in the practical aspects of experimental design and data analysis. Instructor: Huettel. 3 units. C-L: Psychology 362

COURSES CURRENTLY UNSCHEDULED

324. Structure of the Vertebrate Brain

355. Neuroethology

360. Neuropharmacology: From Molecules to Behavior

Center for Nonlinear and Complex Systems (NCS)

Professor Behringer, Director; Professor Virgin, Associate Director; Professors Beale (mathematics), Behringer (physics), Dowell (mechanical engineering and materials science) Greenside (physics), Haff (earth and ocean sciences), Hall (mechanical engineering and materials science), Kepler (bioinformatics and biostatistics), Katul (aquatic and atmospheric sciences), Lewis (neurology), Nijhout (biology), Palmer (physics), Rosenberg (philosophy), Schaeffer (mathematics), Trangenstein (mathematics), Venakides (mathematics), and Virgin (mechanical engineering and materials science); Associate Professors Gauthier (physics), Henriquez (biomedical engineering) Howle (mechanical engineering and materials science), Krassowska (biomedical engineering), Krystal (psychology and behavioral science), Layton (mathematics), Socolar (physics), Teitworth (physics), Wilson (biology), and Wolf (biomedical engineering); Assistant Professors Lin (physics), Liu (chemistry), McShea (biology), Murray (earth and ocean sciences), Sterrett (philosophy), and Witelski (mathematics)

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, especially in complex systems. 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, such as Dynamic Days as well as focused workshops. 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 transferable 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, Civil and Environmental Engineering, Computer Science, Electrical and Computer Engineering, Earth and Ocean Sciences, Mathematics, Mechanical Engineering and Materials 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 choices follow.
- Complete a thesis on a topic within the domain covered by the CNCS, with at least two faculty from the center on the student's thesis committee.

201. Survey of Nonlinear and Complex Systems. 2 units. C-L: see 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 and Environmental 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 and Computer 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

Nicholas School of the Environment and Earth Sciences

216. Applied Population Ecology
290. Physical Oceanography
356. Environmental Fluid Mechanics

Nursing

Catherine L. Gilliss, Dean; Professors E. Clipp and R. Anderson, Co-Program Directors.

The Ph.D. Program in Nursing will prepare strong scientists to conduct nursing research in the broad area of Trajectories of Chronic Illness and Care Systems. Graduates will assume roles primarily in academic and research settings. Our approach is to admit a small number of highly qualified applicants so that every student will work closely with one or more faculty members in a series of mentored experiences, supported by formal course work, to (a) ensure socialization to the role of research scientist; (b) ensure significant knowledge and skill acquisition for launching a successful program of research post doctorate; and (c) to prepare for an entry level role in an academic setting.

The program requires a minimum of 54 credit hours of course work prior to a dissertation. Students will work on active research projects and it is expected that most will graduate with a record of publication. Course work is structured with a substantial core (36 credits) of nursing science and research methods to be taken in the School of Nursing. This core will be expanded with elected statistics, research methods, and minor area courses (18 credits) to be taken mainly outside of nursing in other Duke University departments. In addition to course work and a dissertation, the Ph.D. Program in Nursing will include two program-long structured activities which include mentored research and teaching experiences and development of the student's scholarly portfolio. Each student takes a comprehensive exam 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. All students will be expected to complete the program in four to five years.

A baccalaureate or master's degree in nursing from an accredited program (NLN or CCNE) is required for admission to the Ph.D. Program in Nursing. The student entering the Ph.D. program without a nursing master's degree must complete additional coursework (30 credit hours in addition to PhD requirements-see Duke University School of Nursing Bulletin).

Post-master's students. The student entering the Ph.D. program with a master's degree in nursing must show evidence of a master's level nursing research course and a graduate statistics course. These prerequisites may be met by taking N307 (Research Methods) and N308 (Applied Statistics) before proceeding with Ph.D. coursework (see Duke University School of Nursing Bulletin).

Post-baccalaureate students. The post-baccalaureate student will be admitted following demonstration of exceptional qualification and clear research-oriented career goals. The student entering the Ph.D. program post-baccalaureate must meet specific requirements (30 credit hours as described below) for a master's degree that will be awarded only at the completion of the Ph.D. program. The post-baccalaureate students in the Ph.D. program will declare a substantive focus area (e.g., gerontology, oncology, pediatric nursing, nursing and healthcare leadership). The post-baccalaureate student that does not complete the Ph.D. requirements will not receive a Master's degree unless they complete the full requirements of the MSN program (see the Duke University School of Nursing Bulletin).

For further information and course details visit the web site accessible from <http://www.nursing.duke.edu/academics/degree.html> or e-mail NursingPhD@duke.edu.

Pathology (PATHOL)

Professor Pizzo, Chair (301B Davison); Professor Abraham, Director of Graduate Studies (255 Jones); Professors Bigner, Goldschmidt-Clermont, Dewhirst, Dzau, Friedman, Greenberg, Hoffman, Jirtle, Klintworth, Pizzo, Proia, and Telen; Associate Professors Kane and Kraus; Assistant Professors Datto, Fields, Lawson, Marks, Hale, Ortel, Staats, Wahl, Yan, and Zalutsky; Professor Emeriti S. Bigner

The Ph.D. program in the Department of Pathology is designed to train students for research and teaching careers in molecular medicine and experimental pathology. 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. Consent of instructor required. 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: 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. 3 to 6 units. Instructors: Lewis and staff. 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. 3 to 6 units. Instructors: Lewis and staff. 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. 3 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. 1 to 4 units. Instructors: Pizzo and staff. 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 (for example, sarcoid, alveolar proteinosis). Ventilatory experiments will be done on excised human lungs. Instructor: 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

360. Cytochemistry

381. Cancer Biology

Pharmacology (PHARM)

Professor Means, Chair (C238 LSRC); Professor McDonnell, Director of Graduate Studies (C259 LSRC); Professors Abou-Donia, Casey, Colvin, Ellinwood, Heitman, Kuhn,

McNamara, Mills, Nadler, Newgard, Pendergast, Schanberg, Schwartz-Bloom, Slotkin, Thiele, and Wang; Associate Professors Haystead, Hellinga, Kwatra, Kornbluth, Levin, Lew, VanDongen, Whorton, Yao, and York; Assistant Professors Blobe, Counter, Ehlers, Muoio, Rathmell, Reya, and Wechsler-Reya; Professors Emeriti Kirshner, Lack, Ottolenghi and Wilder; Medical Research Professor Wilson.

Pharmacology offers a graduate program that 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. Instructor: Nadler and staff. 4 units.

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.

234. Interdisciplinary Approach to Pharmacology. Several model systems (cancer, immunological disorders, and infectious diseases) will be used to explore the molecular, biochemical, and physiological basis of drug action. Instructors: Heitman, Rathmell, Wang. 4 units.

235. Interdisciplinary Approaches to Pharmacology Part II. Several model systems (CNS, cardiovascular, and infectious diseases) will be used to explore the molecular biochemical, and physiological basis of drug action. Instructor: 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 toxicokinetics, 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: Means. 2 units.

297. Research Independent Study. Independent Study. 3 units.

298. Research Independent Study. Independent Study. 3 units.

314. Integrated Case Studies in Toxicology. 1 unit. C-L: see Environment 314

315. Focused Topics in Toxicology. 1 unit. C-L: see Environment 315

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. Ethical issues in data handling and presentation. Student presentations in addition to formal lectures. Intended for third-year graduate students. Instructor: Slotkin. 2 units. C-L: Neurobiology 333

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: Staff. 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

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: Counter 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. Instructor: Ellinwood and staff. 4 units.

Philosophy (PHIL)

Professor Brandon, Chair (201 West Duke); Professor Schmaltz, Director of Graduate Studies; Professors Buchanan, Flanagan, Gillespie (political science), Golding, Grant (political science), Mahoney, Purves (neurobiology), Rosenberg, Sanford, and Wong; Associate Professors Ferejohn, Güzeldere, and McShea (biology); Assistant Professors Einheuser, Janiak, and Sterrett; Professors Emeriti Peach and Welsh; Associate Professor of the Practice Kiss (political science); Adjunct Associate Professor Ward; Senior Research Professor 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 qualifying exams 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.

If a student's dissertation is devoted to any considerable extent to an author, that student must be able to read the author's works in his or her own original language. By the end of the sixth semester, every student must either demonstrate a reading knowledge of French, German, Greek, Latin, or some other appropriate language approved by the Director of Graduate Studies, or petition for an exemption from the requirement that includes an acceptable plan to complete substantial academic work outside of Philosophy that is essential for the student's area of research.

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. and J.D./Ph.D. programs. 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. J.D./M.A. and J.D./Ph.D. degrees are 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 J.D./Ph.D. students must apply for admission to both the Law School and the Graduate School. Both kinds of students 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. and J.D./Ph.D. programs, 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, Golding, or Wong. 3 units. C-L: Political Science 289S

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. Selected dialogues. Instructor: Ferejohn. 3 units. C-L: Classical Studies 211S

217S. Aristotle. Selected topics. Instructor: Ferejohn. 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

- 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: Sterrett. 3 units. C-L: Linguistics 228S
- 229S. Topics in the History of Philosophy.** Topics in one or more periods in the history of philosophy (for example, ancient, medieval, or modern) such as skepticism, mind-body relations, the nature of persons and personal identity, the relation between physics and metaphysics, causation and explanation. Instructor: Flanagan, Ferejohn, Janiak, Mahoney, Rosenberg, Schmaltz, or Sterrett. 3 units.
- 231S. Kant's Critique of Pure Reason.** Instructor: Janiak. 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 or Rosenberg. 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 or Rosenberg. 3 units. C-L: Biology 234S
- 236S. Hegel's Political Philosophy.** Within context of Hegel's total philosophy, an examination of his understanding of phenomenology and the phenomenological basis of political institutions and his understanding of Greek and Christian political life. Selections from *Phenomenology*, *Philosophy of History*, and *Philosophy of Right*. Research paper required. Instructor: Gillespie. 3 units. C-L: Political Science 236S
- 237S. Nietzsche's Political Philosophy.** 3 units. C-L: see Political Science 226S; also C-L: German 276S
- 238S. Problems in the Philosophy and Policy of Genomics.** An examination of normative, methodological, and metaphysical issues raised by molecular biology, and its relations to other components of biology, including human behavior. Instructor: Rosenberg. 3 units.
- 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: Dretske or 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: Dretske or Güzeldere. 3 units.
- 259. Introduction to Audition, or Why We Hear What We Do.** 2 units. C-L: see Neurobiology 259; also C-L: Psychology 265, Music 259

273S. Heidegger. 3 units. C-L: see Political Science 273S

291S. Special Fields of Philosophy. Instructor: Staff. 3 units.

292. Special Fields of Philosophy. Instructor: Staff. 3 units.

For Graduates

300. Problems in the Theory of Value and Judgment. 3 units. C-L: see Literature 300; also C-L: English 386

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.

359S. Cognitive Neuroscience I. 3 units. C-L: see Psychology 359S; also C-L: Neurobiology 349S

360S. Cognitive Neuroscience II. 3 units. C-L: see Psychology 360S; also C-L: Neurobiology 350S

COURSES CURRENTLY UNSCHEDULED

202S. Aesthetics: The Philosophy of Art

204S. Philosophy of Law

205S. Philosophy of History

210. Logic for Computer Science

220. The Presocratic Philosophers

232S. Recent Continental Philosophy

250S. Topics in Formal Philosophy

254S. Topics in Philosophy of Religion

256. Philosophy of Computing

331. Seminar in Special Fields of Philosophy

332. Seminar in Special Fields of Philosophy

Philosophy of Biology

The Duke Center for the Philosophy of Biology offers a formal interdisciplinary graduate certificate in the philosophy of biology. The program which draws upon course work and faculty from departments of biology and philosophy, as well as from the University of North Carolina at Chapel Hill and North Carolina State University. It is designed to enable students with substantial backgrounds in one of the two disciplines to learn about the major issues that animate research and scholarship on the intersections between biology and philosophy. The philosophy classes enable students to acquire experience in methods of philosophical analysis and to explore the broader philosophical background of problems in the philosophy of biology. The biology classes provide exposure to theoretical questions in biology that raise conceptual issues, to experimental methods and quantitative modeling with substantive and often unarticulated philosophical implications. Students generally apply to the program in their first or second years of doctoral study.

The interdisciplinary certificate will require at least two 200-level seminars in the Philosophy Department in philosophy of biology, at least two 200-level courses in Evolutionary and/or Developmental biology in the Biology Department; a directed reading class supervised by a faculty member in the Center for Philosophy of Biology, which eventuates in a capstone research paper; and regular participation in the philosophy of biology seminar over a two-year period. The certificate will have as prerequisites prior enrollment in at least one 100-level class in the philosophy of science or the philosophy of biology, and at least two courses in biology at the 100 level.

Photonics

The purpose of the Graduate Certificate Program in Photonics is to broaden the scope of the typical disciplinary graduate student education program. Students are encouraged to

develop interdisciplinary and transferable sets of skills in their course work and research activities. The program is designed to accommodate both Masters of Science and Ph.D. students who have been admitted to one of the participating departments. The certificate program helps to guide students toward this broad view by requiring the completing of a survey course entitled Introduction to Photonics; three courses from the approved course listing; one formal presentation in the Fitzpatrick Center Seminar Series; attend at least four Fitzpatrick Center Seminars a year (as documented by the student's advisor); and if the student is pursuing a Ph.D., two members of the center should be on the Ph.D. dissertation committee. For more information about the program, contact Bob Guenther, Box 90305, Duke University Fitzpatrick Center, Durham, NC 27708; (919) 660-2659.

Physics (PHYSICS)

Professor Gauthier, Chair (108 Physics); Associate Professor Plesser, Associate Chair for teaching; Associate Professor Springer, Director of Graduate Studies; Professors Baranger, Behringer, Chang, Edwards, Gauthier, Goshaw, Greenside, Han, Howell, Johnson, Morrison, Mueller, Oh, Palmer, Petters, Thomas, Tornow, and Weller; Associate Professors Aspinwall, Chandrasekharan, Gao, Kotwal, Matveev, Plesser, Socolar, Springer, and Teitsworth; Assistant Professors Bass, Finkelstein, Kruse, Lin, Mehen, Samei, Scholberg, Walter, and Wu; Professors Emeriti Bilpuch, Evans, Fairbank, Meyer, Roberson, Robinson, Walker, and Walter; Associate Research Professor Phillips; Assistant Research Professor Dutta; Adjunct Professors Ciftan, Everitt, Guenther, Kohena, Lawson, Rogosa, Skatrud, and West; Visiting Professor Brown

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, particle physics and string theory. In addition, the Physics Department is a major part of the university-wide Center for Nonlinear and Complex Systems.

For Seniors and Graduates

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: Virgin. 2 units. C-L: Nonlinear and Complex Systems 201

203. Introduction to Statistical Mechanics. Fundamentals of kinetic theory, thermodynamics and statistical mechanics with applications to physics and chemistry. Undergraduate enrollment requires consent of director of undergraduate studies. Prerequisite: Physics 211. Instructor: Bass. 3 units.

205. Introduction to Nuclear and Particle Physics. Introductory survey course on nuclear and particle physics. Phenomenology and experimental foundations of nuclear and particle physics; fundamental forces and particles, composites. Interaction of particles with matter and detectors. $SU(2)$, $SU(3)$, models of mesons and baryons. Weak interactions and neutrino physics. Lepton-nucleon scattering, form factors and structure functions. QCD, gluon field and color. W and Z fields, electro-weak unification, the CKM matrix, Nucleon-nucleon interactions, properties of nuclei, single and collective particle models. Electromagnetic and hadronic interactions with nuclei. Nuclear reactions and nuclear structure, nuclear astrophysics. Relativistic heavy ion collisions. Prerequisites: for undergraduates, Physics 211, 212; for graduate student, Physics 315, which may be taken concurrently. Instructor: Gao. 3 units.

- 211. Quantum Mechanics I.** Experimental foundation, wave-particle duality, the Schrodinger 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 104 or 111 and Physics 143L. Instructor: Edwards. 3 units.
- 212. Quantum Mechanics II.** 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: Chandrasekharan. 3 units.
- 213. Nonlinear Dynamics.** Introduction to the study of temporal patterns in nonequilibrium 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. Prerequisites: Computer Science 6, Mathematics 111, and Physics 51L, 52L. Instructor: Lin. 3 units. C-L: Computer Science 264
- 214. Biophysics in Cellular and Developmental Biology.** Application of the experimental and theoretical methods of physical sciences to the investigation of cellular and developmental systems. Topics include the physical techniques for investigating biological organization and function as well as examples of key applications. Prerequisites: Calculus-based introductory physics, Biology 119 or equivalent or consent of instructor. Instructor: Edwards (Physics) and Kiehart (Biology). 3 units. C-L: Biology 214
- 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: Oh. 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: Plesser. 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.
- 246S. Selected Topics in Theoretical Physics.** Introduction to group theory for physicists, representation theory of finite groups, general structure and classification of Lie algebras, Dynkin diagrams, SU(n) tensors and Young tableaux, Casimir operators, reducing product representations, branching rules, applications to theoretical and experimental physics. Prerequisites for Undergraduates Only: Math 104 or 111. Instructor: Staff. 3 units.
- 252. Introduction to Geophysics.** 3 units. C-L: see Earth and Ocean Sciences 252
- 255. Astrophysics.** An introductory survey of astrophysics with an emphasis on topics of current interest. Introduction to General Relativity, Stellar and Galactic Evolution, Standard Cosmology, Big-Bang Nucleosynthesis, Early Universe, Neutrino Astrophysics, Supernovae and Cosmic Rays, Special Topics. Prerequisites: Phy 176, Phy 181, Phy 182, Phy 211; Phy 212 is recommended. Instructor: Kruse. 3 units.
- 271. Quantum Optics.** The linear and nonlinear interaction of electromagnetic radiation and matter. Topics include lasers, second-harmonic generation, atomic coherence, slow and fast light, squeezing of the electromagnetic field, and cooling and trapping of atoms. Prerequisite: Physics 212 and 230. 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: Socolar. 3 units.

292. General Relativity. This course introduces the concepts and techniques of Einstein's general theory of relativity. The mathematics of Riemannian (Minkowskian) geometry will be presented in a self-contained way. The principle of equivalence and its implications will be discussed. Einstein's equations will be presented, as well as some important solutions including black holes and cosmological solutions. Advanced topics will be pursued subject to time limitations and instructor and student preferences. Prerequisite: A familiarity with the special theory and facility with multivariate calculus. Instructor: Plesser. 3 units. C-L: Mathematics 236

293. Representation Theory. 3 units. C-L: see Mathematics 253

For Graduates

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, nonequilibrium statistical mechanics. Prerequisite: Physics 303 and 316. Instructor: Staff. 3 units.

306. Radiation Detection. Introduction to detection of charged particles, photons and neutrons. Emphasis on active detector techniques: ionization detectors, scintillators and semiconductors; some passive methods mentioned. Quick review of radiation interaction with matter, followed by general detector characteristics, practical measurement techniques, signal processing and brief overview of radiation protection. Prerequisite: Core courses in graduate physics program. Instructor: Vylet. 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 203, 211, 212. Instructor: Behringer. 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: Staff. 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, 203, or equivalent. Instructor: Palmer. 3 units. C-L: Computer Science 364

315. Advanced 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. Prerequisite: Physics 212 or equivalent. Instructor: Mehen. 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: Chang. 3 units.

319. Advanced Electrodynamics. Lienard-Wiechart potentials, scattering theory, radiation theory, MHD and plasmas. Prerequisite: Physics 318. Instructor: Wu. 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 281, 318 or equivalents. Instructor: Wu. 3 units.

341. Quantum Field Theory. Classical field theory, symmetries and conservation laws, representations of the Lorentz Group, canonical quantization, Feynman diagrams and perturbation theory, elementary quantum electrodynamics, radioactive corrections, renormalization. Prerequisite: Physics 211, 212 and 315. Instructor: Staff. 3 units.

342. Advanced Quantum Field Theory. Study of a variety of topics in quantum field theory, selected from nonabelian gauge theory, anomalies, instantons, super-symmetry, topological defects, large-N techniques, spontaneous symmetry breaking, effective potentials, and finite temperature methods. Prerequisite: Physics 341. Instructor: Plesser or Springer. 3 units.

346. Topics in Theoretical Physics. Topics vary; check Physics Department website. Consent of instructor required. 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: Springer. 1 unit.

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: Staff. 1 unit.

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

240. Econophysics

261. Laser Physics

273. Fundamentals of Nonlinear Fiber Optics

291S. Physics at the Cutting Edge

308. Introduction to High-Energy Physics

314. Introduction to Fluid Mechanics

332. Advanced Quantum Optics

Political Science (POLSCI)

Professor Munger, Chair (303A Perkins); Associate Professor Haynie, Director of Graduate Studies (303A Perkins); Professors Aldrich, Feaver, Fish, Gillespie, Grant, Grieco, Hamilton, Horowitz, Hough, Jentleson, Kitschelt, Kornberg, Lange, McClain, Mickiewicz, Niou, Paletz, Price, Remmer, Rohde, and Spragens; Associate Professors Coles, Eldridge, Gelpi, Hacoen, Mayer, McKean, and Shi; Assistant Professors Büthe, Charney, deMarchi, Downes, Kelley, Krishna, Morgenstern, Siegel, Transue, Trejo, and Wilkinson; Research Professors Brennan, Euben, and Soskice; Associate Professor of the Practice Kiss; Professors Emeriti Braibanti, Hall, Holsti, and Johns; Adjunct Professors MacKuen and Stimson; Adjunct Associate Professor Kessler

The Department of Political Science offers graduate work leading to the A.M. and Ph.D. degrees. Instruction is designed to prepare the student primarily for teaching and research. Instruction is currently offered in the following fields: American government and politics, comparative government and politics, international relations, political methodology, and political theory.

The candidate for the degree of Doctor of Philosophy in political science must take at least 12 courses in all, and demonstrate competence in at least two general fields of the discipline by taking three courses in each field. The candidate must also fulfill a statistics and/or foreign language requirement, and write a satisfactory dissertation.

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; 3) complete and defend an M.A. thesis. In addition, candidates for the M.A. degree must demonstrate competence in one foreign language or in statistics.

These requirements for the M.A. degree apply both to students enrolled in the terminal M.A. program and to students originally enrolled in the Ph.D. program who decide to end their involvement in the Ph.D. program with a terminal M.A. degree.

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.

Related Course Work In The School Of Law

Students at the School of Law earning an M.A. degree in Political Science along with the J.D. degree may take four courses (twelve credits) in Political Science as part of their required 84 credits for the J.D. To be eligible to receive the M.A., they must complete four additional courses in Political Science, for a total of eight, and complete and defend an M.A. thesis. The courses chosen must be approved by the director of graduate studies. Further details on the M.A. program in political science may be obtained from the director of graduate studies, Department of Political Science.

For Seniors and Graduates

203S. Politics and Media in the United States. 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. Collective Action, Property Rights, and the Environment. The rational choice tradition (public goods, collective action, game theory, property rights, new institutionalism) 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. 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.

209. Computational Political Economy. Introduction to the field of computational modeling. Emphasis on conducting formal replicable investigations of political phenomena with clearly defined assumptions and hypotheses. Study of current literature in cognitive psychology, political psychology, and experimental economics. Instructor: DeMarchi. 3 units.

211S. Current Problems and Issues in Japanese Politics. 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. 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: Staff. 3 units.

213S. Theories of International Political Economy. Issues include politics of trade, finance, economic development, conflict and cooperation in the world economy, and causes and consequences of economic globalization. Both advanced industrialized and developing countries. Open to qualified seniors with consent of instructor. Instructor: Buthe. 3 units.

215S. Democratic Institutions. 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.

216S. American Power and Grand Strategy in the New Century: Unilateralism versus Multilateralism. The question of unilateralism versus multilateralism in American grand strategy. Topics include United States balancing between unilateral and multilateral policies toward Iraq, North Korea, and Iran, and in respect to the containment and defeat of international terrorism. Recent debates about unilateralism and multilateralism placed in historical perspective. The role of United States public opinion. Instructor: Grieco. 3 units.

217. Comparative and Historical Methods. 3 units. C-L: see Sociology 214

218. Political Thought in the United States. 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. 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. 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. Basic applications of statistical theory to political questions: research design, hypothesis tests, computer data analysis. Consent of instructor required for undergraduates. Instructor: De Marchi. 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. 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.

226S. Nietzsche's Political Philosophy. 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, Philosophy 237S

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.** Instructor: Spragens. 3 units.
- 230S. Introduction to Positive Political Theory.** 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.** 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.
- 233. Intermediate Statistical Methods.** 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.
- 236S. Hegel's Political Philosophy.** Within context of Hegel's total philosophy, an examination of his understanding of phenomenology and the phenomenological basis of political institutions and his understanding of Greek and Christian political life. Selections from *Phenomenology*, *Philosophy of History*, and *Philosophy of Right*. Research paper required. Instructor: Gillespie. 3 units. C-L: Philosophy 236S, German 275S
- 238S. Courts, Wars, Legacies of Wars.** The impact of international wars, 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. Also taught as Law 548S. Instructor: Fish. 3 units. C-L: History 255AS
- 239S. American Mass Political Behavior.** Several facets of the political behavior of mass actors in American politics. Likely topics include the factors that cause the type and amount of individual participation, mobilization by elites, ideology and information, partisanship, partisan stability and change, socialization, macro-level change, negative advertising, economic voting, issue evolution, and the effects of institutional changes (especially election rules) on voter turnout. Instructor: Transue. 3 units.
- 241S. The European Union and World Peace.** Analysis of the European Union as a model for international reconciliation among former enemies. Investigations of ways in which European former enemies—in particular, France and Germany—ended their rivalries and moved toward a positive peace; whether Western European reconciliation experience can be applied to other high-conflict regions and relationships. Instructor: Grieco. 3 units.
- 242S. The United States and Western Europe.** America's political, military, economic, and cultural engagement with Western Europe. History of United States-European relations in the twentieth century; key contemporary issues confronting Europe and America; cultural, political, economic, and social conditions within the two partners that might be serving either to bind or to separate them at present and in the years to come. Instructor: Grieco. 3 units.
- 243S. Political Applications of Game Theory.** Emphasis on acquiring good working knowledge of standard game theory techniques and models used in political science literature, hence emphasis on examples and problem sets. No knowledge of game theory presupposed, but good basic knowledge of calculus and elementary probability theory. Includes examples from voting, congressional committees, ethnicity, IPE and IR, and CPE. Instructor: De Marchi, Niou or Soskice. 3 units.

247. Politics and Philosophy of Self and Other. 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. 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: Staff. 3 units.

249. The Politics of Health Care. 3 units. C-L: see Public Policy Studies 253

252S. The Nation-State and the International System. The interaction between state structures and the international system, with a focus on the rise and development of European nations. Topics include war and its effects on national political institutions, nationalism, and state formation; war and national revolution; imperialism and decolonization; and economic dependency and national autonomy. Research paper required. Prerequisite: Political Science 93. Instructor: Grieco. 3 units.

255S. State and Society in China. An examination of selected aspects of Chinese politics. Prerequisite: Political Science 117 or equivalent. Instructor: Shi. 3 units.

256S. Theory and Practice of National Security. 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 warfighting, 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.

257S. Politics, Society and Development in China. Issues affecting development in China including financial markets, labor, capital, democracy, and cultural patterns. Instructor: Shi. 3 units.

259S. American Civil-Military Relations. Theory and practice of relations between the military, society, and the state in the US. Special attention paid to how civil-military relations play out in the use of force. Other topics include: public opinion, casualty sensitivity, and the role of the military in partisan politics. Consent of instructor required. Instructor: Feaver. 3 units.

260S. Social Theory and Social Practice. Comparison and critique of some of the most important answers given by philosophers and social theorists to the questions: what can we know about society and what is the practical utility of that knowledge? Theorists and topics include Aristotle, early modernity's "new science of politics," Marxist praxis, Weber's "wertfrei" science, Mill's logic of the "moral sciences," Comte's sociology, Mannheim's sociology of knowledge, behavioralism and its critics, the vocation of social science. Instructor: Spragens. 3 units.

261S. Institutions and Reforms in China. Institutions set the framework of rules and incentives that affect how people utilize resources in political and economic decision-making. Course studies the creation and evolution of Chinese and political and economic institutions from both the historical and theoretical perspectives. Topics include taxation schemes, granary systems, political participation, voting methods, political control mechanisms, community compact and local governance, and money raising methods. Instructor: Niou. 3 units.

264. Marine Policy. 3 units. C-L: see Environment 276; also C-L: Public Policy Studies 297

266S. Topics in Early Modern Political Thought from Machiavelli to Mills. Topics vary from semester to semester. Instructor: Staff. 3 units.

268S. The Regulatory Process. 3 units. C-L: see Public Policy Studies 269S

271S. International Environmental Regimes. 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

272S. International Relations Theory and Chinese Foreign Policy. Examines range of theories and conceptual approaches to the study of international relations to see how these may or may not work in explaining Chinese foreign policy and whether or not patterns of Chinese foreign policy require evaluation of theories. Instructor: Shi. 3 units.

273S. Heidegger. An examination of the philosophy of Martin Heidegger from its phenomenological beginnings to its postmodernist conclusions with particular attention to its meaning for questions of identity, history, nihilism, technology, and politics. Instructor: Gillespie. 3 units. C-L: Philosophy 273S

275. The American Party System. 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. 3 units. C-L: see Public Policy Studies 243S

277. Comparative Party Politics. 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. Race and American Politics. A broad overview of the salience of race in the American political fabric and how it structures racial attitudes on a number of political and policy dimensions. Instructor: McClain. 3 units. C-L: African and African American Studies 278S, Public Policy Studies 278S

279S. Collective Action and Political Regime Change. Survey of theories, methods, and empirical studies of political mobilization outside institutional channels; protest behavior and strategies; responses of the state to these challenges; the success of collective mobilization. Emphasis on comparative analyses of revolutions and other modes of disruptive regime changes. Instructor: Kitschelt. 3 units.

280. Comparative Legislative Politics. Analysis of legislative politics in comparative perspective. Designed for seniors and graduate students. Instructor: Staff. 3 units.

283S. Congressional Policy-Making. Lawmaking and oversight of the executive branch by the U.S. Congress. Committee, party, executive, and interest group roles. Instructor: Munger. 3 units. C-L: Public Policy Studies 283S

284S. Public Policy Process in Developing Countries. 3 units. C-L: see Public Policy Studies 284S

285S. Seminar in North American Studies. Topics vary each semester. Instructor: Staff. 3 units.

286. Theory and Practice of International Security. 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: Staff. 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: Staff. 3 units. C-L: History 255B

289S. Contemporary Ethical Theories. 3 units. C-L: see Philosophy 203S

291. Research Methods in Japanese. 3 units. C-L: see Japanese 291; also C-L: 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. Introduction to fundamental research and theoretic statements in American politics. Instructor: Aldrich 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: Staff. 3 units.

306. Public Opinion. Intensive study of the causes and consequences of public attitudes toward politics, with special attention given to recent research in the field. Instructor: Staff. 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: Staff. 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. 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 staff. 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: Staff. 3 units.

315. Noncooperative Game Theory. 3 units. C-L: see Economics 315; also C-L: Statistics and Decision Sciences 386

316. Racial and Ethnic Minorities in American Politics. Graduate-level course on politics of the United States' four principal racial minority groups—blacks, Latinos, American Indians, and Asian Americans. Importance of race and ethnicity in American politics is also explored. Instructor: McClain. 3 units. C-L: Law 597, Public Policy Studies 345

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: see 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.

324. Seminar in Comparative Politics. 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. 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. Research Design and Qualitative Methods. Systematic exploration of key issues in research design and methods: Examines epistemology, observation and description, causality, case selection, and case study research design. Also covers specific tools, methods, and special topics such as survey design and sampling, qualitative interviews, historiography and archival research, content analysis, experiments, field research, temporality and institutional change. Instructor: BA^{1/4}the. 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 or Soskice. 3 units. C-L: Sociology 333

338. Social and Economic Data. 3 units. C-L: see Economics 310; also C-L: Sociology 310

340. Seminar in American Politics and Institutions. Survey, analysis, and critique of the literature. Instructor: Aldrich 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.

345. Comparative Constitutional Design. Consideration of configurations of political institutions apt for democratizing countries, especially those divided by ethnic or religious affiliations. Begins with theories of constitutional and legal change and of efficacy of constitutions as instruments of conflict management, as well as alternative approaches. Specific issues include: electoral systems; federalism and regional devolution; the presidential-parliamentary debate; costs and benefits of judicial review; the special issue of Islam and the state. Extensive discussion of the overarching question of adoptability and emphasis on the relations between processes of constitutional change and the content of the institutions adopted. Instructor: Horowitz. 3 units.

345. Comparative Constitutional Design. 3 units. C-L: see Law 717

351. Comparative Law and Politics: Ethnic Group Relations. 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: Staff. 3 units.

395A. Research Seminar in Political Science I. Consideration of various elements involved in the conduct of research, including identifying topics for study, theory construction and application, gathering and marshaling evidence, and framing and presenting analysis. Ideas will be applied in collaborative research. Content of the course continues in Political Science 395B. Instructor: Rohde. 3 units.

395B. Research Seminar in Political Science II. Consideration of various elements involved in the conduct of research, including identifying topics for study, theory construction and application, gathering and marshaling evidence, and framing and presenting analysis. Ideas will be applied in collaborative research. Students must complete POLSCI 395A before taking this course. Consent of instructor required. Instructor: Rohde. 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

201S. Problems in International Security

204S. Ethics in Political Life

207S. American Constitutional Interpretation

210S. Politics and Markets in Modern Capitalism

213S. Theories of International Political Economy

225. Topics in Comparative Government and Politics: Western Europe

227S. Issues in International Communications

232. Political Economy: Theory and Applications

234S. Political Economy of Development: Theories of Change in the Third World

237S. Understanding and Managing Global Capital Markets Crises

244S. The Politics of the European Community

250S. International Security after the Cold War

253S. Comparative Government and the Study of Latin America

265S. The Process of International Negotiation

267S. Policy-Making in International Organizations

274S. Seminar in Urban Politics and Urban Public Policy

281. American Political Thought Since the Gilded Age

282S. Canada

287. Revolution, Reform, and Democratization

360. Seminar in Government and Politics in the Soviet Union

Psychology (PSY)

Graduate training leading to the Ph.D. degree in Psychology is offered at Duke through two departments: the Department of Psychological and Brain Sciences, and the Department of Psychology: Social and Health Sciences.

Department of Psychological and Brain Sciences

Professor C.L. Williams, Chair; Associate Professor Needham, Director of Graduate Studies; Professors Bauer, Eckerman, Lockhead, McCarthy, Meck, Rubin, Staddon, and C.L. Williams; Associate Professors Cabeza, Needham and Schmajuk; Assistant Professors Brannon, Dobbins, LaBar, Marsh, Mittroff, and Pelphrey; Research Professor L. Wallach; Assistant Research Professor Cerutti; Professors Emeriti Alexander, Carson, Crovitz, C. Erickson, R. Erickson, Hall, Kimble, Kremen, H. Schiffman, M. Wallach, and Wing. *Faculty with secondary appointments in Psychological and Brain Sciences, primary appointments in other departments:* Professors Bettman, Brodie, Flanagan, Guzeldere, W.C. Hall, Levin, Madden, Nicoletis, Nowicki, Palmer, Payne, Purves, Putallaz, and S. Schiffman; Associate Professors Day, Mazuka, Welsh-Bohmer, and Woldorff; Assistant Professor S. Huettel; Adjunct Professors Barbarin, Cox, McLoyd, Ornstein, Reznick, Swartzwelder, Vernon-Feagans; Adjunct Associate Professors Curran, Gariépy, Hussong, and Kurtz-Costes; Adjunct Assistant Professors Hopfinger and Taylor

Department of Psychology: Social and Health Sciences

Professor Strauman, Chair; Professor Bonner, Director of Graduate Studies; Professors Asher, Cooper, Costanzo, Hamilton, Putallaz, Roth, Strauman, Thompson, and Wood; Associate Professors: Day, Hill, and Mazuka, and Shah; Assistant Professors: Feng, and Moore; Research Professor Hoyle. *Medical School Faculty with joint appointment:* Blumenthal, Bonner, Curry, (Director of Clinical Training), Keefe, Lynch, Robins, Surwit, and R. Williams; Professors Emeriti Alexander, Carson, Coie, and Lakin. *Faculty with secondary appointment:* Bettman, Brodie, Chartrand, Coard, Dodge, Eckerman, Edwards, Epstein, Fairbank, Fitzgerald, George, Gold, Gustafson, Logue, Linville, Madden, March, Needham, Payne, Quinn, Rabiner, Reese, Richman, Serra, Sheppard, Sherwood, Siegler, Spenner, Stocking, Valentine, Vidmar, L. Wallach, M. Wallach, Wells, and Weinfurt; Adjunct Professors Barbarin, Cox, McLoyd, Ornstein, Reznick, and Vernon-Feagans; Adjunct Associate Professors Gariépy and Kurtz-Costes

The Department of Psychological and Brain Sciences studies relations between brain, behavior, and cognition in humans and animals from developmental, neuroscience, and computational perspectives. The Department of Psychology: Social and Health Sciences investigates human psychological processes in development, health, personality, psychopathology and social behavior from a social and behavioral science perspective and houses the doctoral training program in clinical psychology. Training in aspects of developmental psychology is available for students in both departments, although the particular emphasis of that training in each department is oriented towards its broader research activities, as described below. It is expected that graduate students in all areas of psychology will take advantage of the training opportunities in a number of departments, irrespective of their particular site of enrollment.

Further distinctions between the research and training of the two departments can be summarized as follows: the Department of Psychological and Brain Sciences focuses upon four interrelated areas: Behavioral and Computational Neuroscience, Cognitive Neuroscience, Cognitive Psychology, and Developmental and Evolutionary Processes. Its programs are highly collaborative with other units of the university, especially with departments such as Biology, Computer Science, Neurobiology, and Philosophy, as well as the Center for Cognitive Neuroscience and the Brain Imaging and Analysis Center. The Department of Psychology: Social and Health Sciences focuses on research and training in Clinical, Developmental and Social Psychology. It too collaborates widely with other university units, especially with such departments as Psychiatry, Sociology, and Cultural Anthropology, as well as with the Ph.D. program in Business Administration, the Center for Child and Family Policy, and various University programs. Both departments are formal members of the Duke-University of North Carolina Collaborative Graduate Certificate Program in Developmental Psychology.

For Seniors and Graduates

202S. Autobiographical Memory. A review and critical analysis of the literature, theory, and empirical study of autobiographical memory within cognitive 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. 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. 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: Bonner. 3 units.

216S. Gender, Pain, and Coping. Sex and gender differences in and pain coping; psychological, social, cultural, and biological mechanisms that underpin these differences. Consent of instructor required. Instructor: Keefe. 3 units.

218S. Personality, Stress, and Disease. The interaction between person and social environment as a contributor to development of physical disease. Both epidemiological and laboratory-based research considered. Prerequisite: Psychology 109A for undergraduates and consent of instructor. Instructor: R. B. Williams. 3 units.

220S. Psycholinguistics. 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. Consent of instructor required. Also taught as Linguistics 220S. Instructor: Day. 3 units. C-L: English 204S

221S. Ethnicity, Culture, and Family Processes. Focus on the impact of culture and ethnicity on family processes; definitions and measurement of culture as a family level variable; family dynamics/interactions, family constellations, and parenting. Prerequisite: Consent of instructor. Instructor: Hill. 3 units. C-L: African and African American Studies 221S

223S. Animal Learning and Cognition: A Neural Network Approach. 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.

226S. Cognitive Neuroscience of Memory. Research on the neural correlates of memory in humans. Neuropsychological studies with brain-damaged patients and functional neuroimaging studies with healthy individuals. Cognitive neuroscience models of memory,

including episodic memory, working memory, semantic memory, priming, and procedural memory. Prerequisite: Psychology 91 or Psychology 92 and consent of instructor. Instructor: Cabeza. 3 units.

227S. Behavioral Physiology: Basic Systems. 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.

238S. Everyday Cognition. 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.

241S. Affective Neuroscience. A critical examination of current theory and experimental research related to neurobiology of emotional information processing and emotion-cognition interactions. Topics range from animal studies to clinical disorders, including neurogenomics, social cognition, functional brain imaging, emotional learning and memory, neuroethics, and individual differences. Basic background in neuroanatomy and cognitive neuroscience expected. Consent of instructor required. Prerequisites: Psychology 135 or Psychology 112. Instructor: LaBar. 3 units.

242S. Nonverbal Cognition. Exploration of Nonverbal cognition in animals and human infants. Focus on nonverbal counting and the relationship between the representation of number, time, and space. Topics include animal cognition, developmental psychology, neuropsychology, and brain imaging to sketch a complete picture of how the mind represents number in the absence of linguistic counting. Upper level undergraduates may enroll with consent of the instructor. Prerequisite: Consent of instructor. Brannon. 3 units.

250S. Hormones, Brain, and Cognition. Current research on how hormones modify and modulate cognitive processes across the lifespan. Consent of instructor required. One course. C. Williams. 3 units.

258S. Social Behavior and Personality. 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 101, Psychology 117 or equivalent and consent of instructor for undergraduates. Instructor: Coard. 3 units.

262S. Minority Mental Health: Issues in Theory, Treatment, and Research. Survey and discussion of theoretical, research, and clinical issues in minority mental health with special emphasis on African-Americans. Prerequisite: Psychology 119A for undergraduates and consent of instructor. Instructor: Coard. 3 units. C-L: African and African American Studies 262S

265. Introduction to Audition, or Why We Hear What We Do. 2 units. C-L: see Neurobiology 259; also C-L: Philosophy 259, Music 259

268S. Brain and Language. 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: Staff. 3 units. C-L: Linguistics 268S

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.

272S. Obesity and Eating Disorders. A review of obesity and of the major clinical eating disorders (including binge eating disorder, bulimia nervosa and anorexia nervosa) and their pathophysiology, and their treatments. Consent of instructor required. Prerequisite: Introductory Biology. Instructor: Surwit. 3 units.

For Graduates

305. Adult Psychopathology. Examination of current diagnostic and theoretical approaches to adult psychopathology and personality disorders and the implications of diagnostic and theoretical systems for assessment and treatment. Instructor: Strauman. 3 units.

306. Interventions in Behavioral Medicine and Health Psychology. Review critical elements of randomized clinical trials in behavioral medicine and clinical health psychology. Discuss basic issues of study design including identification of target population, selection of outcome measures, blinding, use of control groups, randomization, power analyses, and data analytic approaches. Examine a variety of behavioral interventions including stress management, diet, exercise, pain management, and coping skills training. Key clinical trials in four health areas-cardiovascular disease, cancer, metabolic disorders, and pain will be reviewed. Students will be expected to prepare an oral presentation on a research topic of their choice, and submit a written research proposal at the end of the semester. Prerequisites: Psychological Assessment; Psychotherapy. Consent of instructor required. Instructor: Blumenthal. 3 units.

307. Models of Intervention and Prevention. Review of empirically-supported treatments for adult disorders. Therapeutic relationship issues and communication style; strategies commonly used across disorders in empirically-supported treatment and prevention programs; their application to specific disorders; development of theoretically integrative treatments. Course balances discussion of theory and research findings with practical and ethical issues in treatment delivery, illustrated by case transcripts and videotapes. Instructor: Robins. 3 units.

315. Seminar in Consumer Behavior. 3 units. C-L: see Business Administration 562

316. Behavioral Decision Theory. 3 units. C-L: see Business Administration 525; also C-L: Statistics and Decision Sciences 231

318. Research Design. Methodological principles of research design in clinical, developmental, and social psychology. Emphasis on theory and practical applications. Permission of instructor required. Instructor: Moore. 3 units.

320. Applied Multivariate Statistics. Applications of multivariate statistics in psychology and related disciplines. Topics include: MANOVA, factor analysis, principal components analysis, cluster analysis, multidimensional scaling, multiple logistic regression, and various approaches to longitudinal data analysis. Covers issues in applied data analysis such as a priori and post-hoc power analyses, transformation of data, and graphical/written/oral presentation of results. Data analyzed using the SAS statistical software package, as well as other specialty programs. Mandatory weekly lab sessions. Prerequisite: Psychology 273 and 274 or equivalent. Consent of instructor required. Instructor: Staff. 3 units.

321. Social Development. Analysis of children's social development from multiple theoretical perspectives including biological, social cognitive, social learning, and ecological perspectives. Includes socialization in the contexts of families, peers, schools, and neighborhoods and the role of media. Implications for prevention/intervention programs

and social policy are discussed. Permission of the instructor required. Instructor: Staff. 3 units.

322. Advanced Cognitive Development. Advanced level introduction to critical issues in the study of cognitive development from birth to adolescence. Emphasis on both theoretical accounts of cognitive development and recent research that informs these explanations. Permission only. Instructor: Feng or Needham. 3 units.

325. Seminar in Contemporary Psychotherapy. An intensive seminar providing training in a contemporary empirically supported psychotherapy. Includes readings and discussion of the strategies and techniques of the selected treatment modality, examination of the empirical support for the treatment, and where possible, supervised practicum experience providing the treatment to appropriate patient populations. Prerequisite: Previous practicum experience in clinical psychology and consent of the instructor. 3 units.

327. Theories of Developmental Psychology. Examine worldviews and assumptions that underlie theories in developmental psychology; discuss the philosophical and historical foundations for key ideas and theories in the study and understanding of human development, take on the perspectives of key historical figures in developmental psychology; understand how change and development have been conceptualized over the history of the field; debate ongoing controversies in the field such as nature-nurture, continuity-discontinuity, universal-culturally specific development; explore the link among theoretical perspectives, research methodologies and data interpretation. Permission of instructor required. Instructor: Hill. 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. This course examines major emotional and behavioral disorders of childhood/adolescence from a developmental perspective. Issues addressed include risk and protective factors, long-term outcomes, and prevention/intervention. Instructor: Rabiner. 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. A course for clinical graduate students on assessment of persons through a variety of methods, including personological, clinical and semi-structured interviews, analysis of narrative material, and psychological tests. Introduction to self-report, observer-report, and projective methods. Consent of instructor. Instructor: Curry. 3 units.

339. Ethical Issues in Research and Clinical Practice. Topics including ethical issues in teaching, research, and clinical practice. 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. 0 to 6 units. Instructor: Staff. Variable credit.

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. 0 to 6 units. Instructor: Staff. Variable credit.

348. Child/Adolescent Psychotherapy. Introduction to psychodynamic and cognitive-behavioral approaches to clinical problems of children and adolescents, with an emphasis on empirically-supported interventions. Instructor: Curry. 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 Whidby. 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.** Graduate students (2nd year and higher) and other research trainees (e.g. postdocs) in cognitive neurosciences will each take a turn at presenting a research topic (e.g. a research update, a practice talk, an experimental proposal, presentation of a scientific article) in a forum aimed at helping junior researchers develop and hone their presentation skills. Consent of instructor required. Instructor: Woldroff and Staff.. 1 unit.
- 358S. Cognitive Neuroscience Colloquia II.** Graduate students (second-year and higher) and other research trainees (e.g. postdocs) in cognitive neurosciences will each take a turn at presenting a research topic (e.g. a research update, a practice talk, an experimental proposal, presentation of a scientific article) in a forum aimed at helping junior researchers develop and hone their presentation skills. Consent of instructor required. Instructor: Woldroff and Staff.. 1 unit.
- 359S. Principles in Cognitive Neuroscience I.** Introduction to the cognitive neuroscience of emotion, social cognition, executive function, development, and consciousness. Topics also include cognitive disorders, and computer modeling. Highlights current theories, methodological advances, and controversies. Students evaluate and synthesize findings across a variety of research techniques. Consent of instructor required. Instructor: Cabeza, Labar, Purves, or Woldorff. 3 units. C-L: Neurobiology 349S, Philosophy 359S
- 360S. Principles in Cognitive Neuroscience II.** Introduction to the cognitive neuroscience of emotion, social cognition, executive function, development, and consciousness. Topics also include cognitive disorders, and computer modeling. Highlights current theories, methodological advances, and controversies. Students evaluate and synthesize findings across a variety of research techniques. Consent of instructor required. Instructor: Cabeza, Labar, Purves, or Woldorff. 3 units. C-L: Neurobiology 350S, Philosophy 360S
- 362. Functional Magnetic Resonance Imaging.** The course covers all aspects of functional magnetic resonance imaging, from its basic principles in physics, engineering, biophysics, and physiology; through computational, analytic, and signal processing issues; to its applications in neurobiology and cognitive neuroscience. The course will consist of weekly lectures and integrated laboratory sessions. Lectures will be given by BIAC faculty, and will incorporate primary readings in the field to encourage discussion. The laboratory sessions will involve analysis of fMRI data sets that illustrate issues discussed in the lectures. Students will gain experience both in the theoretical principles of fMRI and in the practical aspects of experimental design and data analysis. Instructor: Huettel. 3 units. C-L: Neurobiology 381
- 363S. PBS First Year Seminar I.** Analysis and discussion of current models and research in psychological and brain sciences. Focus is on theories and research in brain-behavior relations, particularly those relevant for perception, memory, and attention in humans and animals. Instructor: Staff. 0.5 units.
- 364S. PBS First Year Seminar II.** Analysis and discussion of current models and research in psychological and brain sciences. Focus is on theories and research in brain-behavior relations, particularly those relevant for perception, memory, and attention in humans and animals. Instructor: Staff. 0.5 units.

366. Applied Analysis of Variance. Application of analysis of variance typical in psychology and related disciplines. Introduction to the general linear model. Foundations of experimental design, probability, inference. Topics include: one factor ANOVA, factorial ANOVA with two- and three-way interactions, trend analysis, within-subjects designs, analysis of covariance, effect size and power estimation. Equips students to apply, interpret, and report results of ANOVA. Training in the use of SAS statistical computing system. Mandatory weekly lab sessions. Assumes undergraduate statistics course; understanding of basic statistical concepts. Consent of instructor required. Instructor: Staff. 3 units.

367. Applied Correlation and Regression Analysis. Applications of correlation and regression analysis typical in psychology and related disciplines. Correlation topics include: computing, testing, and comparing zero-order, partial, and semi-partial correlation coefficients. Regression topics include: logic of model comparison, hierarchical analysis, effect and dummy coding, interaction effects, curvilinear effects, diagnostics, and power estimation. Equips students to apply, interpret, and report results of correlation and multiple regression analyses. Training in the use of the SAS statistical computing system. Mandatory weekly lab sessions. Assumes prior graduate training in general linear model. Consent of instructor required. Instructor: Staff. 3 units.

368. Applied Structural Equation Modeling. Applications of structural equation modeling typical in psychology and related disciplines. Topics include: notation, path diagrams, specification and identification, estimation, modification, power estimation, measurement models, multivariate regression models, panel models, growth models. Emphasis on model comparisons, limits on causal inference. Equips students to apply, interpret, and reports results of structural equation modeling analyses. Training in the use of relevant software. Mandatory weekly lab sessions. Prerequisite: Psychology 274 or equivalent. Consent of instructor required. Instructor: Staff. 3 units.

369. Research Synthesis and Meta-Analysis. 3 units. C-L: see Education 369

370. Applied Multilevel Modeling. Applications of multilevel modeling typical in psychology and related disciplines. Estimation and interpretation of models for multilevel data structures, including data generated by clustered and longitudinal designs. Examination of conceptual, substantive, and methodological issues in analyzing multilevel data. Focus on appropriately conceptualizing, modeling, and reporting research on multilevel data. Training in the use of relevant statistical software. Mandatory weekly lab sessions. Assumes prior graduate training in applications of analysis of variance and multiple regression. Consent of instructor required. Instructor: Staff. 3 units.

380S. Behavioral and Computational Neuroscience. Survey and in depth discussion of the methods, theory, and current research in the field of behavioral and computational neuroscience. Emphasis on animal models and neurobiological underpinnings of learning, memory, and cognition. Covers the latest developments in research on neuroanatomical, cellular and molecular substrates of behavior with emphasis on the influence of development, environment, and experience across the lifespan. Instructor: Buhusi, Williams, Staff. 3 units.

381. Data Methods in Cognitive Psychology. Introduction to the analysis of behavioral data from cognitive research with a focus on the separation of accuracy and response strategy. Particular emphasis on Signal Detection Theory and other basic statistical decision models. Application of Matlab to both basic Monte Carlo simulation and cognitive experiment generation. Simple estimation of the parameters of decision models using iterative search algorithms and the use of bootstrap techniques to estimate the variability of parameter estimates. Investigation of the basic relationship between decision models and statistical tests typically used behavioral data analysis such as Student's t-test. Instructor: Dobbins. 1 unit.

390. Proseminar in Academic and Professional Psychology. The ethical, teaching, and research components of the profession of psychology are issues covered in this course.

These include the study of teaching technology and techniques; the initiation of programmatic research and the attainment of federal and private support, interdisciplinary directions in the behavioral and social sciences; clinical ethics; human subjects protections; emerging approaches to psychological inquiry, and the translation of research into policies and applications. The format will combine seminar discussions with presentation by experts and specialists. The understanding of the full breadth of the discipline of psychology is the goal. Instructor: Costanzo. 3 units.

396. Graded Research. 1 to 3 units. Instructor: Staff. Variable credit.

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

COURSES CURRENTLY UNSCHEDULED

209S. The Cognitive Psychology of Oral Traditions

211S. Neural Development and Comparative Cognition

212S. Human Memory

224S. Timing and Time Perception

232S. Advanced Seminar in Perception

233S. Nature and Nurture in Animal and Human Development

249S. Anthropology and Psychology

261S. Advanced Learning Theory

264S. Gender, Hormones, and Health

284S. Feminist Theory and Methods in the Social Sciences

288S. Advanced Topics in Social Science and Law

301. Group Psychotherapy and Group Influence Processes

302. Personality Theory

303S. Family Theory and Family Therapy

323. Seminar in Community Psychology

324. Seminar in Community Psychology

Public Policy Studies (PUBPOL)

Professor B. Kuniholm, Chair (124 Sanford Institute); Associate Professor Mayer, Director of Graduate Studies (Rubinstein Hall, Sanford Institute); Professors Buchanan, Clotfelter, Cook, Dodge, Feaver (Political Science), Fleishman (law), Hamilton, Healy (environment), James, Jentleson, B. Kuniholm, Ladd, McClain (Political Science), Mickiewicz, Munger (Political Science), Price (Political Science), Schroeder (Law), Sloan (Economics) and Weiner (Law); Associate Professors Conrad, Korstad, and Peck; Assistant Professors Charney, Gibson, Kelley, Krishna, Taylor, E. Vigdor, J. Vigdor and Whetten; Research Professors Cook-Deegan and Darity; Assistant Research Professor Conover; Professors of the Practice Brown, Glenday, Harris, Joseph, Kelly, Lethem, Raspberry, Shukla, Spengler, and Tiffit; Associate Professor of the Practice Fernholz; Adjunct Professor Yaggy; Lecturers Blount, O'Dor, and Payne; Senior Research Scientist Vaupel; Research Associate Rogerson; Visiting Associate Professor Krupp; Visiting Research Scholar Mirovitskaya; Visiting Lecturers Ahearne and D. Kuniholm

The Master of Public Policy (M.P.P.) degree requires two academic years of coursework (51 credit hours), including a master's project (the equivalent of a master's thesis) to be researched and written on a problem of current policy concern for an actual client, and a summer public policy internship. Students may opt for a concentration in Global Public Policy or Social Policy. The summer internship may be with a national, state, or local agency of government, an international organization, a not-for-profit organization, or a business provided the internship is public policy related.

In the first year, the fall semester core courses include: Policy Analysis I (Public Policy 303), Microeconomics and Public Policy-Making (Public Policy 310), Politics of the Policy Process (Public Policy 314), Statistics and Data Analysis for Policymakers (Public Policy

222), and Ethics and Policy-Making (Public Policy 316) or, for students in the global policy concentration, Globalization and Governance (Public Policy 320), plus at least one elective. In the spring, first-year students take Quantitative Evaluation Methods (Public Policy 313), Microeconomics: Policy Applications (Public Policy 311), and Policy Analysis II (Public Policy 304), plus at least one elective. The second-year curriculum includes course work in public management, electives in substantive policy areas, and the master's project.

Students who are concurrently enrolled in a Ph.D. or professional degree program (M.D., J.D., M.B.A., M.E.M., M. Div., etc.), can apply for a compressed version of the M.P.P. program. The joint or concurrent M.P.P. can be completed in one additional year. Students in the concurrent program complete the full first-year curriculum, the summer internship, and the master's project, but are waived from the public management requirements. Students usually apply for the joint or concurrent M.P.P. 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. program can be obtained by writing the Director of Graduate Studies or the Director of Admissions at the Terry Sanford Institute of Public Policy, Box 90243, Duke University, Durham, NC 27708-0243 or e-mail MPPadmit@duke.edu. The Terry Sanford Institute's web page address is <http://www.pubpol.duke.edu>.

Related Programs

In addition to the M.P.P., the Terry Sanford Institute offers a mid-career Program in International Development Policy (PIDP) through its Duke Center for International Development. 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 Duke Center for International Development. For further information, go to <http://www.pubpol.duke.edu/dcid> or contact the Duke Center for International Development, Box 90237, Duke University, Durham, North Carolina 27708-0237, email pidpinfo@duke.edu.

202S. Policy Journalism and Media Studies Capstone Course. Capstone course for the Policy Journalism and Media Studies certificate. Includes an internship, followed by assignments designed to integrate the student's practical experience with the more conceptual and theoretical knowledge gleaned from the classroom. Students meet in formal course setting to discuss what they have learned, present examples of the work they have accomplished and write systematic paper covering what they have learned during the course of their participation in the certificate program. Requirements include a portfolio of print, audio or video clips resulting from the internship, a journal chronicling the internship experience, and a paper that synthesizes ideas and concepts learned in coursework with the hands-on experience at the internship. Instructor: Staff. 3 units.

209S. Global Issues in Population and Development. 3 units. C-L: see Economics 209S

218. Macroeconomic Policy and International Finance. 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: Staff. 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.

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: Spengler. 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.

243S. Media in Post-Communist Societies. 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

251S. Regulation of Vice and Substance Abuse. The traditional vices of drinking, smoking, gambling, and the recreational use of drugs. Evaluation of government policy on these activities. The intellectual framework for evaluation drawn from economics, although readings refer to law, psychology, philosophy, and statistics. Instructor: Cook. 3 units. C-L: Economics 251S

253. The Politics of Health Care. The history, status, and future of health care policy. Grounded in political theories such as distributive justice, altruism, and contractarianism. Focus on policy formation. Case discussions of American reform controversies in light of international experience. Instructor: Conover. 3 units. C-L: Political Science 249

255. 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. C-L: Health Policy 255

257S. United States Policy in the Middle East. From World War II to the present with a focus on current policy options. Instructor: Kuniholm. 3 units. C-L: History 296S

258S. International Environmental Regimes. 3 units. C-L: see Political Science 271S

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 Research Methods and Issues. 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. 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.

266S. Risk and Regulation. Environmental, health, and technological risk. Major methods to analyze risk. Current public issues regarding understanding, describing, and managing risk. Regulatory approaches. Risk-benefit, cost-benefit, probabilistic analysis. Undergraduates only with consent of instructor. Instructor: Ahearne. 3 units.

268. Media Policy and Economics. Use of economics to examine the production and consumption of information in communications markets and impact of media on society. Topics include regulation of television/radio/newspapers, intellectual property and Internet, content diversity, and news markets. Instructor: Hamilton. 3 units. C-L: Economics 235

269S. The Regulatory Process. 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: see 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. 3 units. C-L: see Environment 270; also C-L: Economics 270

273S. Public Policy and African American Life. Race-based public policies and African American responses to these policies over the course of the twentieth century to the present; education, employment, housing, political participation, and social relations. The significance of race in the politics and policies of the United States; the legacy of twentieth-century racial policies. Instructor: Korstad. 3 units. C-L: African and African American Studies 273S

274. Resource and Environmental Policy. 3 units. C-L: see Environment 274

278S. Race and American Politics. 3 units. C-L: see Political Science 278S; also C-L: African and African American Studies 278S

280S. Philanthropy, Voluntarism, and Not-for-Profit Management. 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. Also taught as Law 585. Instructor: Fleishman. 3 units.

283S. Congressional Policy-Making. 3 units. C-L: see Political Science 283S

284S. Public Policy Process in Developing Countries. 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: Staff. 3 units. C-L: Political Science 284S

285. Land Use Principles and Policy. 3 units. C-L: see Environment 285

286S. Economic Growth and Development Policy. Basic principles and policy issues in the study of economic growth and development. The roles of physical, natural and human capital, technological innovation, productivity improvements and institutions in explaining patterns and causes of variations in growth and development performance of countries. Effects on growth and development of many current policy issues including HIV-AIDs, financial crises, foreign aid and investment, debt burdens and forgiveness, corruption and governance. Prerequisites: Public Policy 110 or Economics 149. Instructor: Fernholz, Glenday, or Shukla. 3 units. C-L: Economics 286S

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 (Public Policy Studies 114, 116, 128 or equivalent, or Statistics 101), and consent of director Instructor: Staff. 3 units.

For Graduates

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. Variable credit.

307. Master's Project I. 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.

308. Master's Project II. 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: Spengler. 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

320. Globalization and Governance. Seminar explores economic, political, and social aspects of globalization and their implications for public policy making in the twenty-first century. Focus on issues of governance, particularly international cooperation, the design of international organizations, and the role of international NGOs. Policy areas include international trade and finance, environment, security, human rights, media and communications, and international development. Instructor: Mayer. 3 units.

330. Special Topics in Leadership and Management. Selected topics. Prerequisite: graduate level. Instructor: Staff. 1.5 units.

340. Advanced Special Topics in Public Policy. Contents and methods vary with instructors and from semester to semester. Instructor: Staff. 3 units.

341. Advanced Special Topics in Public Policy. Contents and methods vary with instructors and from semester to semester. Instructor: Staff. Variable credit.

345. Racial and Ethnic Minorities in American Politics. 3 units. C-L: see Political Science 316; also C-L: Law 597

350. Special Topics in Social Policy. This course will introduce students to the major methods used in the analysis of problems in social policy. These methods derive from economics, political science, human development, ethics, and systems analysis. Students will learn to apply these methods to contemporary problems. Students will learn to think critically, analytically, and synthetically. Students will write critical reactions, policy briefs, and opinion papers. Class time will be devoted to lectures, student discussion of readings, oral presentations by students, and occasional guest speakers. Instructor: Staff. 3 units.

360. Global Policy & Governance. This course seeks to explore some central questions of global policy and governance. Taking advantage of its location in Geneva, it provides students with an opportunity to experience the "real world" of international diplomacy, to access key actors and institutions involved in global policy processes, and to think critically about the international system today, and what it might become. It is designed to give students access to a range of international organizations, and to develop the skills knowledge and contacts necessary to enter a career in international affairs. Consent of instructor required. Instructor: Staff. Variable credit.

380. Policy Analysis of Development. Seminar examines role of policy in solving important social problems and develops the analytical and communication skills of participants. Examines public policy objectives and role of policy analysis in achieving objectives, market and government failures, role of public and private sectors, policy analysis tools (cost-benefit analysis, decision analysis, etc.), and policy implementation and evaluation. Emphasis on specific policy problems based on interests of participants. Seminar relies on case studies, application of policy analysis tools, exercises, memos, policy critiques, and discussions with policy analysts. Instructor: Mirovitskaya or R. Fernholz. 3 units.

381. Economic Foundations of Development. Overview of microeconomic and macroeconomic principles related to development. Objective of course is to provide

analytical tools for the study of economic policies and problems in developing countries. Includes presentation of theoretical material and its application to current topics and problems. Instructor: Krupp. 3 units.

382. Economic Analysis of Development. Survey of basic principles and policy issues in study of economic growth and development. Overview of patterns and causes of variations in growth, income distribution and development performance of countries. Roles of physical, natural and human capital, technological innovation and productivity improvements in explaining growth explored along with effects of different institutional environments in less developed and transitional economies. Explores economic growth and development in policy areas. Instructor: Fernholz, Glenday, Shukla. 3 units.

383. A-C. Development Management Courses - International Development Policy. A. Institutional Design for Managing the Environment B. Managing the Project Cycle C. Strategic Management for Policy Change. Courses cover areas of development project management, entrepreneurship development, not-for-profit management, civil society and governance, decentralization, media policy, aid coordination, science and technology policy, regional planning, rural or urban development, or other sector development issues. For complete course descriptions, see <http://www.pubpol.duke.edu/centers/dcid/pidp/masters.html>. Instructor: Lethem (383A,B), Van Sant (383C). Variable credit.

383A. Institutional Design for Managing the Environment. Variable credit.

383B. Managing the Project Cycle. Variable credit.

383C. Strategic Management for Policy Change. Variable credit.

384. A-C. Applied Economics Courses - International Development Policy. A. Statistics for Development B. Public Finance Policy in LDC and Transitional Countries C. Budgeting and Financial Sector Management. Topics of economic policy aspects of development; including issues of international trade and competitiveness, public finance and evaluation of public expenditures, banking and financial sector management, privatization, external debt management, and international capital markets. Instructor: Fernholz, Glenday, Shukla (384B,C), Tham (384A). Variable credit.

384A. Statistics for Development. Variable credit.

384B. Public Finance Policy in LDC and Transitional Countries. Variable credit.

384C. Budgeting and Financial Sector Management. Variable credit.

385. A-F. Social Policy, Environmental Policy and Peace and Conflict Courses - International Development. A. Urban and Rural Development in Developing Countries B. Structural Adjustment and Poverty C. Development and Social Sector Reform D. Communities and Sustainable Development E. International Development, Conflict and Cooperation: Crucial Linkages F. Peace, Conflict and Sustainable Development: The Challenge of Transition. Education, health, gender, ethnic and economic inequality, social entrepreneurship; international environmental policy, security, institutional development; democracy, negotiation, conflict resolution, cooperation in international development, resource management, global environment, sustainable development for world peace. Instructor: Staff. Variable credit.

385A. Urban and Rural Development in Developing Countries. Variable credit.

385B. Structural Adjustment and Poverty. Variable credit.

385C. Development and Social Sector Reform. Variable credit.

385D. Communities and Sustainable Development. Instructor: Staff. Variable credit.

385E. International Development, Conflict and Cooperation: Crucial Linkages. Instructor: Mirovitskaya. Variable credit.

385F. Peace, Conflict, and Sustainable Development: The Challenge of Transition. Instructor: Admay. Variable credit.

386. Independent Research Topics in International Development Policy. Selected topics. Consent of instructor required. Instructor: Staff. Variable credit.

387. Master's Project in International Development Policy. Emphasis on individual projects. Open to PIDP students only. Consent of instructor required. Instructor: Staff. Variable credit.

388. Special Topics in International Development Policy. Course descriptions at <http://www.pubpol.duke.edu/centers/dcid/pidp/masters.html>. Variable credit.

389. Program in International Development Policy Mini-Seminars. Short term, one credit mini-seminars on variable topics in International Development Policy. Instructor: Staff. 1 unit.

399. Special Readings in Public Policy Studies. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

242S. Chinese Economy in Transition

259S. State and Local Public Finance

265S. The Process of International Negotiation

267S. Policy-Making in International Organizations

275S. Seminar in Urban Politics and Urban Public Policy

Religion (RELIGION)

Professor Kort, Chair (123A Gray); Professor E. Meyers, Director of Graduate Studies (209A Old Divinity); Professors Berger, Bland, Clark, Crenshaw, Davis, Hauerwas, Hays, Heitzenrater, Hillerbrand, Jones, Lawrence, Lischer, Marcus, C. Meyers, Peters, Steinmetz, Surin, Van Rompay, Verhey, Wacker, and Wainwright; Associate Professors Fulkerson, Huetter, Jaffe, Keefe, and Nickerson; Assistant Professors Byrne, Campbell, Carter, Chapman, Hall, Jennings, Portier-Young, Prasad, and Smith; Associate Research Professor Moosa; Associate Professor of the Practice Turner; Assistant Professor of the Practice Eastman

The Graduate Program in Religion offers graduate work in numerous programs leading to the A.M. and Ph.D. degrees. In Program I, students may concentrate their studies in one of the following fields of study: Hebrew Bible/Old Testament, New Testament, Early Christianity, European Christianity (Christianity in Reformation Europe and Modern European Christianity), American Religious History, History of Judaism, Islamic Studies, Christian Theological Studies, and Religion and Modernity.

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 or program, 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 determined by the faculty in the field of specialization 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 Graduate Program in Religion's web site at <http://www.duke.edu/web/gradreligion/> or send email to grotter@duke.edu.

For Seniors and Graduates

201. Studies in Intertestamental Literature. Selected documents of the Apocrypha and Pseudepigrapha examined exegetically and theologically in their relation to postexilic Judaism. Consent of instructor required. Instructor: Staff. 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 offers a special focus, such as: 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) are included. Also offered as Church History 206 and Medieval and Renaissance Studies 206. 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. Consent of instructor required for undergraduates. Also taught as Old Testament 207. Instructor: Chapman, Davis, Peters, or Portier-Young. 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. Consent of instructor required. Also taught as Religion 208. Prerequisites: OLDTEST 115, 116. Instructor: Chapman, Davis, Peters, or Portier-Young. 3 units.
- 209. Old Testament Theology.** Studies of the Old Testament in regard to theological themes and content. Instructor: Crenshaw. 3 units.
- 212S. Theorizing Religion.** Late nineteenth- and twentieth-century theories, interpretations, and approaches to the study of religion. Instructor: Staff. 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. Elementary Syriac.** Introduction into the language; reading and analysis of simple texts. Instructor: Van Rompay. 3 units.
- 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. Consent of instructor required for undergraduates. Instructor: E. Meyers or staff. 3 units.
- 221. Readings in Hebrew Biblical Commentaries.** Selected Hebrew texts in Midrash Aggadah and other Hebrew commentaries reflecting major trends of classical Jewish exegesis. Consent of instructor required for undergraduates. Instructor: Bland. 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 Consent of instructor required for undergraduates. 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. Consent of instructor required for undergraduates. 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. Consent of instructor required for undergraduates. Instructor: Staff. 3 units.
- 227F. Exegesis of the Greek New Testament II: The Synoptic Gospels.** Concentration on the "classical" methods of studying the first three gospels: source criticism, form criticism, and redaction criticism. Some attention to textual criticism. Students expected to become proficient in using the Greek synopsis. Prerequisite: two years of Greek or the equivalent. Also taught as New Testament 227F. Consent of instructor required for undergraduates. 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
- 236. Luther and the Reformation in Germany.** The theology of Martin Luther in the context of competing visions of reform. Instructor: Steinmetz. 3 units.
- 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.
- 245S. 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. Also taught as Church History 247 and Medieval and Renaissance Studies 247. Prerequisite: knowledge of Latin. Instructor: Keefe. 3 units.
- 248. Theology of Karl Barth.** A historical and critical study of Barth's theology. Instructor: Huetter. 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.
- 252. Feminist Theology from the Third World.** An introduction to feminist theologies 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 emergence 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 jurisprudence; Islamic legal reasoning; approaches to ethics and procedural justice, the ethical regulation of commerce, including a detailed study of pertinent issues in Islamic law. Also taught as Law 568. Instructor: Moosa. 3 units. C-L: African and African American Studies 254, Medieval and Renaissance Studies 254
- 257. New Testament Ethics.** The distinctive patterns of ethical teaching in the various 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.

265. Epics of India: Ethics, Politics, and Performance Traditions. Wide variety of epics across linguistic, geographical, and community orientations. Moral discourses, literary theory relating to epic form, performance traditions and media representations of epic narrative, and connections between political ideology and epic visions. Consent of instructor required. Instructor: Prasad. 3 units. C-L: Asian & African Languages and Literature Studies 210

267. American Religious Thought. Examination of selected classic studies of American religious thought. Instructor: 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 American 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.

283. Islam and Modernism. Cultural, religious, and ideological forces which shape Muslim responses to modernism. Instructor: Lawrence. 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: Lawrence. 3 units.

285. Freedom and Law. Lecture course will explore the centrality of freedom and law to doctrine of God as well as to the understanding of the human being and unfold their complex interrelationship in the traditions of theology and philosophy. Also taught as Christian Theology 285. Instructor: Huetter. 3 units.

286. The Second Vatican Council (1962-1965). A theological introduction to the Second Vatican Council, offering the opportunity to reflect on some of the fundamental aspects of the nature and identity of the Roman Catholic Church. Instructor: Berger. 3 units.

287. Popular Religion/Culture. 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

288. Buddhist Thought and Practice. A historical introduction to Buddhist thought and practice, with special attention to their interrelationship in the living religion. Instructor: Jaffe. 3 units.

293. Religious Issues in American History. A reading seminar devoted to selected topics, problems, and issues in American religion. Instructor: 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.** Study texts representing "Standard Literary Aramaic": Biblical, Qumran, and Targumic (Targum Onkelos). Other Aramaic language forms may be included. Prerequisite: Should preferably have elementary knowledge of Hebrew. Instructor: E. Meyers or Van Rompay. 3 units.
- 304A. Targumic Aramaic.** An introduction to the language and literature of the Aramaic translations of the Old Testament. Instructor: E. Meyers. 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.
- 306. Advanced Syriac.** Reading and study of Early Syriac Christian texts (2nd-7th) with a general introduction into scholarship on Syriac Christianity. Combination of class work and individual reading. Spring only. Instructor: Van Rompay. 3 units.
- 307. History and Theory.** Explores debates among historians, philosophers, and theorists during nineteenth and twentieth centuries over the status of history as a discipline and as an intellectual enterprise. Particular attention given to the study of religious texts as an aspect of the "new" intellectual history. Seminar will seek to relate these discussions to students' respective sub-disciplinary specialties. Instructor: Clark. 3 units.
- 308. Philosophy and Theology After Wittgenstein.** Follow-up to Theology of Wittgenstein course to see various ways his work has influenced philosophers and theologians, including Anscombe, Edwards, Diamond, Preller, Burrell, Ernst, McCahe, Kerr, R. Williams, and McClendon. Instructor: Hauerwas. 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: Hays. 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.
- 317. God, Freedom, and Evil.** Study of phenomenon of evil by approaching through works of three eminent thinkers: Thomas Aquinas, F.W.J. Schelling, and Karl Barth. Also taught as Christian Theology 317. Permission only. Instructor: Huetter. 3 units.
- 323. Ethnography of Religious Experience.** Examines emergence of ethnography as major research methodology in study of religion. Considers how anthropology has historically constructed a "religious" subject and how contemporary ethnographic theory and praxis are articulated by postcolonial and postmodern critiques representation. Includes proto-ethnographic accounts of religious practice from the 16th and 17th century in Europe and Asia, colonial documentation so-called tribal communities, and ethnographic studies of contemporary religious settings ranging from women's storytelling in Himalayan foothills to Cuban Catholicism in United States. Instructor: Prasad. 3 units. C-L: Cultural Anthropology 323S
- 325. Philosophical Theology I.** Theology, as the knowledge of God, considered in dialogue with selected pagan and Christian philosophers from Plato to Kant. Instructor: Langford. 3 units.
- 333. The Doctrine of the Trinity.** Biblical bases, patristic developments, contemporary statements and connections. Instructor: Wainwright. 3 units.
- 336. Faith and Reason.** Seminar will take up the impulse given by the encyclical *Fides et Ratio* and explore the relationship of faith and reason, of theology and philosophy, on the threshold of a new century. Consent of instructor required. Instructor: Huetter. 3 units. C-L: Christian Theology 336
- 337A. Theology of St. Thomas Aquinas.** Seminar on themes and problems in the thought of Thomas Aquinas. Consent of instructor required. Also taught as Historical Theology 337. Instructor: Steinmetz. 3 units.

- 337B. Theology of St. Thomas Aquinas.** Seminar on themes and problems in the thought of Thomas Aquinas. Consent of instructor required. Also taught as Christian Theology 337. Instructor: Huetter. 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. Fall 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. Spring 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: Staff. 3 units.
- 357. Catholic Traditions in the United States.** Historical exploration of the U.S. Catholic traditions, including Roman Catholicism, independent Catholicism, and other religions' engagements with Catholicism, both friendly and hostile, through primary and secondary texts and other media. Course themes include historiography of American Catholicism, theories of Catholic difference, the new "Catholic Studies," "Catholicizing" the field of U.S. religious history, and professional development. Instructor: Byrne. 3 units.
- 358. Christian Theology/Western Metaphysics.** Offers an explanation of the delicate, albeit crucial function of metaphysics in relationship to Christian theology. Also taught as XTIANTHE 385. Consent of Instructor required. Instructor: Huetter. 3 units.
- 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.
- 361. Modern Historical Study of the Prophets.** With in the history of scholarship on biblical prophecy, the late twentieth-century 'turn to the book' entailed the reevaluation of a consensus established one hundred years earlier. By tracing the trajectory of modern critical study of the Bible's prophetic literature, contemporary interpretive debates and theories are contextualized and illuminated. Instructor: Chapman. 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 intercreedal 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.

368. Spaces, Bodies, & Narratives: Mapping Religion in Colonial India. How imperial cartography, understood as the mapping of territories, human bodies, cultural practices, and oral traditions, influenced mapping of religion in colonial India. Political and personal contexts of British and Indian-authored ethnographies, folklore collections, colonial census reports, and their impact on anthropological imagining of religion in South Asia. Instructor: Prasad. 3 units. C-L: History 345A

381. Destinations. 3 units. C-L: see Art History 381

391. Special Readings in Religion. Readings vary from semester to semester. Consent of instructor required. Instructor: Staff. 3 units.

396. Teaching in Religion. Course specifically designed for students in Graduate Program in Religion. Offers students chance to engage with different faculty members on methods and strategies concerning classroom teaching. Students will be asked to reflect on their own classroom experience and student evaluations of their teaching. Pass/fail only. Consent of instructor required. Instructor: Staff. 1 unit.

COURSES CURRENTLY UNSCHEDULED

203. Studies in American Methodism

211. Authority in Theology

213. Christian Ethics in America

217. Islam and Islamic Art in India

218. Advanced Studies in Religions of East Asia

222. John among the Gospels

224A. Comparative Semitic I

224B. Comparative Semitic II

230. Sainthood in Comparative Perspective

231S. Seminar in Religion and Contemporary Thought

235. Heresy: Theological and Social Dimensions of Early Christian Dissent

237. History of the Ancient Near East

239. Introduction to Middle Egyptian I

240. Introduction to Middle Egyptian II

241. Classical Islamic Theology and Ethics

242. Life after Death in Semitic Thought

249. The Lord's Prayer

251. Goodness and Personhood

253. Feminist Theory and the Study of Christianity

255. Christians in Religious Dialogue

256. John Wesley in Controversial and Ecumenical Theology

258. Coptic

259. Icon Theology

- 260. Life and Times of the Wesleys
- 261. Islam in the African American Experience
- 262. Special Topics in Gender and Religion
- 263. Third World Theology
- 264. The Sociology of the Black Church
- 266. Ethics and Health Care
- 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
- 280. The History of the History of Religions
- 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
- 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
- 311. Pharisaic Judaism in the First Century
- 312. Pauline Theology
- 313. Greek-Speaking Judaism
- 314. Judaism and Christianity in the New Testament
- 315A. Problems in the Study of Paul
- 319. The Gospel According to Saint Matthew in Recent Research
- 320. Origins of Orthodoxy 380-750 C.E
- 321. The Theology of Paul: Coherence and Development
- 322. Nineteenth-Century European Theology
- 324. Readings in the History of Religion
- 326. Philosophical Theology II
- 327. Philosophical Method in Religious Studies
- 328. Twentieth-Century European Theology
- 329. Readings in Theology and Language
- 344. Zwingli and the Origins of Reformed Theology
- 346. Practical Reason and Personal Identity: Explorations in Narrative
- 355. Islam and Its World
- 356. History and Culture of Islamic Cairo
- 373. Elementary Akkadian
- 374. Elementary Akkadian
- 383. Moral Theology in the Twentieth Century
- 389. Christian Ethics and Contemporary Culture
- 397. Readings in North American Religious History
- 398. Colloquium on the Teaching of Religion

Romance Studies

Professor Greer, Chair, (205 Languages); Professors Bell, Finucci, Garci-Gómez, Jameson, Kaplan, Longino, Mignolo, Moi, Moreiras, Orr, Stewart, and Thomas; Associate Professors

Dainotto, Hardt, Nouzeilles, Sieburth, Solterer, and Vilarós; Assistant Professors Adrian, Fischer, Gabara, Jonassaint, Paredes, Schachter, and Viego; Research Professor Keineg; Professor of the Practice and Director of the French Language Program Tufts; Associate Professor of the Practice 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 (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. C-L: Linguistics 221

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. Genres may include fables, letters, memoirs, sermons, treatises, novels, plays. Instructor: Longino. 3 units. C-L: Medieval and Renaissance Studies 249

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 or staff. 3 units. C-L: History 256

257. Problems of Identity in the Nineteenth-Century Novel. Romanticism and romantic realism, studied especially in the works of Chateaubriand, Stendhal, Constant, de Staël, and Sand. Instructor: Bell or Jameson. 3 units.

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: Schachter. 3 units.

- 326. Topics in Renaissance Poetry.** Instructor: Schachter. 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: Staff. 3 units.
- 356. Topics in Nineteenth-Century French Literature.** Includes genres, authors, movements, and works. Instructor: Bell, Jameson, 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, 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 such as Regionalism, Nationalism and Postcolonialism; the status of fiction in a totalitarian space; Transtextuality and Francophone Literature. Readings include literary and nonliterary texts by writers such as Aquin, Chamoiseau, Confiant, Chauvet, Faye, De Certeau, Depestre, Miron. 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 theoretical and sociological issues on citizenship, migration, transnational writers, and postnational literature. Readings might include literary and nonliterary texts by, among others: Ben Jelloun, 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

223. Semiotics for Literature

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 (ITALIAN)

For Seniors and Graduates

211S. Methodologies in Italian Studies. Critical methods and theoretical issues concerning the study of Italian literature and culture. Instructor: Dainotto, Finucci, or Hardt. 3 units.

240. Seminar in Medieval and Renaissance Studies. The study and interpretation of medieval and Renaissance culture. Instructor: Finucci. 3 units.

248. Topics in Italian Civilization. Specific aspects of Italian history, civilization, culture, and institutions. Topics may vary. Instructor: Dainotto, Finucci, or Hardt. 3 units.

For Graduates

381. Special Topics Tutorial. Directed reading and research in areas unrepresented by regular course offerings. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

283. Topics in Italian Literature

PORTUGUESE (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.

392S. Contemporary Brazilian Culture and Society. Core course for Duke in Brazil. Taught in English. Introductory course on major aspects of Brazil and Brazilian history; race, religion, culture, social movements, film, theatre and visual arts. Course option for students to receive graduate credit for work done in Duke in Brazil. Students will be expected to attend class and complete assignments for PTG 140S and complete a complementary individual research project at the graduate level. Taught in Rio de Janeiro. Instructor: Damasceno and Staff. 3 units.

ROMANCE STUDIES (ROMST)

200S. Seminar in Romance Studies. Topics to be announced. 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: Staff. 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

210S. Topics in Linguistics

SPANISH (SPANISH)

For Seniors and Graduates

200S. Seminar in Spanish Literature. Topics to be announced. Instructor: Staff. 3 units.

210S. History of the Spanish Language. Formation and development. Internal forces and external contributions. Instructor: Garci-Gómez. 3 units. C-L: Medieval and Renaissance Studies 210AS, Linguistics 210S

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. Instructor: Staff. 3 units. C-L: Linguistics 212S

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: Gabara or Moreiras. 3 units.

248. Studies in Spanish-American Literature. Concentration on single authors, genres, movements, or themes. Instructor: Staff. 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: Staff. 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. Study of interaction between literature and visual culture during the twentieth century. Specific topics may focus on movements such as the avant-garde and *concretismo*, or concepts such as the neo-baroque and interdisciplinary fictions. Instructor: Gabara. 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 Quixote, 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.

367. The City, Modernity, Gender, and Literature: Nineteenth-Century Madrid. The course will examine the intersections among four terms: the city, modernity, gender, and literature. We will focus on 19th-century Madrid. We will explore the following topics: the concept of the public sphere and its contradictions; the gendering of public and private spheres and of the experience of modernity; the problem of representation in , and of, the city; mass culture and the city; the realist novel and women in the streets. Instructor: Staff. 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.

372. Latin American Vanguards. A seminar on the major avant-garde movements between 1915 and 1940, based in an interdisciplinary study of literature and visual culture. Examines contemporary criticism as well as theoretical texts from the period. Topics include: critical nationalism, indigenism vs. primitivism, formalism and political art, the "gender of modernity." Instructor: Gabara. 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

251S. Spanish Film

255. Topics in Early Modern Spanish Literature and Culture

262. The Romantic Movement

276. Modern Spanish Drama

277. Modern Spanish Novel

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 and Earth Sciences, 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, Box 90260, Duke University, Durham, NC 27708-0260; or visit the web site at <http://www.duke.edu/web/CSEEEES>.

Slavic Languages and Literatures

Professor Andrews, Chair; Associate Professor Gheith, Director of Graduate Studies; Professor Miller; Associate Professor Tetel; Professor of the Practice McAuliffe; Associate Professor of the Practice Flath; Assistant Professors of the Practice Maksimova and Van Tuyt; Adjunct Professor Newcity; 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

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.

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.

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.

218S. The Russian Intelligentsia and the Origins of the Revolution. 3 units. C-L: see History 201S

243. Contemporary Russian Culture: Detective Novels and Film. Popular novelists and film/television from 1900s-early twenty first century Russia. Theories of genre, anthropological approaches to defining cultural trends, mass cultural phenomena, and impact of globalization. Authors include Marinina, Dashkova, Dontsova, Kunin, Ustinova, and Serova. Readings and films in Russian. Research paper of publishable quality required. Instructor: Andrews. 1 unit.

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.

256. Twentieth-Century Russian Women. Issues of gender and society in Russia in the twentieth century. Readings include autobiographical writings, works of fiction, and selected historical sources. Taught in English. Readings in Russian. Instructor: Staff. 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.

271S. Bunin: Mystery of the Russian Soul and Metaphysical Memory. Same as Russian 171S, but includes additional assignments. Taught in Russian. Readings in Russian. Intensive critical component. Instructor: Maksimova. 3 units.

272S. Pushkin and His Time. Pushkin and the literary revolution around 1830. Prose works (*The Tales of Belkin*, *The Queen of Spades*, *The Captain's Daughter*) and major lyrical poetry. Taught in English. Readings in Russian. Instructor: Gheith or Van Tuyl. 3 units.

275. Tolstoy. Introduction to life, works, and criticism, including Tolstoy's philosophical and ethical discourse. Readings include: *War and Peace*, *Anna Karenina*, the shorter fiction, dramatic works and essays. Taught in English. Readings in Russian. Instructor: Van Tuyl. 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 or Gheith. 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 Aksyonov, Trifonov, Baranskaya, Bitov, Solzhenitsyn, Rasputin, Shukshin, and Zalygin. Readings in Russian. Instructor: Staff. 3 units.

286S. Zamyatin. The novel *We*, short fiction, plays, and critical essays. In-depth textual analysis and study of Russian, American, and European criticism on Zamyatin, including his role in science fiction and anti-utopian literature in Russia and the West. Readings in Russian and English. Final research project required. Instructor: Andrews or Maksimova. 3 units.

288AS. Apocalyptic Visions and Diabolic Drama: The Works of Mixail Bulgakov. Critical analysis of Bulgakov's short stories, novellas, plays and novels. In-depth exposure to major critical works on Bulgakov and influential figures. Taught in Russian. Readings in Russian. Instructor: Andrews. 3 units.

288BS. Apocalyptic Visions and Diabolic Drama: The Works of Mixail Bulgakov. Critical analysis of Bulgakov's short stories, novellas, plays and novels. In-depth exposure to major critical works on Bulgakov and influential figures. Taught in English. Readings in English. Instructor: Andrews. 3 units.

299. Special Topics. Non-seminar version of Russian 299S. Instructor: Staff. 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. 1 unit.

351. Topics in Teaching Methodology. Application of linguistic principles in the classroom. No prior knowledge of linguistics required. Instructor: Staff. 2 units.

399. Special Readings. Advanced readings in nineteenth- and twentieth-century Russian literature in the original. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

201S. Topics in Comparative Slavic Linguistics

203S. Old Church Slavonic

204S. Russian Folklore and Popular Culture

207S. Semantics

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
- 250. Trends in Russian and East European Literary Criticism and Beyond
- 257. Law, Culture, and the Russian Legal Tradition
- 261. Masterpieces of Nineteenth-Century Russian Literature I
- 262. Masterpieces of Nineteenth-Century Russian Literature II
- 264. Symbolist Movement in Russia
- 265S. Literature of Early Russia
- 266S. The Sources of Modern Russian Literature: The Eighteenth Century
- 269. Women and Russian Literature
- 273S. Gogol
- 277S. Chekhov
- 278. Russian Short Fiction
- 279S. Literature of the Former Soviet Republics
- 280. Early Twentieth-Century Russian Literature: From Symbolism to the 1920s
- 281. The Soviet 1920s: The Road to a New Synthesis
- 282. Socialist Realism: Soviet Literature of the 1930s and 1940s
- 284. Late- and Post-Soviet Literature
- 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. Prerequisites: 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. Prerequisites: 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 (SERBCRO)

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 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.

TURKISH

235. Identity and Cultural History: The Ottoman Context. Reading and assessment of new scholarship on Ottoman culture, society, politics, and state. Supplemented by critical texts on historiography, identity, gender, religion, and orientalism. Topics include "gazi thesis," secular and Islamic law, "Kadi justice," everyday life, and role of women. Final research project with interdisciplinary focus. Instructor: Goknar. 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 Morgan, Chair (268 Sociology-Psychology); Professor Wilson, Director of Graduate Studies (341 Sociology-Psychology); Professors Carroll (divinity), P. Cook (public policy), DiPrete, Gao, George, Gereffi, Land, Lewin (business), Lin, McPherson, Morgan, O'Barr (cultural anthropology), O'Rand, Payne (history), Simpson, Smith-Lovin, Tiryakian, Wilson, and Zhou; Associate Professor Gold (psychiatry and Aging Center); Assistant Professors Brady, J.Cook, Hughes, Parrado, and Shanahan; Professors Emeriti Maddox, 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 (Sociology 301, 302, 303) for the exposure of frontier research issues and professional activities in sociology. The core courses include: Sociological Theory (206), Social Statistics I and II (Sociology 212, Sociology 213), and two out of three methods courses (Sociology 208, Sociology 214, Sociology 215). Specializations (with the associated proseminars indicated in parentheses) include Population Studies (Sociology 224S), Comparative and Historical Sociology (Sociology 222S); Economic Sociology (Sociology 225S), Medical Sociology (Sociology 227S), Stratification (Sociology 228S),

and Social Psychology (229S). 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 specialties and their requirements, departmental facilities, the faculty, ongoing research, and stipends available may be obtained from the director of graduate studies.

For Seniors and Graduates

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 posttesting, response effects, validity and reliability, scaling of data, data reduction and analysis. Instructor: Brady, 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, Land, McPherson, or Zhou. 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, Land, McPherson, or Zhou. 3 units.

214. Comparative and Historical Methods. Introduction to the theory of comparative research and analysis in the social sciences with special emphasis on comparative methods, quasi-experimental designs, and case studies. Instructor: Gereffi, Lin, or Tiryakian. 3 units. C-L: Political Science 217

215. Basic Demographic Methods. 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, Land, or Morgan. 3 units.

216. Advanced Methods of Demographic Analysis. Mathematical methods and computer software for the analysis of population dynamics. Life table and stationary population theory; methods of life table estimation; multiple-decrement and multistate life tables; stationary population theory and its extensions; model life tables and stationary populations; two-sex models and interacting populations; hazard regression models, grade-of-membership analysis, and cohort studies. Instructor: Land or Stallard. 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, Land, Lin, McPherson, or Zhou. 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: Brady, Gao, Gereffi, Lin, or Shanahan. 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, Parrado, or O'Rand. 3 units.

225S. A-F. Proseminars in Economic Sociology. Selected topics in organizations and institutions, social networks and social capital, globalization and markets, and occupations and work.

- A. Basic Concepts, Theories, and Methods.
- B. Organizations and Institutions.
- C. Social Networks and Social Capital.
- D. Globalization and Markets.
- E. Occupations and Work.
- F. Special Topics.

Instructor: Brady, Cook, DiPrete, Gao, Gereffi, Lin, Merckx, Spenner, or Zhou. 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, Hughes, or Lin. 3 units.

228S. A-F. Proseminars in Stratification. 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: Brady, 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 application 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, Lin, Smith-Lovin, or Spenner. 3 units.

291. Research Methods in Japanese. 3 units. C-L: see Japanese 291; also C-L: Cultural Anthropology 290, History 292, Political Science 291

298S. Seminar in Selected Topics. Substantive, theoretical, or methodological topics. Restricted to Sociology graduate program majors only. Instructor: Staff. 3 units.

299S. Seminar in Selected Topics. Substantive, theoretical, or methodological topics. Instructor: Staff. 3 units.

For Graduates

301. Current Debates and Professional Concerns in Sociology. A two-semester overview of the sociological research being conducted in the Department, a discussion of current

controversies in the discipline, how to prepare for a professional career in sociology, the ethics of doing sociological research, the practice of teaching, how to apply for research grants. Instructor: Staff. 1.5 units.

302. Workshop on Sociological Research. A two-semester workshop in which each student carries out a research project from beginning to end. Weekly seminars offer the opportunity for students to critique each other's work. Instructor: Staff. 3 units.

303. Developing a Dissertation Proposal. A two-semester workshop in which students develop their dissertation proposals. Instructor: Staff. 3 units.

310. Social and Economic Data. 3 units. C-L: see Economics 310; also C-L: Political Science 338

333. Seminar in Political Economy: Macro Level. 3 units. C-L: see Political Science 333

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 208 or consent of instructor. Instructor: Staff. 3 units.

COURSES CURRENTLY UNSCHEDULED

234S. Political Economy of Development: Theories of Change in the Third World

282S. Canada

Institute of Statistics and Decision Sciences (STA)

Professor of the Practice Stangl, Director (214 Old Chemistry); Professor Gelfand, Director of Graduate Studies; Professors Berger, Kepler, Lavine, West, Winkler, and Wolpert; Professor of the Practice Banks, Associate Professor Clyde; Assistant Professors Huber, Liang, Mukherjee, and Schmidler; Assistant Professor of the Practice Reiter; Professor Emeriti Burdick and Sacks; Adjunct Associate Professor Dunson; Assistant Research Professors Dobra and Iversen; Visiting Associate Professor Dinwoodie; Visiting Assistant Professor Jang

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, interdisciplinary applications of statistics, and bioinformatics. 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 Statistical and Applied Mathematical Sciences Institute (SAMSI) and 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 ISDS, visit the department web site at: <http://www.stat.duke.edu>.

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: Staff. 3 units.

207. Probability. 3 units. C-L: see 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, a 100-level Statistics course or Statistics 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 queuing 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.

217. Ordinal Data Modeling. Bayesian and likelihood-based of ordered categorical data and rank data using latent variable constructs. Binary and ordinal regression models, multi-rater ordinal data models, multi-rater rank data models, item-response models, and graded-response models. MCMC estimation. Prerequisites: Statistics 213 or equivalent; working knowledge of a low-level computing language like C, C++, or Fortran. 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: see Business Administration 525; also C-L: Psychology 316

232. Statistical Analysis of Ecological Data. 3 units. C-L: Biology 266, Environment 241

234. Choice Theory. 3 units. C-L: see Business Administration 513

240. Applied Data Analysis for Environmental Sciences. 3 units. C-L: see Environment 210

242. Applied Regression Analysis. 3 units. C-L: see 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. Prerequisite: Statistics 213 and 290 or equivalent. Instructor: Staff. 3 units. C-L: Mathematics 217

250. Numerical Analysis. 3 units. C-L: see Computer Science 250; also C-L: Mathematics 221

253. Applied Stochastic Processes. 3 units. C-L: see Mathematics 216

270. Statistical Methods for Computational Biology. 3 units. C-L: see Bioinformatics & Genome Technology 200

271. Statistical Genetics. 3 units. C-L: see Bioinformatics & Genome Technology 201

273. Genome Informatics and Sequence Analysis. 3 units. C-L: see Bioinformatics & Genome Technology 203

277. Computational Methods for Macromolecular Structure. 3 units. C-L: see Bioinformatics & Genome Technology 207

278. Gene Expression Analysis. 3 units. C-L: see Bioinformatics & Genome Technology 208

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. Variable credit.

292. Independent Study. Directed reading and research. Consent of instructor and director of graduate studies required. Instructor: Staff. Variable credit.

293. Special Topics in Statistics. Prerequisite: Statistics 213 or consent of instructor. Credit/Non-Credit grading only. Instructor: Staff. 3 units.

294. Special Topics in Statistics. Prerequisite: Statistics 213 or consent of instructor. Credit/Non-Credit grading only. Instructor: Staff. 3 units.

294A. Special Topics. 1.5 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. Variable credit.

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.

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: see Economics 315; also C-L: 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. 1 unit.

395. Readings in Statistical Science. Advanced seminar on topics at research frontiers in statistical sciences. Consent of instructor required. Instructor: Staff. Variable credit.

COURSES CURRENTLY UNSCHEDULED

203S. Senior Seminar in Statistics

241. Environmental Experimental Design

245. Introduction to Multivariate Statistics

246. Experimental Design

282. Optimization Methods

297. Topics in Probability Theory

333. Sequential Statistical Analysis

345. Multivariate Statistical Analysis

346. Experimental Design and Optimization

University Program in Structural Biology and Biophysics

Associate Professor Oas, Director (biochemistry); Professor Beese, Director of Graduate Studies (biochemistry); Professors Beratan (chemistry), Erickson (cell biology), Hammes (biochemistry); Hellinga (biochemistry), Hsieh (biochemistry), McIntosh (cell biology), Palmer (chemistry), D. Richardson and J. Richardson (biochemistry), Shaw (chemistry), J. Simon (chemistry), S. Simon (neurobiology), Spicer (biochemistry), Toone (chemistry), and Yang (chemistry); Associate Professors Fitzgerald (Chemistry), Van Dongen (pharmacology and cancer biology), and York (pharmacology and cancer biology); Assistant Professors Gewirth (biochemistry), Rudolph (biochemistry), and Zhou (biochemistry)

The program in structural biology and 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 Structural Biology and 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 Structural Biology and 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 Structural Biology and 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 Structural Biology and Biophysics, contact the program office at sbb@biochem.duke.edu or at Duke University, Box 3567 DUMC, Durham, North Carolina 27710.

222. Structure of Biological Macromolecules. 3 units. C-L: see Biochemistry 222

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

259. Structural Biochemistry II. 2 units. C-L: see Biochemistry 259; also C-L: Cell Biology 259, Immunology 259, University Program in Genetics 259

291. Physical Biochemistry. 3 units. C-L: Biochemistry 291

292. Advanced Physical Biochemistry. 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: Oas. 3 units.

345. Structural Biology and Biophysics Seminar. Required of all Structural Biology and Biophysics students. Instructor: Oas. 1 unit.

346. Structural Biology and Biophysics Seminar. Required of all Structural Biology and Biophysics students. Instructor: Oas. 1 unit.

COURSES CURRENTLY UNSCHEDULED

293. Membrane Biophysics

Teaching College Biology

Paula Lemons, Program Director

The Certificate in Teaching College Biology aims to enhance the professional development of graduate students by preparing them to teach biological sciences in academic venues that range from community colleges to Research I Universities. In this program, graduate students work with faculty from nearby partner institutions (e.g., Durham Technical Community College, Elon University, and Meredith College) and from Duke to develop as teachers and to gain awareness about the roles of faculty. These experiences help to prepare graduate students for the academic job market. Program participants take courses on pedagogy, are mentored by faculty at partner institutions, gain practical teaching experience, and receive formal evaluation of their teaching. These requirements are

designed to be flexible enough to be pursued alongside full-time disciplinary studies yet ensure that participants are rigorously trained in biological pedagogy.

For more information see <http://www.biology.duke.edu/teachcert/> or contact the Program Director, Paula Lemons at plemons@duke.edu.

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, 01 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.

302. Educating Adolescents. Focus on understanding the adolescent as a learner. Study of selected theories of adolescent development and theories and principles of educational psychology emphasizing secondary education. Open only to MAT students. Instructor: Bingham. 3 units.

303. Effective Teaching Strategies. During the first part of the course students learn general teaching strategies for secondary classrooms such as time management, student behavior management, planning for instruction, instructional presentation, designing effective lessons, feedback, promoting critical thinking skills, and cooperative learning. In the second part students work on methodologies in specific subject area groups. Open only to MAT students. Instructor: Teasley. 3 units.

341. Internship and Reflective Practice. During fall semester MAT students are placed in supervised internships in local high schools under the direction of trained and certified mentor teachers. The accompanying seminar provides students with an understanding of the adolescent as learner, and opportunities for directed reflection on themselves as teachers and learners, and their students as learners. Open only to MAT students. Instructor: Staff. 6 units.

342. Internship and Content Methodology. The internship continues through second semester under the supervision and coaching of the mentor. The seminar brings together interns, high school teachers, and content faculty members in specific subject area groups to explore emerging knowledge in the discipline, and the ways that knowledge is best delivered in the high school classroom. Open only to MAT students. Instructor: Staff. 6 units.

Women's Studies (WOMENST)

Associate Professor Wiegman, Director (210 East Duke Building); Professor of the Practice O'Barr; Associate Professors Camp, Rudy and Weeks; Research Professor Pierce-Baker. *Associate Faculty:* Professors Koonz (history) and Roth (psychology/social and health sciences); Associate Professors Edwards (history), Fulkerson (divinity), Lubiano (African and African American studies and literature), Nelson, (cultural anthropology), and Wald (English), Yoda (Asian and African languages and literature); Assistant Professor Khanna (English and literature). *Adjunct Faculty:* Adjunct Professor of the Practice White; Adjunct Assistant Professors Keeling (University of North Carolina at Chapel Hill), Krahulik, and Lisker

Women's Studies is part of an historical educational enterprise inaugurated by social movements and dedicated to the study of identity as a complex social phenomenon. In the

field's first decades, feminist scholarship reoriented traditional disciplines toward the study of women and gender and developed new methodologies and critical vocabularies that have made interdisciplinarity a key feature of Women's Studies as an autonomous field. Today, scholars continue to explore the meaning and impact of identity as a primary - though by no means transhistorical or universal - way of organizing social life by pursuing an intersectional analysis of gender, race, sexuality, class, and nationality. In the classroom, as in our research, our goal is to transform the university's organization of knowledge by reaching across the epistemological and methodological divisions of historical, political, economic, representational, technological and scientific analysis. In our program's dual emphasis on interdisciplinarity and intersectionality, we offer students new knowledge about identity while equipping them with a wide range of analytical and methodological skills.

Women's Studies at Duke is a focal point within the university for the study of women, gender, and feminist theories—a structure which allows graduate students to address complex issues beyond their traditional disciplinary and classroom boundaries and to explore problems in ways that connect theories and approaches of different disciplines. Women's Studies serves students' intellectual interests by offering credit courses, housing a variety of research projects, and implementing programs for diverse audiences. Graduate students can earn a four-course certificate in Women's Studies and are encouraged to teach introductory or special topics courses. Professional students and doctoral candidates may join a scholarly society that deepens their knowledge of the field of Women's Studies and provides a cohesive, supportive community. All affiliated students on the mailing list receive newsletters, lecture notices and invitations to special events. For additional information, visit the program Web site at <http://www.duke.edu/womstud>.

Requirements for the Graduate Certificate in Feminist Studies:

A. Four Courses:

1. One required course:

Women's Studies 220 Introduction to Feminist Studies (prerequisite:
Women's Studies 205 or its equivalent)

2. Two of the following:

Women's Studies 210S Selected Topics in Women's Studies
Women's Studies 220 Introduction to Feminist Studies
Women's Studies 230 Feminist Knowledge and Social Change
Women's Studies 240 Critical Genealogies
Women's Studies 260 Interdisciplinary Debates
Women's Studies 290 Interdisciplinary Research Workshop
Women's Studies 300 Advanced Topics in Feminist Studies

3. One course offered by Women's Studies from the list below or one course focusing on women, gender, sexuality, race, and/or feminism offered by another academic unit (must be approved by the program):

Women's Studies 205 Foundations of Women's Studies
Women's Studies 271 Selected Topics in Feminist Studies (crosslisted
with English 271)
Women's Studies 310 Gender & Sexuality in Latin America (cross listed
with History 346)
Women's Studies 391 or 392 Tutorial in Special Topics

B. Competencies

1. Professional School/MA Students: certificate earners pursuing degrees in the professional schools at Duke or terminal Masters *normally* complete course work only.

2. Ph.D. Students: certificate earners pursuing the Ph.D. *normally*:
 - a. have women, gender, sexuality, or feminism as a significant aspect of their exams and dissertation projects
 - b. include a women's studies core, associate, adjunct, or affiliated faculty member with faculty standing in the Graduate School on their exam and dissertation committees.

WOMEN'S STUDIES COURSES (WOMENST)

205. Debates in Women's Studies. Designed for students with little or no experience with feminist scholarship, this course explores major debates in feminist studies. Topics may include abortion, motherhood and new reproductive technologies, gendered divisions of labor, sex work, welfare, sexual freedom, and immigration. Consent of instructor required. Instructor: Staff. 3 units.

208S. Economics of the Family. 3 units. C-L: see Economics 208S

210S. Selected Topics in Women's Studies. A seminar in contemporary issues, methodology, and/or selected theoretical questions pertaining to feminist scholarship. Instructor: Staff. 3 units.

220. Foundations in Feminist Theory. Required for all students pursuing the graduate certificate in Women's Studies, this course serves as an in-depth introduction to the various theoretical frameworks that have and continue to inform scholarship in the field of Women's Studies. It explores differences between distinct feminist theoretical traditions (Marxist feminism, poststructuralism, psychoanalysis, queer theory) and seeks to historicize accounts of identity, difference, social movement, globalization, nationalism, and social change. Consent of instructor required. Instructor: Staff. 3 units. C-L: Literature 220

225S. Space, Place, and Power. 3 units. C-L: see Cultural Anthropology 285S; also C-L: Asian & African Languages and Literature Studies 230S, Literature 287S

230. Feminist Knowledge, Interdisciplinarity, and Social Change. This course explores feminism as a knowledge formation by considering Women's Studies as a specific interdisciplinary, politics, and epistemological project in relation to feminist studies in the disciplines. The course is highly recommended for students seeking part or full time academic employment in Women's Studies. Consent of instructor required. Instructor: Staff. 3 units.

240. Critical Genealogies. This course serves as an in-depth investigation into the many different theoretical traditions that inform interdisciplinary feminist studies. Specific foci include Marxist-feminism, poststructuralism, feminist film theory, psychoanalysis, French feminism, postcolonial theory, deconstruction, the Frankfurt school, etc. Instructor: Staff. 3 units.

271. Selected Topics in Feminist Studies. May be taken only once for certificate credit. Instructor: Staff. 3 units.

290. Interdisciplinary Research Workshop. This course focuses on research and writing, paying particular attention to the intellectual and methodological demands of interdisciplinary knowledge production. Instructor: Staff. 3 units.

297S. Teaching Race, Teaching Gender. 3 units. C-L: see African and African American Studies 297S; also C-L: History 297S

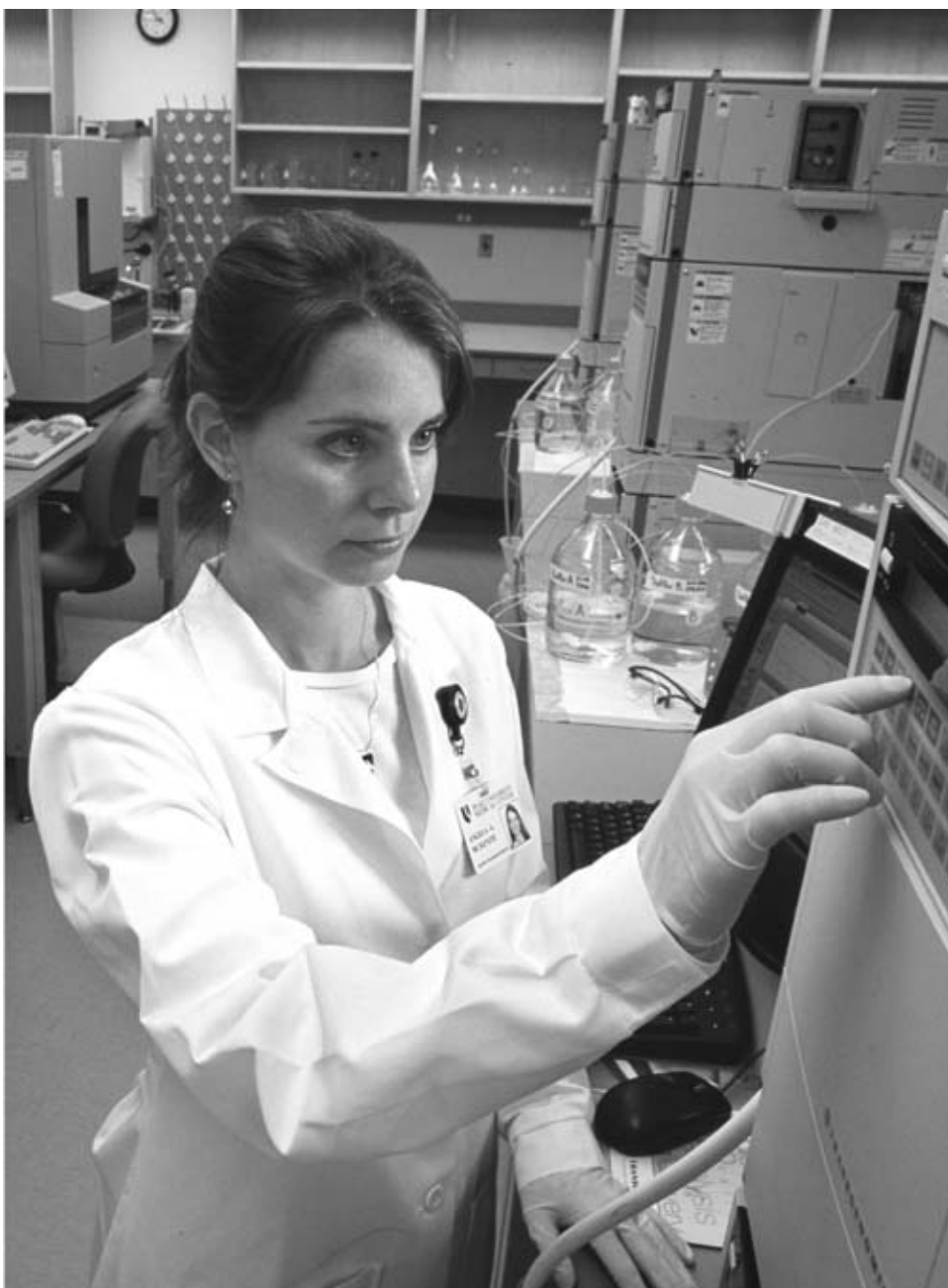
300. Advanced Topics in Feminist Studies. A selected topics seminar on emergent theoretical and empirical questions in feminist scholarship. Prerequisite: must have taken either Women's Studies 211, 212, 213, or 214 or have consent of instructor. Instructor: Staff. 3 units.

360. Interdisciplinary Debates. Designed for advanced graduate students, this course will highlight current debates in feminist studies through a topical approach that draws on faculty research and expertise. 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 Advanced Computing and Communication

The Center for Advanced Computing and Communication (CACC) is a joint effort of Duke University and North Carolina State University. Its research goal is to create concepts, methods and tools for use in the analysis, design and implementation of advanced computer and communication systems. The Center strives to carry out basic and applied research on fundamental problems with both industrial and academic relevance, to transfer these results to members, and to provide students with a unique and challenging educational opportunity. For information, contact Kishor S. Trivedi, Director, Center for Advanced Computing and Communication, Box 90291, Duke University, Durham, North Carolina, 27708-0291.

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 web site at www.geri.duke.edu for more information.

Asian/Pacific Studies Institute (APSI)

The Asian/Pacific Studies Institute (APSI) is the focal point of research and teaching on the Asian/Pacific region at Duke University. Started in 1981, today APSI has 30 fulltime faculty members at Duke and 20 affiliated faculty members from regional universities. It is the largest center for research and teaching on East Asian in the southeast. The Institute offers an interdisciplinary MA program in East Asian Studies as well as a joint JD/MA program. APSI administers conferences, a speaker series, research clusters, a visiting scholar program, and the Duke Study in China Program. 2111 Campus Drive, Box 90411, Duke University, Durham, North Carolina 27708-0411. Send e-mail to: apsi@duke.edu or visit our web page at: <http://www.duke.edu/APSI/>.

Center for Canadian Studies

Duke has a strong tradition in Canadian Studies dating back more than three decades. Over the years, we have graduated more than 100 Ph.D.s whose work has focused on Canada. Today, these former students teach at leading universities across Canada and the United States.

We also have a strong tradition of Canadian speakers, including prime ministers Pierre Trudeau, Brian Mulroney, and Jean Chrétien. Currently there are 50 undergraduate and 91 graduate students studying at Duke. We also have Canadian faculty members including visiting scholars.

The Center for Canadian Studies maintains an active research program for faculty. The Center also supports the research of a number of graduate students and offers undergraduates the option of a second major or a minor in Canadian Studies.

For more information, contact the Center for Canadian Studies Program, P.O. Box 90422, 2204 Erwin Road, Durham, North Carolina 27708; or visit the Web site at: <http://www.jhfc.duke.edu/canadianstudies>.

Center for Child and Family Policy

The mission of the Center for Child and Family Policy is to contribute to solutions to important problems affecting today's children and families, through an integrated system of scientific research, debate and dissemination, public service, and teaching. The Center emphasizes the bridge from basic research to policy and practice.

The Center addresses the needs of the whole child, from the prenatal period through adolescence, and involves the full array of institutions, practices and issues that affect the healthy development of children: medical care and public health, welfare, education, juvenile justice, family court, preschool and childcare provision, community services and family health and vitality. The Center is international in the sense both of seeking foreign models for American policies and in addressing international problems. The Center seeks to understand the stresses, strengths and challenges of the average family, particularly as these relate to gender, education, and economic status. The Center also devotes attention to children suffering from significant problems, such as poverty, abuse and neglect, and mental or physical illness. Finally the Center also addresses the development of children with special talents and giftedness. It is the integration across these diverse areas that provides the most important insights to children's well-being.

For more information, contact the Center for Child and Family Policy, Box 90264, Durham, North Carolina, 27708-0264; telephone (919) 613-7319; email: childpolicy@duke.edu, or visit the web site at: <http://www.childandfamilypolicy.duke.edu>.

Center for Cognitive Neuroscience

The Center for Cognitive Neuroscience (CCN) is committed to research, education and training in the psychological, computational and biological mechanisms underlying higher mental functions, including perception, attention, memory, language, emotion, and consciousness. Cognitive neuroscience is by its nature interdisciplinary, addressing long-standing questions about the brain and mind from new perspectives, and defining new issues that cut across traditional intellectual boundaries. To advance this agenda, the CCN brings together the expertise of faculty from various 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 post-graduate training in cognitive neuroscience should apply to the Interdisciplinary Training Program for Graduate Study in Cognitive Neuroscience. This admitting program offers an intensive sequence of courses and laboratory work intended to prepare each student for the research they will carry in their thesis work. Following two years of course work and laboratory rotations that provide a general training in cognitive neuroscience, students select two advisors for their thesis research who have expertise in the subdisciplines that best define their interests. Students enrolled in the program will gain a thorough understanding of the intellectual issues that drive this rapidly growing field, as well as expertise in the major methods used in cognitive brain research.

For additional information and updated instructions, visit our web site at <http://www.mind.duke.edu>. or send an email to darcylew@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, medical, and economic demography of aging is coordinated by the center. Inquiries for training and research opportunities may be directed to Dr. Kenneth C. Land, Director, Center for Demographic Studies, Duke University, Box 90408, Durham, North Carolina 27708-0408.

Program for the Study of Developed Shorelines

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 and Earth Sciences, 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. The center teaches, engages in, and presents documentary work grounded in collaborative partnerships and extended fieldwork that uses photography, film/video, audio, and

narrative writing to capture and convey contemporary memory, life, and culture. 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. Graduate students may participate in a variety of courses that the center offers under the auspices of several Duke departments and programs, including art, 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 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

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, the University of Alabama at Birmingham, the University of Memphis, Tulane, and New Mexico State University 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 European Studies

The Duke Center for European Studies was established in 1989. In 1994 the U.S. Department of Education awarded the consortium with a Title VI grant and designated it as a National Resource Center. This grant was renewed for another three years in 1997. In the summer of 1998, the European Union awarded the Center a three-year grant, and it became one of the ten official European Union Centers in the United States. The Duke Center for European Studies brings together a depth and quality of faculty drawn from highly regarded departments in the humanities, social sciences, law, business and public policy.

The Center promotes interdisciplinary programs, courses and research that directly address questions concerning Europe and the European Union. The Center's goal is to ensure that faculty, students and the larger community have access to the finest scholarship and the most current resources on Europe. The Center offers a Graduate Certificate in Interdisciplinary European Studies to those students meeting the requirements listed on the Center Web site (see below). The Center hosts conferences, workshops, and visiting scholars, supports a graduate student colloquium and faculty/student working groups on focused research lines. The Center also supports Duke faculty and graduate students with academic year research grants and travel awards, and graduate students with the Provost's Pre-Dissertation Summer International Research Fellowships.

For further information, please contact the Center for European Studies, Room 299, John Hope Franklin Center, 2204 Erwin Road, Box 90406, Durham, NC 27708; telephone 919.684.6449; or check the Center website at: <http://www.jhfc.duke.edu/ces>.

John Hope Franklin Center for Interdisciplinary and International Studies

The John Hope Franklin Center for Interdisciplinary and International Studies is home to 20 different Duke programs with the intention to probe the critical issues of our

times in scholarly fashion. It asks fundamental questions, searching for answers across the globe. Besides investigating the concept of race and researching international perspectives, the Center also focuses on issues related to society, art, ethics and new technologies. For more information, visit the Center's web site at: <http://www.jhfc.duke.edu>.

Institute for Genome Sciences and Policy

The Institute for Genome Sciences and Policy is Duke University's response to the Genome Revolution, with global, comprehensive approaches to the study of life. We—scientists and the public together—stand at a new threshold leading to deeper understanding and enhancement of the human experience. What distinguishes IGSP is its breadth and its purposeful focus on health and social policy. We bring together scientists, engineers, physicians, lawyers, policymakers, business leaders, economists, ethicists, humanists and students to explore the genome, embrace its potential and enrich the human condition.

Areas of expertise include:

- Ethics, law and policy in genome sciences
- Genomic medicine
- Genome technology and its applications
- Computational genome sciences
- Connecting genome sciences to society
- Pharmacogenetics
- Population genomics
- Evolutionary genomics

The IGSP is comprised of faculty and students from across Duke University and is organized in a network of Centers and related programs that together form an integrated approach to advancing the Genome Revolution and addressing its implications for health and society. Each center provides core competencies and areas of scholarship that comprise the comprehensive scope of the IGSP's mission.

- Center for Applied Genomics & Technology
- Center for Genome Ethics, Law & Policy
- Center for Genomic Medicine
- Center for Bioinformatics & Computational Biology
- Center for Models of Human Disease
- Center for Population Genomics & Pharmacogenetics
- Center for Evolutionary Genomics

While the IGSP is the major focal point on campus for the study of genome sciences and policy, it collaborates with other multidisciplinary research units at Duke doing related work in genomics.

Center for Geometric and Biological Computing

The Center for Geometric and Biological Computing at Duke is a university-wide center that promotes interdisciplinary research in geometric computing. Participants are affiliated with the Departments of Computer Science, Chemistry, Biomedical Engineering and Mathematics; the Institute for Statistics and Decision Sciences; and the Nicholas School of the Environment and Earth Sciences. The center grew out of a collaborative center with Brown University and Johns Hopkins University.

The center at Duke focuses on the following research topics: bioinformatics, biomolecular computing, classification, external memory algorithms and data structures, geographic information systems, graphics, and robotics. To find out more about the center, visit the web site at: <http://www.cs.duke.edu/CGC/> or contact one of the co-directors: Pankaj Agarwal (email: pankaj@cs.duke.edu), John Harer (harer@math.duke.edu) or Jeff Vitter (jsv@cs.duke.edu).

Duke Center for International Development

The Duke Center for International Development (DCID) is located 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, gender studies and peace and conflict resolution. The faculty's teaching, research, and consulting experience are international in scope, encompassing a broad range of development policy issues.

The center consists of four distinct components: 1). The Program in International Development Policy (PIDP), which provides graduate-level education in policy and economic analysis and problems related to sustainable development for mid-career professionals. PIDP Fellows may pursue either a Master's degree or non-degree certificate in International Development Policy; 2). Executive Education programs on issues related to public finance and sustainable development; 3). The Rotary Center for International Studies in Peace and Conflict Resolution, one of seven centers in the world funded by Rotary International and hosted jointly by DCID and the University of North Carolina at Chapel Hill's Center for International Studies; and 4). Overseas advising to governments in developing countries in the fields of public finance, project appraisal, and development.

DCID also sponsors conferences, a monthly "Rethinking Development Policy" speaker series, and co-sponsors the North Carolina Triangle Chapter of the Society for International Development. For additional information about the graduate program, email pidpinfo@duke.edu or dcidexed@duke.edu for information about the executive program, or visit our Web site at <http://www.pubpol.duke.edu/dcid>.

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, John Hope Franklin Center, 2204 Erwin Road, Box 90404, Durham, North Carolina 27708-0404.

Kenan Institute for Ethics

The Kenan Institute for Ethics 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. The Institute sponsors a variety of programs and projects related to its mission, including a Dissertation Fellowship, a Graduate Instructorship, an interdisciplinary Graduate Colloquium in Ethics, and Campus Grants of up to \$500 to support initiatives at Duke that promote ethical or moral reflection, deliberation and dialogue. For information, contact Kenan Institute for Ethics, 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 and Caribbean studies, and promotes research and dissemination of

knowledge about the region. Chaired by Professor John French, 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 Consortium in Latin American Studies at UNC-Chapel Hill and Duke University, 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 and Caribbean content offered by departments, see the section on "Courses of Instruction" in this bulletin. Graduate students interested in obtaining the certificate in Latin American and Caribbean Studies, or the certificate in Latin American Cultural 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, e-mail: las@duke.edu.

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 88 colleges and universities and a 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 nation; 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 (ORISE), the DOE facility that ORAU operates, 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 *ORISE Catalog of Education and Training Programs*, which is available on the web at <http://www.ornl.gov/orise/educ.htm>, or by calling either of the contacts below.

ORAU'S Office of Partnership Development seeks opportunities for partnerships and alliances among ORAU's members, private industry, and major federal facilities.

Activities include faculty development programs, such as the Ralph E. Powe Junior Faculty Enhancement Awards, the Visiting Industrial Scientist Program, consortium research funding initiatives, faculty research and support programs, as well as services to chief research officers.

For more information about ORAU and its programs, contact: Judith Dillon, Director, Office of Research Support, ORAU Councilor for Duke University, or Monnie E. Champion, ORAU Corporate Secretary (phone: 865.576.3306), or visit the ORAU Web page at <http://www.ornl.gov>.

Office of Research Support

The Office of Research Support (ORS) assists campus researchers, including graduate students and faculty, in locating external funding information for thesis and dissertation,

postdoctoral support, research, travel, summer study, postdoctoral awards, as well as other projects and programs. Students may access the majority of ORS resources via the website at <http://www.ors.duke.edu>. These resources have extensive information on funding opportunities including three web-based funding databases; links to campus, government and private funding sources; tips on proposal writing; and various specialized funding and deadline listings. *Duke Funding Alert*, a weekly online funding newsletter produced by ORS, publicizes new and updated funding resources including graduate fellowships.

ORS also maintains a funding resource center, where students may make an appointment for assistance in searching for funding and access various directories of grants, fellowships and loans, and guides to proposal preparation. Graduate student workshops on locating funding and proposal preparation are available regularly throughout the year, publicized via the website and the Duke online calendar.

In addition to funding information, ORS is the office responsible for the review of proposals to external sources that require an institutional signature. The ORS pre-award staff can assist with proposal and budget preparation, both online and hardcopy. Graduate students planning human-subject based research also need to communicate with ORS concerning the IRB (Institutional Review Board) review process. Students may access the website for information on research with human subjects: "*The Fundamentals*," the ORS guide: "*Preparing the Proposal*," and university policies governing research.

The Office of Research Support website includes detailed information about these and other services. The offices are located at 334 North Building on Research Drive. Office hours are from 8:30 am to 5:00 pm daily. For more information or an appointment, students should contact ORS by telephoning (919) 684-3030.

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 conservation advocacy. 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 regularly offers the following English language courses in Costa Rica: Tropical Biology: An Ecological Approach (twice per year - OTS-1 January to March and OTS-3 June to August); Tropical Plant Systematics (OTS-9 June to July even numbered years). OTS regularly offers the following courses in Spanish: Ecología Tropical y Conservación (OTS-2 January to March in Costa Rica); Agroecología (OTS-7 June to July in Costa Rica); Ecología de Ecosistemas Amazónicos (OTS-13 May in Peru); Sistemática de Plantas Tropicales (OTS-18 June to July in Costa Rica odd numbered years). Additionally, graduate courses covering various specialized topics in tropical ecology (e.g. marine/coastal ecosystems, molecular methods in tropical ecology) are offered from time to time. Students can also apply for courses in East Africa through OTS. Graduate research fellowships are available from OTS on a competitive basis for research conducted at OTS field stations in Costa Rica (La Selva, Palo Verde, Las Cruces). Outstanding proposals for research at other

locations may also be considered when sufficient funds are available. Proposals are accepted twice each academic year. Information about OTS courses and fellowships is available from Duke's OTS delegates: William Morris and Gregory Wray, both in the Department of Biology. 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; Music; Rare Book, Manuscript, and Special Collections; the Pearse Memorial Library at the Duke Marine Laboratory in Beaufort, and the Vesic Library for Engineering, Mathematics and Physics; as well as the independently administered libraries of Divinity, Law, Medicine, and Business (Fuqua). As of June 2003, these libraries contained over 5.3 million volumes. The collection includes 17.7 million manuscripts, and over 1.2 million 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 one of 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 15 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 Lilly Library houses the university's research collections for the visual arts, art history, philosophy, and theater studies. The primary film, video, and media collection for the Perkins Library System is also housed in Lilly. This collection numbers more than 14,000 feature films, documentaries, experimental and animated titles, and is international and interdisciplinary in scope. Media viewing facilities, including U.S. and foreign format VHS and DVD players, are located on Lilly's first floor. Lilly Library also maintains a general reference collection and a periodicals collection that numbers over 350 titles. A rotating collection of current literature titles is located in the lobby.

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 house a music collection which stands at over 110,000 volumes (including books, music scores, and bound journals), plus about 10,000 microform units (including microfilm, microfiche, and a small collection of microcards). Current journal subscriptions alone comprise about 200 current titles, and ongoing serials as a whole (including national monuments, composer editions, and other series and sets) total about 400 titles. The media collection is presently comprised of about 20,000 sound recordings (including 6,000 CDs), more than 340 music videos, 200 laser disks, and a collection of educational software. The music collection is intended primarily for teaching and research in the areas of musicology, historical performance practice, and composition; it is very strong in keyboard music (monographs as well as scores), music and art, musical instruments, Felix Mendelssohn-Bartholdy (1809-1847), the Strauss Family (Johann Sr. and Jr., Eduard, and Joseph), Viennese printing and publishing in the 19th century, British music in general, Venetian music in the baroque and early classic periods, and music of the Indian subcontinent.

The subject-focused branch libraries on the west campus (biological and environmental sciences, chemistry, and engineering and mathematics/physics) collect books, journals, and reference materials needed by scholars working in the corresponding disciplines. Access to networked electronic resources and specialized databases is also available in the branches.

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 all three of these libraries.

Reference librarians are on duty at 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. Reference service is also 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.

UNIVERSITY ARCHIVES

The Duke University Archives, the official archival agency of the university, and a division of the Duke University Libraries, 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.

THE DIVINITY SCHOOL LIBRARY

The Divinity School Library collects materials and provides services in the fields of religion and theology. Though administered separately, the Divinity School Library works with the Perkins Library system, and serves the entire University community.

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. More than 300,000 volumes are available; approximately 2,360 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 law library collection currently contains over 535,000 volumes. The core of the collection consists of virtually all reported decisions of the federal, state and territorial courts of the United States, the British Commonwealth and representative foreign jurisdictions. It also includes the constitutions, codes, statutes, and subsidiary legislative publications of these jurisdictions, as well as digests, indexes, bibliographies and related research tools.

A large section of the library collection is devoted to treatises on all areas of law, and works in the fields of history, economics, government and other social and behavioral sciences relevant to legal research. Selected government documents and pamphlets are

also available. The library maintains subscriptions to all current legal periodicals of general interest printed in the English language, many nonlegal periodicals, and most major legal periodicals published in foreign languages.

Science Laboratories

The Office of Information Technology. OIT is the home of information technology for the university community; it is responsible for computing, telephone, 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 labs 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 Dukesupported software, hardware, and services. The Help Desk Web site is at <http://www.oit.duke.edu/helpdesk>; you can contact the Help Desk via www.dunk.duke.edu/submit.

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, earth and ocean sciences, and the basic medical sciences). Scientists in plant and animal biology with common interests are clustered in two buildings: the Biological Sciences Building, and the Levine Science Research Center. The two 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 include a shared DNA sequencing facility, animal rooms, greenhouses, refrigerated and controlled environment laboratories, scanning transmission electron microscopes, a confocal microscope, Model Systems Genomics computer support and facilities, a computerized morphometrics laboratory, a stable isotope 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 Phytotron also houses a brand new state-of-the-art facility for stable isotope mass spectrometry.

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 ecology; and the Nicholas School's 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 Department of Biology, 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. 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 is an important tool 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.

The Duke Environmental Stable Isotope Laboratory houses two new Finnigan MAT Delta Plus XL continuous-flow mass spectrometer systems. They are configured for rapid automated high precision isotope ratio analyses of hydrogen, oxygen, carbon, sulfur, and nitrogen in biological and geological samples.

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 7,000 acres of land in five main 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 above sea level. 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 teaching and research in such areas as ecology, forestry, zoology, and botany 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. Much information is available electronically through a Geographic Information System. Current work on issues associated with human impacts on the environment, and integrated approaches to natural resource management have multiplied the value and benefit of the Forest. Further information can be found on the Forest web site: <http://www.env.duke.edu/forest> or by contacting Judson Edeburn, Duke Forest Resource Manager, judeburn@duke.edu, A114 Levine Science Research Center, Duke University, Box 90332, Durham, North Carolina 27708-0332.

Earth and Ocean Sciences Laboratories. *Seismology Laboratory.* The seismology laboratory of Dr. Peter Malin serves several purposes. A primary function of the lab is to allow for the design, construction, and testing of prototype geophysical instruments such as borehole seismographs and strainmeters, and portable land-surface seismographic stations. Current efforts on the development of the former instruments are part of the Earthscope-SAFOD project to monitor the San Andreas fault at depth and the LVEW Phase IV Downhole Geophysical Observatory project. The latter instruments are associated with both the CALIPSO volcano monitoring and the UNEP-Kenya and CEC geothermal projects. The lab also provides space for the assembly, testing, and repair of the standard seismographic data loggers and the electronic and mechanical systems associated with all projects. Included

in these activities are surface electronics for the borehole sensors, cables and rigging for instrument installation, and shipping materials.

Coastal Simulation Lab. Dr. Brad Murray's lab and equipment include 5 Silicon Graphics computers (2 O2 workstations, 2 Octane workstations, and 1 Origin 200 server) and a Linux PC, with a total of 8 processors. Along with students, postdocs, undergraduate assistants and visiting scholars, Dr. Murray has used these machines chiefly for developing and running numerical models of surface processes. At times, all the processors are kept running continuously for weeks or months, with models of rivers, coastal marshes, rip currents, shorelines, and nearshore-seabed patterns. His group uses the graphics and animation capabilities of this computer lab to produce images and movies of the model behaviors. One of the O2s features video I/O capabilities and video-analysis software, and they have analyzed laboratory and field video data using recently developed techniques (time averaging and rectification) to extract information from the observations. Misc: Video camera and tripods, high quality Hi-8 and VHS player/recorders and TV set display; diving equipment used for observing nearshore-seabed features.

Petrology Laboratory. The laboratory space of Dr. Boudreau is used largely for general rock sample preparation by members of the petrology/geochemistry group, and includes the following equipment: separatory funnels for mineral separations using the heavy liquids; small sample crushing and sieving equipment; precision diamond wafering blade rock cutting equipment; thin section polishing laps for polished sections for petrographic and electron microprobe study; small Deltech experimental 1 atmosphere high temperature furnace, used for making electron microprobe standards and for high temperature experiments; rock tumbling equipment for aggrading mineral separates; acid dissolutions that are not standard as are used for ICP-MS analysis. An example includes perchloric acid dissolutions, for which the OSHA-required wash down hood in the lab is the only one in the division.

Electron Microprobe Laboratory. The electron microprobe lab, directed by Dr. Alan Boudreau, is used by the petrology and geochemistry groups at Duke and UNC. As such, it is an indispensable basic tool in mineral analyses. The machine consists of a Cameca CAMEBAX (French manufacture) electron microprobe with 4 wavelength-dispersive spectrometers, an energy dispersive spectrometer and digital electron microbeam imaging system. It is automated with control through an Apple Macintosh operating system. The lab is part of a Duke-UNC shared laboratory facilities agreement.

Geochem Laboratory. Dr. Paul Baker's lab has all facilities necessary for major and minor wet chemical analyses. This includes an atomic absorption spectrophotometer, an ion chromatograph, a UV-Vis spectrophotometer, and a Phillips X-Ray diffractometer. Field equipment includes the following: the R/V Neecho, outfitted at Woods Hole Oceanographic Institution and transported by ship to Arica, Chile, then driven over the Andes and launched in Lake Titicaca. The Neecho is a capable 39 foot, twin-diesel boat with a hydro winch and coring winch, two generators, and an air compressor for seismic reflection work. Dr. Baker has an oceanographic-scale piston core (and has taken a 17 m long Kullenberg piston core off the boat), a large and a small box corer and a Seabird Seacat CTD. For smaller lakes there is a zodiac and other small boats and small motors. Dr. Baker has Russian peat corers and a Livingstone piston corer, a gamma/SP/resistivity well logger and 500 m winch.

Micropaleontology Laboratory. Dr. Bruce Corliss has a micropaleontology laboratory which is set up to process marine sediments for the analysis of microfossils. A Carlo-Erba C-N-S Analyzer is included in the equipment, and the lab has a copy of the Catalogue of Foraminifera for taxonomic work. Corliss also maintains an 8x10' environmental room, which is temperature controlled and used for culturing of deep-sea organisms.

High Temperature Chemistry/Petrology Laboratories. Instruments and laboratory facilities overseen by Dr. Emily Klein within the high-temperature chemistry/petrology group include the following instruments and laboratory equipment for sample preparation.

1) ARL-Fisons Spectraspan 7 direct current plasma (DCP) spectrometer was purchased in 1993 through a grant to NSF Ocean Sciences submitted by Emily Klein, with matching funds provided by Duke. It is equipped with a 24 channel multi-element cassette for major- and high-abundance trace-element analysis for elements and high abundance trace elements (to ppm levels). 2) VG PlasmaQuad-3 inductively-coupled-plasma mass-spectrometer (ICP-MS) is equipped with the S-option pump for increased sensitivity and a UV laser-ablation microprobe for spot analyses to 6 microns (for ultra-trace-element spot analyses in the ppb levels). Detection with peak:blank ratios of better than 3:1 has been demonstrated down to 1 ppt or better for heavier elements (mass greater than 80) and 5 ppt for most lighter elements. This instrument is commonly used for the bulk analysis of low abundance trace elements including the rare earth elements, high field strength elements and a wide range of other elements.

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 forest economics, carbon cycling, productivity, 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 Duke University Marine Laboratory (DUML) of the Nicholas School of Environment and Earth Sciences is an educational and research facility. DUML 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 teaching and research at the undergraduate, masters, and doctoral levels. There are approximately 30 masters and 20 resident doctoral students. (For additional information concerning the M.A., M.S., and Ph.D. graduate programs refer to the section "Courses and Academic Programs" in this bulletin and for the MEM graduate program refer to the current Bulletin of Duke University: Nicholas School of the Environment and Earth Sciences.) The Marine Laboratory accommodates nearly 3,700 visitors per year. The physical plant consists of 23 buildings including six research buildings, four dormitories, a dining hall, classroom laboratories and a maintenance complex. Research from the molecular to the population level is supported at the Marine Laboratory. DUML 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. DUML 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.

For information concerning teaching and research space, write to the Auxiliaries and Administrative Services Office, Duke University Marine Laboratory, 135 Duke Marine Lab Road, Beaufort, North Carolina 28516-9721; telephone 252/504-7652 or dominick.brugnolotti@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, biomechanics, 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. William L. Hylander, Director, Duke University Primate Center, 3705 Erwin Road, Durham, North Carolina 27705.

Psychological and Brain Sciences Laboratories. Our department faculty reside in three locations: the Psychology/Sociology building, the Center for Cognitive Neurosciences, and the Genome Science Research Building II. These facilities contain state-of-the-art laboratories to study perception and cognition in human infants and adults—including the areas of autobiographical memory, developmental cognitive and affective neuroscience, and visual perception. Equipment is available for electrophysiology, eye tracking, and video recording. There are also laboratories equipped for the study of animal learning and cognition, and time and number perception in rats, mice, pigeons, fish, and monkeys. These labs are designed to conduct research in behavioral and computational neuroscience and are supported by facilities for animal housing, surgery, histology, microscopy, and electrophysiology. There is support for building of new apparatus, and for computer networking. Additional facilities for access to prosimian animal models, patient populations, and for brain imaging are available in Duke's Brain Imaging and Analysis Center, the nearby Primate Center, and the Duke and V.A. Medical Centers.

Chemistry Laboratories. The Department of Chemistry is housed in the P. M. Gross Chemical Laboratory, a building containing 146,400 square feet of total area, with additional research space in the Levine Science Research Center to accommodate chemistry at the biology interface. This well-equipped chemical laboratory provides conditions conducive to research in many areas of current interest. Major shared instruments, including those for nuclear magnetic resonance and mass spectrometry, are housed in the departmental instrumentation facility, along with optical and other instrumentation, including FTIR, UV-VIS, and fluorescence spectrometers. A wide array of more specialized instrumentation is available in the various research laboratories, from ultrafast laser systems to atomic force microscopes to automated solid-phase synthesizers. Other major facilities on campus include the Free Electron Laser Laboratory and the University NMR Center, which maintains several ultra high field NMR instruments. A broad range of instrumentation for biological and materials science applications is accessible in the Medical Center and School of Engineering, with additional facilities available at the neighboring universities and in Research Triangle Park, including those for X-ray diffraction and structure determination.

Computing facilities in chemistry include SGI and Redhat Linux workstations, Beowulf clusters, and clusters of PC's associated with the teaching laboratories and the library. The department is linked to the university's high speed fiber optic network and to the university's high performance shared computing cluster. In addition, the department has state-of-the-art computer/video projection systems in its lecture halls and is installing wireless networking for incorporation of the latest computational research tools into the undergraduate chemistry curriculum.

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 over 500 current 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 (this facility is used, among other things, to produce a high-intensity gamma-ray source known as the HIGS project); 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; a scanning electron microscope with electron beam lithographic capability; 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 Teer Engineering 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. With the opening in the Fall of 2004 of the Fitzpatrick Center for Interdisciplinary Engineering, Medicine and Applied Science (FCIEMAS), an extensive new infrastructure exists for interdisciplinary laboratory and teaching activities. Departmental facilities already present in Hudson Hall are now augmented by extensive new infrastructure facilitating interaction involving all Pratt departments and research centers, working in close proximity to units from medicine and the sciences. 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, Ultimage 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, 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 distributed through departmental research facilities. Additionally, the department houses and maintains its own computing facility, providing UNIX workstations and IBM-compatible PC's. 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. Several BEOOLF computing clusters are housed in the department. 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.

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 eastern section of the campus are Pickens Rehabilitation Center, Civitan Mental Retardation and Child Development Center, and Trent Drive Hall. 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.

Student Life



Living Accommodations

Duke offers two residential apartment facilities in which graduate and professional students live. These facilities are within short walking distance of university bus service. All apartments are air-conditioned, fully furnished and utilities (except telephone) are included. Each complex has a swimming pool for residents' use, and the Central Campus Apartments also feature basketball and tennis courts. Licenses to occupy space in these facilities are issued for the academic year. The rental rates vary depending upon the apartment type assigned. Please contact Residence Life and Housing Services at (919) 684-4304.

Requests for Duke University housing may be submitted after you have been admitted and have returned the official acceptance form. Students may apply online at <http://rlhs.studentaffairs.duke.edu>. Space is limited, and all students who intend to request housing are encouraged to apply early. In recognition of the special needs of newly accepted international students, priority for assignment to graduate and professional student housing will be awarded to those students arriving from abroad on student visa status.

Duke Community Housing is an off-campus rental housing resource for graduate students. Staff members are available to answer questions concerning housing needs and maintain a database of rental properties, accessible via the Internet at <http://www.communityhousing.duke.edu>. For more information, contact Duke Community Housing at (919) 684-6711 or email: communityhousing@duke.edu.

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) which is a food court offering a great deal of variety in one location. The Loop Pizza Grill (West Union) offers gourmet salads, California- and Chicago-style pizza, and burgers. Subway serves submarine sandwiches and an assortment of frozen treats. Just off the Bryan Center walkway, Pauly Dogs (located on the patio outside The Loop) offers hot dogs, soft drinks and assorted snacks. 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 (Bryan Center) features a full McDonald's menu for breakfast, lunch and dinner. We also

have operations in the Law School that offer sandwiches, hot and cold beverages, grad and go entrees, pastries and bagels (the Café at Duke Law), and in the Sanford Institute for Public Policy offering a typical deli-style menu (Sanford Deli). Rick's Diner and Blue Devil Beanery (WEL): Rick's Diner serves breakfast all day, Southern comfort food, soups, sandwiches and salads. The Blue Devil Beanery serves coffee, assorted hot and cold beverages, pastries and ice cream. 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. The Terrace Café (Duke Gardens) serves hot and cold beverages, sandwiches, salads, and gourmet desserts.

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, pastries, salads and snacks.

On North Campus (Trent), Grace's Café offers a variety of American and authentic Chinese cuisine.

On Research Drive, Blue Express (LSRC) offers 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

Student Disability Access Office. Duke University is prepared to make reasonable academic adjustments and accommodations to allow students with disabilities full participation in the same programs and activities available to students without disabilities. The Student Disability Access Office (SDAO) assists students who are enrolled in the Graduate School. In order to receive consideration for reasonable accommodations under the Americans with Disabilities Act (ADA), a student must have a physical or mental impairment that substantially limits one or more major life activities such as, but not limited to, hearing, seeing, speaking, breathing, performing manual tasks, walking, caring for oneself, and learning. Substantially limited refers to an impairment that prevents an individual from performing a major life activity or significantly restricts the condition, manner, or duration under which an average person can perform a major life activity.

Students requesting accommodations under the provisions of ADA (e.g. academic, housing) must consult the Director of the Student Disability Access Office at (919) 668-1267 or (919) 668-1329 (TTY) to explore possible coverage. Receiving accommodations or special assistance in high school, at another college or university or from a testing agency does not necessarily qualify an individual for the same accommodations and/or assistance at Duke University.

The Vice-President for Institutional Equity is the designated compliance officer for the ADA and the Rehabilitation Act of 1973. The compliance officer can be reached at (919) 684-2222.

The Student Health Center. The Student Health Center, (919) 681-WELL, is a joint program supported by the Department of Community and Family Medicine, Duke University Medical Center, and Student Affairs. A wide variety of services is available:

general medical care, nutrition counseling, laboratory, pharmacy, travel and immunization, x-rays, cold/flu self-help table, and allergy clinic. There is a charge for x-rays, prescription drugs and some laboratory tests. The Student Health Center, located on Flowers Drive in the Duke Clinic complex, is the primary location for medical care and health promotion. Medical services are provided by board-certified faculty and by physician assistants, nurse practitioners, and resident physicians under faculty supervision. Students are seen by appointment, (919) 681-WELL, Monday-Friday, 8:30 a.m. - 5:30 p.m. (Wednesday, 9:30 a.m.–5:30 p.m.). During the academic year, a Nurse Advice Clinic operates from 5:30 p.m.–10:00 p.m. on weekdays, and an Acute Care Clinic is held on Saturday and Sunday from 11:00 a.m.–2:00 p.m. Nurse advice is available by telephone from HealthLink at 966-3820 when the Student Health Center is closed.

Students are encouraged to use the Student Health 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.

In the event of an obvious life-threatening emergency, students should go directly to the Emergency Department. If necessary, Duke Police (call 911 or (919) 684-2444) provides on-campus transportation to the Emergency Department.

Health Promotion. Health promotion staff are available to assist students in making informed decisions that promote their health. Topics include fitness assessment, nutrition, alcohol and other drug usage, eating and body image concerns, sexual activity and sexually transmitted diseases, stress management, and others. Consult the Healthy Devil online at <http://healthydevil.studentaffairs.duke.edu>.

Student Health Physical Therapy. The Student Health Physical Therapy Consultation Service is located in the Wilson Recreation Center on West Campus in the basement of Card Gym. A physical therapist is available from 1:00 p.m. - 5:00 p.m. Monday, Wednesday, and Friday, and 2:00 p.m. - 5 p.m. on Thursday 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 (919) 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 except in life-threatening circumstances. As a member of the Duke University Medical Center, the Student Health Center is fully compliant with HIPAA federal regulations.

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 Center. Therefore, all students are required to have such insurance. At the beginning of each fall semester, students must use the ACES online system to provide proof of coverage under an accident and hospitalization insurance policy or purchase the Duke Student Accident and Hospitalization Insurance policy. This insurance policy provides protection 24 hours per day during the 12-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 can be obtained from Hill, Chesson, and Woody (919) 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 Center during each enrolled semester. Students not enrolled in the university for medical, judicial, or personal reasons are not eligible to pay the health fee or receive services normally covered by the health fee. An optional summer health fee for students not enrolled in summer sessions is also available through the Student Health Center. Waivers are

based on access to campus facilities. Therefore, waivers can be granted if the student resides more than 50 miles away and *does not* come to campus for research or other academic activity for the entire semester. Duke employees and spouses may request waiver. Students studying at the Duke Marine Lab are not eligible for waiver.

Please consult the website <http://healthydevil.studentaffairs.duke.edu> for information about which services are covered by the health fee.

Counseling and Psychological Services. Counseling and Psychological Services (CAPS) provides a range of excellent counseling and psychiatric services to address the acute emotional and psychological difficulties of students. The professional staff is composed of psychologists, clinical social workers, and psychiatrists experienced in working with college students. They provide evaluation and brief counseling/ psychotherapy for a wide range of concerns, including college adjustment, self-esteem and identity, family relationships, academic performance, and intimacy and sexuality. While students' visits with counselors are usually by appointment, emergencies are addressed when they arise.

Each semester, CAPS offers counseling groups and seminars focusing on enhanced self-understanding and coping strategies. Support groups have been offered for second generation Americans; African-American students; students completing dissertations, students with eating disorders; and gay, lesbian, and bisexual students. Other groups have addressed such topics as eating and body image concerns, emotional regulation, meditation and perfectionism.

The staff is available to the university community for consultation regarding student development and mental health. CAPS' staff work with campus personnel, including administrators, faculty, student health staff, religious life staff, resident advisors, and student groups, in meeting mental health needs identified through such liaisons. Staff members are also available to lead workshops and discussion groups on topics of interest to students.

CAPS, consistent with professional ethics and the North Carolina law, maintains a policy of strict confidentiality concerning information about each student's contact with CAPS. If a student desires information to be released, written authorization must be provided. CAPS' services are covered by the student health fee. There are no additional costs for these services. For additional information, call (919) 660-1000.

The Career Center. All Career Center services are available to Duke graduate students for the assessment and revision of career objectives and the search for experiential and employment opportunities to match their interests and expertise. Career-related information and advice are available whether they plan academic or other professional employment or do not yet have a firm plan for how they will use their Duke master's or Ph.D. credential. Services for graduate students include one-on-one confidential counseling, workshops for practical skill development, and special events to connect with employers and alumni. Career Center counselors encourage new graduate students to begin early to plan a successful transition to the workplace and to develop skills for navigating its challenges. For details, see the graduate student section of the Career Center's Web site at: <http://career.studentaffairs.duke.edu>.

Student Affairs

The Office of Graduate Student Affairs. The central mission of Graduate Student Affairs (GSA) is to enhance the quality of graduate student life by working closely with individual students, student organizations, faculty, and other campus offices. The aim is to provide a broad array of programs on issues related to graduate student life such as health, child care, safety, housing, mentoring, and professional development.

Graduate Student Affairs has a particular role in establishing support services that address the specific needs of students from different ethnic backgrounds, international students, gay and lesbian students, students with disabilities, women, and other groups. At the same time, we recognize that each student is an individual, who, while maturing

intellectually, is also developing personally and professionally. This office is committed to helping students to become active participants in the Duke University community. The office is located in 120 Allen Building, phone: (919) 684-2056, web: <http://www.gradschool.duke.edu/gsa>.

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 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, an 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; 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 first summer session. Copies of the Duke University calendars may be obtained online at <http://calendar.duke.edu/>, 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.

The Center for Multicultural Affairs supports the campus in addressing the academic and socio-cultural needs of African, Asian, Latino, and Native American students, and conducts diversity education programs for the general student body. In addition, the Center offers the campus community a number of multimedia resources for programming and research purposes that cover a wide array of multicultural topics. Reservable space is available in the center for clubs and organizations to meet, as well as space where individual students can study and relax. The staff also provides technical support to individuals and organizations planning multicultural, racial, and ethnic specific events. The interests and cultural programming activities of student organizations are of major importance to the center. Dedicated to making diversity and community essential aspects of the Duke experience, the Center collaborates with other campus agencies to offer unique educational programs designed to explore the complex dynamics of creating an inclusive campus.

The Community Service Center. The Community Service Center (CSC) is a clearinghouse for 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, caring for people with AIDS, and serving meals at local homeless shelters, to befriending senior citizens. The Community Service Center also sponsors speakers, special events, volunteer training sessions, and many other programs. In these ways, the CSC strives to raise awareness of contemporary social issues, support civic engagement, and strengthen partnerships between Duke University and Durham. Visit the center's web site at <http://csc.studentaffairs.duke.edu>.

International House. International House serves as the center of co-curricular programs for internationals and U.S. Americans interested in other cultures and peoples. As part of the Division of Student Affairs, the mission of International House is: (1) to assist internationals and their families with orientation and acclimation; (2) to enhance cross-cultural interaction through programming and community outreach, and (3) to provide advocacy and support for the Duke international community. In 2004-05, there were approximately 1,466 international students from 98 countries enrolled at Duke. Programs include an intensive orientation program at the beginning of the academic year; the International Friends Program which pairs internationals with local families to provide friendship and cross-cultural learning; Duke Language Partners which pairs internationals with U.S. Americans for weekly conversation and language exchange; Speakers' Panorama which arranges for internationals at Duke to present their countries to local organizations and schools; Friday Coffee Connection (held at noon in the basement of Duke Chapel) a time for people of all nations to come together for refreshments and conversation; Cross-Cultural Training for groups interested in developing awareness and skills needed to manage cultural diversity at both interpersonal and organizational levels; and the International Association, a student-run group which sponsors culture nights, trips, sports, teams, and an annual campus-wide International Festival. In addition to student services and programs, International House also assists arriving international faculty and other visiting scholars with acclimation services. Orientations and assistance for scholars is offered Monday-Friday at 1:30 p.m. For more information, contact Carlisle Harvard, Director, (919) 684-3585, Box 90417, Durham, NC 27708 or email: ihouse@duke.edu, or on the Web at <http://www.ihouse.studentaffairs.duke.edu>.

The Center for Lesbian, Gay, Bisexual, and Transgender Life. Located at 02 West Union Building. 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. 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 LGBT Life presents opportunities for people to challenge intolerance and to create a more hospitable campus climate.

The Mary Lou Williams Center for Black Culture. Established in 1983, the Mary Lou Williams Center for Black Culture is critically engaged with issues of race and social difference at the individual, interpersonal, institutional and structural levels. The Center is a meeting ground for African and African American student communities as well as a gathering place for all at Duke who are interested in increasing their awareness of Black people and Black Culture. African American presence in the Duke University undergraduate community began in 1963. Although it would not be established for two more decades, The Mary Lou Williams Center for Black Culture was born of that moment in history and bears

its markings. The Center is named in honor of Mary Lou Williams, the pianist and composer who taught at Duke University as an Artist-in-Residence from 1977 until her death in 1981.

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 Assault Support Services is also housed in the Women's Center. For more information call (919) 684-3897 or visit the Web site at: <http://wc.studentaffairs.duke.edu>.

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. Check GPSC's web site (<http://www.duke.edu/gpsc/>) for more information on activities as well as links to other graduate student groups.

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. Duke Campus Ministry 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. For more information on Duke Chapel and the variety of Religious Life opportunities on campus, please check: www.chapel.duke.edu, or call (919) 684-2909.

The Freeman Center for Jewish Life works to foster and enrich Jewish life through social, educational, religious, and cultural activities. Its building serves as a visible symbol of the varied and active Jewish life available at Duke University. Organizationally, it acts as the umbrella organization for all Jewish programming on campus. For more information, contact the Freeman Center for Jewish Life, Box 90936, Duke University, Durham, North Carolina, 27708; telephone (919) 684-6422; web site: <http://fcil.studentaffairs.duke.edu>.

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