

The Graduate School of Arts and Sciences

2015 - 2016



Bulletin of Wake Forest University

GRADUATE SCHOOL

2015/2016

Arts and Sciences
Biomedical Sciences

Wake Forest University is committed to administer all educational and employment activities without discrimination because of race, color, religion, national origin, age, sex, veteran status, handicapped status, disability, or genetic information as required by law. In addition, Wake Forest rejects hatred and bigotry in any form and adheres to the principle that no person affiliated with Wake forest should be judged or harassed on the basis of perceived or actual sexual orientation, gender identity, or gender expression.

In affirming its commitment to this principle, Wake Forest does not presume to control the policies of persons or entities not affiliated with Wake Forest, and does not extend benefits beyond those provided under other policies of Wake Forest.

The University has adopted a procedure for the purpose of resolving discrimination complaints. Inquires or concerns should be directed to 336.758.7258. Individuals with disabilities or special print-related needs may contact the Learning Assistance Center at 336.758.5929 or lacenter@wfu.edu for more information.



WAKE FOREST
UNIVERSITY

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Bowman Gray Campus

2015-2016 Academic Calendar

FALL SEMESTER 2014

August 5-7	Wednesday-Friday	Mandatory new student orientation/registration
August 10-21		Analytical Skills Course Starts (MCB 700)
August 18	Tuesday	Introduction to Neuroscience I Starts (NEUR 701)
August 25	Tuesday	Classes begin
September 7	Monday	Labor Day holiday
September 8	Tuesday	Last day to add courses
September 11	Friday	Deadline to file statement of intent to graduate December 30
September 29	Tuesday	Last day to drop courses
November 6	Friday	Deadline to submit thesis to graduate December 30
Nov. 9-Dec. 30		Registration for spring 2016
November 25-27	Wednesday-Friday	Thanksgiving holiday
December 4	Friday	Classes end
December 7-11	Monday-Friday	Examinations
December 11	Friday	Last day to defend to graduate December 30
December 16	Wednesday	Deadline to submit ETD & forms for December graduation
December 17	Thursday	Grades due
December 30	Wednesday	Graduation

SPRING SEMESTER 2016

January 12	Tuesday	Classes begin
January 18	Monday	Martin Luther King Jr. holiday
January 26	Tuesday	Last day to add courses
January 29	Friday	Deadline to file statement of intent to graduate May 16
February 16	Tuesday	Last day to drop courses
March 7-11	Monday-Friday	Spring break
March 25	Friday	Good Friday holiday
April 8	Friday	Deadline to submit final thesis to graduate May 16
April 11-May 6		Registration for summer session 2015
April 27	Wednesday	Classes end
April 29	Friday	Last day to defend to graduate May 16
May 2-6	Monday-Friday	Examinations
May 4	Wednesday	Deadline to submit ETD & forms for May graduation
May 11	Wednesday	Grades due
May 14	Saturday	Hooding and Awards Ceremony
May 16	Monday	Commencement

SUMMER SESSION 2016

May 11	Wednesday	Summer session begins
May 18	Wednesday	Last day to add/drop courses
May 27	Friday	Deadline to file statement of intent to graduate August 15
July 6-20		Registration for returning students for fall 2016
July 6	Wednesday	Last day to submit thesis to graduate August 15
July 26	Tuesday	Last day to defend to graduate August 15
July 29	Friday	Deadline to submit ETD & forms for August graduates
August 1	Monday	Summer session ends
August 8	Monday	Grades due for summer session
August 15	Monday	Graduation

Reynolda Campus

2015-2016 Academic Calendar

FALL SEMESTER 2015

August 25	Tuesday	Classes begin
September 8	Tuesday	Last day to add courses
September 11	Friday	Deadline to file statement of intent to graduate December 30
September 29	Tuesday	Last day to drop courses
October 16	Friday	Fall break
November 2-13	Monday-Friday	Proposed Registration for spring 2016
November 6	Friday	Deadline to submit thesis or dissertation to graduate December 30
Nov. 25-29	Wednesday-Sunday	Thanksgiving holiday
December 4	Friday	Classes end
December 7-12	Monday-Saturday	Examinations
December 11	Friday	Last day to defend to graduate December 30
December 16	Wednesday	Deadline to submit ETD & forms for December graduation
December 30	Wednesday	Graduation

SPRING SEMESTER 2016

January 12	Tuesday	Classes begin
January 18	Monday	Martin Luther King Jr. holiday
January 26	Tuesday	Last day to add courses
January 29	Friday	Deadline to file statement of intent to graduate May 16
February 16	Tuesday	Last day to drop courses
March 5-13	Saturday-2nd Sunday	Spring break
TBA		Registration for Summer 2016
March 25	Friday	Good Friday holiday
March 28-April 8	Monday-2nd Friday	Registration for Fall 2016
April 8	Friday	Deadline to submit thesis/dissertation to graduate May 16
April 27	Wednesday	Classes end
April 29	Friday	Last day to defend to graduate May 16
April 29-30	Friday-Saturday	Examinations
May 2-5	Monday-Thursday	Examinations
May 4	Wednesday	Deadline to submit ETD & forms for May graduation
May 14	Saturday	Hooding and Awards Ceremony
May 16	Monday	Commencement

SUMMER SESSION 2016

TBA		Summer Session I
TBA		Summer Session II
August 15	Monday	Graduation

Reynolda Campus

2015-2016 Academic Calendar for Online Programs

FALL SEMESTER 2015

August 1	Saturday	Tuition Due Date for Fall Terms
August 3-Aug. 23		Student Orientation Course for New Students
August 24	Monday	First Class Day
September 10	Thursday	Last day to drop without academic penalty (part-of-term1)
September 11	Friday	Last day for withdrawal with pro rata refund
September 29	Tuesday	Last day to drop without academic penalty
October 11	Sunday	Last Class Day (part-of-term1)
October 12	Monday	First Class Day (part-of-term 2)
October 28	Wednesday	Last day to drop without academic penalty
November 3	Monday	Last day for withdrawal with pro rata refund
November 25-29	Wednesday-Sunday	Thanksgiving Break
December 3-6	Friday-Monday	Residency I (Cohort 9), Residency II (Cohort 6)
December 6	Sunday	Last Class Day
December 16	Wednesday	Deadline to meet December 30 graduation requirements
December 30	Wednesday	Graduation

SPRING SEMESTER 2016

December 21-Jan. 10		Student Orientation Course for New Students
January 1	Friday	Tuition Due Date for Spring Terms
January 11	Monday	First Class Day (
January 27	Wednesday	Last day to drop without academic penalty (part-of-term 1)
January 29	Friday	Last day for withdrawal with pro rata refund
February 15	Monday	Last day to drop without academic penalty
February 28	Sunday	Last Class Day (part-of-term1)
February 29	Monday	First Class Day (part-of-term 2)
March 7-13	Monday-Sunday	Spring Break
March 16	Wednesday	Last day to drop without academic penalty
March 21	Monday	Last day for withdrawal with pro rata refund
March 25-27	Friday-Sunday	Good Friday Observed
April 24	Sunday	Last Class Day
May, TBA		Residency I (Cohort 10), Residency II (Cohort 7)
May 4	Wednesday	Deadline to meet May 16 graduation requirements
May 14	Saturday	Hooding and Awards Ceremony
May 16	Monday	Commencement

SUMMER SESSION 2016

TBA		Summer Session I
TBA		Summer Session II
August 15	Monday	Graduation

Programs of Study

The Graduate School conducts programs on the Bowman Gray campus (location of the Wake Forest School of Medicine) and the Reynolda campus (undergraduate college and associated graduate programs). On the Bowman Gray and affiliated campuses of the medical school, the Graduate School offers 8 PhD programs in biomedical sciences, and masters programs in biomedical engineering, biomedical science, comparative medicine, clinical and population translational sciences, and molecular medicine and translational science. The PhD programs in biology, chemistry, and physics, and masters-only programs

in twenty-two disciplines, ranging from bioethics, education, mathematics, religion and sustainability, are located on the Reynolda campus. The Graduate School also offers twelve joint degree programs in conjunction with the Wake Forest School of Medicine, Schools of Business, School of Divinity, and School of Law; as well as thirteen certificate programs.

Contact information on all programs and certificates of study may be found on our website at <http://graduate.wfu.edu>.

CERTIFICATES

Bioethics:
 • Bioethics
 • Biomedical Research Ethics
 • Clinical Bioethics
 Clinical & Population Translational Sciences
 Interpreting and Translation Studies:
 • Audiovisual Translation and Interpreting
 • Intercultural Services in Healthcare
 • Interpreting Studies
 • Teaching of Interpreting (Postgraduate)
 • Translation Studies
 Medieval and Early Modern Studies
 Structural and Computational Biophysics
 Sustainability

Liberal Studies (MA/MALS)
 Mathematics & Statistics (MA)
 Molecular Medicine & Translational Science (MS)
 Physics (MS)
 Psychology (MA)
 Religious Studies (MA)
 Sustainability (MA)

PHD PROGRAMS

Biology
 Biomedical Engineering
 Chemistry
 Integrative Physiology and Pharmacology
 Molecular and Cellular Biosciences:
(comprising the following programs)
 • Biochemistry & Molecular Biology
 • Cancer Biology
 • Microbiology & Immunology
 • Molecular Genetics & Genomics
 • Molecular Medicine & Translational Science
 Neuroscience
 Physics

MASTER PROGRAMS

Bioethics (MA)
 Biology (MS)
 Biomedical Engineering (MS)
 Biomedical Informatics (MS)
 Biomedical Science (MS)
 Chemistry (MS)
 Clinical & Population Translational Sciences (MS)
 Communication (MA)
 Comparative Medicine (MS)
 Computer Science (MS)
 Counseling (MA)
 Counseling (MA - *online*)
 Counseling - Human Services (MA - *online*)
 Documentary Film (MA/MFA)
 Education (MAEd)
 English (MA)
 Health and Exercise Science (MS)
 Health Disparities in Neuroscience (MS)
 Interpreting and Translation Studies (MA):
 • Interpreting and Translation Studies
 • Intercultural Services: Healthcare
 • Teaching of Interpreting

JOINT DEGREE PROGRAMS

BS/BA & MA (Bioethics)
 BA-BS/MS (Neuroscience Minors only)
 JD/MA (Bioethics)
 JD/MA (Religious Studies)
 MD/MA (Bioethics)
 MD/MS (CPTS)
 MD/PhD
 MDiv/MA (Bioethics)
 MDiv/MA (Counseling)
 MDiv/MAED (Education)
 MDiv/MA (Sustainability)
 MMS/PhD (PA & MMTS)
 PhD/MBA

The University

Wake Forest University is characterized by its devotion to liberal learning and professional preparation for men and women, its strong sense of community and fellowship, and its encouragement of free inquiry and expression.

Wake Forest Institute was founded in 1834 by the Baptist State Convention of North Carolina. The school opened its doors on February 3 with Samuel Wait as principal. Classes were first held in a farmhouse on the Calvin Jones plantation in Wake County, North Carolina, near which the village of Wake Forest later developed.

Rechartered in 1838 as Wake Forest College, Wake Forest is one of the oldest institutions of higher learning in the state. The School of Law was established in 1894, followed by a two-year medical school in 1902. Wake Forest was exclusively a college for men until World War II, when women were admitted for the first time.

In 1941 the medical school moved to Winston-Salem to become affiliated with North Carolina Baptist Hospital and was renamed the Bowman Gray School of Medicine. In 1946 the trustees of Wake Forest and the Baptist State Convention of North Carolina accepted a proposal by the Z. Smith Reynolds Foundation to relocate the College to Winston-Salem. The late Charles and Mary Reynolds Babcock donated much of the R.J. Reynolds family estate as the site for the campus and building funds were received from many sources. From 1952 to 1956, the first fourteen buildings were constructed in Georgian style on the new campus. The move to Winston-Salem took place in the summer of 1956; the original, or "old" campus, is now home to Southeastern Baptist Theological Seminary.

Following the move, Wake Forest grew considerably in enrollment, programs, and stature and became a University in 1967. The School of Business Administration, first established in 1948, was named the Charles H. Babcock School of Business Administration in 1969 and admitted its first graduate students in 1971. In 1972 the school enrolled only graduate students and the name was changed to the Charles H. Babcock Graduate School of Management; departments of business and accountancy and

economics were established in the College. In 1980 the Department of Business and Accountancy was reconstituted as the School of Business and Accountancy; the name was changed to the Wayne Calloway School of Business and Accountancy in 1995. On July 1, 2009, the Wayne Calloway School of Business and Accountancy and the Charles H. Babcock Graduate School of Management officially merged under the name Wake Forest University Schools of Business.

The Division of Graduate Studies, established in 1961, is now organized as the Graduate School and encompasses advanced work in the arts and sciences on both the Reynolda and Bowman Gray campuses. In 1997 the medical school was renamed the Wake Forest University School of Medicine; its campus is now known as the Bowman Gray Campus. The School of Divinity was established in 1999.

Wake Forest honors its Baptist heritage in word and deed. The University will fulfill the opportunities for service arising out of that heritage. Governance is by an independent Board of Trustees; there are advisory boards of visitors for the College and each professional school. A joint board of University trustees and trustees of the North Carolina Baptist Hospital is responsible for Wake Forest University Baptist Medical Center, which includes the hospital and the medical school.

The College, Schools of Business, School of Law, the Graduate School, and the School of Divinity are located on the Reynolda Campus in northwest Winston-Salem and the Morcroft Campus in Charlotte, NC. The Wake Forest School of Medicine is about four miles away, near the city's downtown. The University also offers instruction regularly at Casa Artom in Venice, at Worrell House in London, at Flow House in Vienna, and in other places around the world.

The College offers courses in more than

forty fields of study leading to the baccalaureate degree. The School of Divinity offers the master of divinity degree.

The Wake Forest Schools of Business offer a four-year bachelor of science degree, with majors in accountancy, business and enterprise management, finance, and mathematical business (offered jointly with the Department of Mathematics); and three graduate degree programs, master of science in accountancy (MSA), master of arts in management (MA), and master of business administration (MBA).

The School of Law offers the juris doctor and master of laws in American law degrees. The school also offers a joint JD/MBA degree with the Schools of Business.

The Wake Forest School of Medicine offers the doctor of medicine degree (MD) as well as the master of medical science (MMS) through the Physician Assistant Program, and the master of science (MS) in Nurse Anesthesia. The School of Medicine and the Schools of Business offer a joint MD/MBA program.

The Graduate School confers the master of arts, master of arts in education, master of arts in human services, master of arts in liberal studies, master of fine arts, and master of science degrees in the arts and sciences and biomedical science; and the doctor of philosophy degree. The Graduate School also offers an MD/MS, MD/PhD, MMS/PhD, as well as an MD/MA in bioethics jointly with the School of Medicine, and a PhD/MBA program jointly with the Schools of Business. In addition, the Graduate School offers an MDiv/MA in bioethics, counseling, or sustainability as well as a MDiv/MAED jointly with the School of Divinity; and a JD/MA in bioethics, religious studies or sustainability jointly with the School of Law. Certificates are offered in Bioethics, Clinical and Translational Science, Interpreting and Translation Studies, Medieval and Early Modern Studies, Science Management, Structural and Computational Biophysics, and Sustainability.

LIBRARIES

The libraries of Wake Forest University

support instruction and research at the undergraduate level and in the disciplines awarding graduate degrees. The libraries of the University hold membership in the American Library Association and in the Association of Southeastern Research Libraries. They rank among the top libraries in the Southeast in expenditures per student.

The Wake Forest University libraries include the Z. Smith Reynolds Library, which is located on the Reynolda Campus and supports the undergraduate College, the Wake Forest School of Business programs, the Graduate School of Arts and Sciences, and the School of Divinity. The Professional Center Library, housed in the Worrell Professional Center on the Reynolda Campus, serves the School of Law. The Coy C. Carpenter Library serves the Graduate School of Arts and Sciences and the Wake Forest School of Medicine and is located on the Bowman Gray Campus.

The three library collections total over 2 million volumes. Subscriptions to more than 50,000 periodicals and serials, largely of scholarly content, are maintained at the libraries. The Z. Smith Reynolds Library holds over 1.4 million volumes in the general collection, complemented by over 200 research databases, over 400,000 e-books, and nearly 25,000 media items. As a congressionally designated selective federal depository and depository of North Carolina government information, the ZSR Library holds nearly 100,000 government documents. The Professional Center Library holds nearly 180,000 volumes and the Coy C. Carpenter Library holds nearly 150,000 volumes. The three libraries share an online catalog, which also provides access to electronic resources, journals and databases, all accessible via the campus network and on the Internet. Through interlibrary loan service, students, faculty and staff may obtain materials from other libraries.

BOWMAN GRAY CAMPUS

The Coy C. Carpenter Library is the principal learning resource serving the academic needs of the faculty, staff, and student body of the Wake Forest University School of Medicine. The

Library contains extensive collections in all of the medical and surgical specialties and the basic sciences, as well as collections in nursing and allied health. Domestic and foreign periodicals, textbooks, audiovisuals, and computer software are included.

The Carpenter Library's website, www.wakehealth.edu/library, offers access to PubMed, UpToDate, Journal Citation Reports, Micro-medex, PsycINFO, and Web of Science, as well as over 70 other bibliographic and full text databases. Nearly 5,000 electronic journals and 200 textbooks are also available. Specific collections deal with the written and oral history of the medical school, the history of neurology, and the Suzanne Meads Art in Medicine Collection. The library produces the Faculty Publications Database which contains over 25,000 citations to WFUSM-authored journal articles, books, and book chapters.

The Library provides assistance to graduate students as they complete the Graduate School's requirement to archive an electronic full-text copy of their thesis or dissertation in Wake Forest University's institutional repository, WakeSpace at etd.wfu.edu.

Computer classroom facilities are available for individual and group instruction and online examinations. The Library offers instruction in individual databases (e.g. PubMed Medline), software (Microsoft Outlook, Word, Excel and PowerPoint), and on other research and publishing resources. Multimedia workstations in the Information Commons have flatbed scanners, Adobe Photoshop and Acrobat Professional, Microsoft Movie Maker, SAS and SPSS statistical software. The library has wireless access to the production network throughout the Library. The Library's Xerox room provides printing, copying, faxing and scanning to email in black and white and in color. The Library is open 100 hours a week, all year.

REYNOLDA CAMPUS

The Z. Smith Reynolds Library holds over 1.7 million volumes in the general collection, research collections in digital, print and microfilm formats, and nearly 12,000 DVDs. The Library

serves as a congressionally designated selective federal depository and depository of North Carolina government information. The Library provides comprehensive reference and research services including assistance with directed and independent research and online searching, discipline-related library instruction, general library orientation, and tours. Its many database subscriptions include the ability to set up journal alerts to help students stay up-to-date in their fields of interest. Reference tools are available in electronic and print formats. Special collections in the Z. Smith Reynolds Library include the Rare Books and Manuscripts Collection and the Ethel Taylor Crittenden Baptist Historical Collection. The Rare Books and Manuscripts Collection, greatly enhanced by the donation of rare and fine books of the late Charles H. Babcock, emphasizes American and British authors of the 19th and 20th centuries. Among the collections are works of Mark Twain, Gertrude Stein, William Butler Yeats, T.S. Eliot and the publications of the Hogarth Press. The extensive Anglo-Irish literature collection includes the Dolmen Press Archive. The archive of alumnus Harold Hayes, editor of *Esquire* magazine in the 1960s-70s, and the Maya Angelou works for theater, television and screen are maintained in the special collections. The Ethel Taylor Crittenden Baptist Historical Collection contains significant books, periodicals, manuscripts, and church records relating to North Carolina Baptists, as well as the personal papers of prominent ministers, educators, and government officials with ties to Wake Forest College/University. The Wake Forest College/University Archive is maintained in the library as well.

The libraries are equipped for wireless Internet access. Facilities in the Z. Smith Reynolds Library include "The Bridge," a collaborative service between Information Systems and the Library. Faculty, students and staff can bring their University issued laptops for repair. The space also offers a multimedia lab. The library has ten group study rooms that are equipped with SmartBoard technology. These rooms can be booked online at <http://zsr.wfu.edu/studyrooms>. In addition, 90 locking study carrels located

throughout the Reynolds stacks may be reserved by graduate students. On the fourth floor of the Reynolds wing, a 120 seat auditorium hosts lectures and DVD viewings and the adjacent Media Center contains a browsable collection of nearly 10,000 DVDs and equipment to view them individually or in groups.

The libraries are open continuously during the fall and spring semesters, 24 hours a day from 10 a.m., Sunday morning through Friday at 7 p.m. Saturday the library is open an additional 9 hours. There are two 24-hour study rooms located near the entrance to the library that may be accessed by keycard any-time, including when the library is closed. The Johnson Graduate Lounge is available for graduate students of the College of Arts and Sciences. Access is available to graduate students by placing the Deacon OneCard at the card reader at the left of the entrance door from the 24/7 Study Room or from the exterior west side building entrance. The study room on one side of the Z. Smith Reynolds Library houses a Starbucks.

For more information on the libraries visit:

Z. Smith Reynolds Library
<http://zsr.wfu.edu>

Professional Center Library
<http://pcl.wfu.edu>

Coy C. Carpenter Library
<http://www.wakehealth.edu/Library/>

INFORMATION TECHNOLOGY / ACADEMIC COMPUTING

BOWMAN GRAY CAMPUS

The Office of Academic Computing is dedicated to the development and support of technology innovations in graduate education. Its mission is to provide the infrastructure for faculty and students to effectively utilize technologies to augment the lifelong learning process. A key role of the department is to facilitate basic understanding with regard to the uses of technology, not only within education but also within the workplace.

The department has developed a ubiquitous

computing environment, focusing on technology standards in hardware, software, and networking. The main strategic initiative has been the development of a Web-based curriculum for the individual programs of the Graduate School. The Web-based curriculum provides an organization framework for the digitized lectures and course materials of each program, education-oriented Web sites, schedules, collaborative discussions, and links to specialty content application.

The Medical Center's Information Technology group provides contiguous technical support for faculty, staff and students 24 hours per day, each day of the year. Both hardware and software support are covered through various groups in this department. In addition to the technical support functions, the office also provides services to the faculty for the development of teaching applications and assistance with the digitization of curriculum content. Three software developers are employed for this specific purpose.

Wake Forest has a gigabit Ethernet connection to the Internet. Wake Forest is also a key member of Internet 2, which is focused on providing advanced network technologies, and the North Carolina Research and Education Network (NCREN), which provides statewide educational programs.

REYNOLDA CAMPUS

Information Systems supports the instruction, research, and administrative needs of the Reynolda Campus of Wake Forest University. The campus computer network offers high-speed wired and wireless connectivity from all campus buildings.

Prior to the beginning of classes, Wake Forest University provides new full-time graduate students with Wake Forest-owned laptops. This practice does not include the Documentary Film Program (DOC). Information Systems provides service and support for the ThinkPad and the standard software that Wake Forest licenses for use by students. Maintenance warranty against manufacturer's defects is provided for the notebook computers for a limited time. Students are responsible for the care of the computer and

will be subject to full replacement cost for loss or damage not covered by warranty.

These notebook computers contain a standard suite of powerful programs that allow students easy access to research and class materials and offer the ability to interact with faculty, staff, and other students through the campus network. Software programs include Microsoft Office, digital media tools, and e-mail and Internet applications like Mozilla. A large variety of instructional, classroom, and research resources are also available. These include online resources, databases, and electronic journals provided by the Z. Smith Reynolds Library. The Library's online resources can be accessed from all campus buildings via the campus network, or from anywhere via the internet.

Information Systems maintains an extensive array of online information systems that support University admissions, student registration, grade processing, payroll administration, accounting services, and many other administrative and academic applications. In addition, the Wake Forest Information Network (WIN) provides the University community with features like faculty, staff, and student directories; an alumni directory and career networking service; online class registration; electronic access to view payroll and tax information; and vehicle registration.

Students also have access to computing resources outside the University. The University is a member of the Inter-University Consortium for Political and Social Research (ICPSR), located at the University of Michigan. Membership in ICPSR provides faculty and students with access to a large library of data files, including public opinion surveys, cross-cultural data, financial data, and complete census data. The University is also a member of EDUCAUSE, a national consortium of colleges and universities concerned with computing issues.

The University has computing facilities that serve both academic and business needs. Wake Forest's network infrastructure includes a ten Gigabit per second Ethernet backbone, a mixture of 100 Megabit and 1 Gigabit per

second switched connectivity to the desktop, and pervasive wireless connectivity in all campus buildings. LINUX and Windows-based servers provide for business computing needs and services. A mix of LINUX systems and Windows-based systems provide for messaging, systems management, Internet, intranet, courseware, various research needs, and file and print services. A LINUX supercomputing cluster provides supercomputing services for math, computer science, physics, and other scientific research applications. These systems are available to students, faculty, and staff 24 hours a day through the Wake Forest University network or over the Internet. All connections are protected by VPN and firewalls.

Information Systems provides assistance online at <http://help.wfu.edu>, by telephone at xHELP (4357), and supports walk-in customers in The Bridge located on the main floor of the Z. Smith Reynolds Library. The Bridge provides assistance with information technology services including multimedia, filming, computer repair, and equipment loans and purchases. For more information about The Bridge visit <http://zsr.wfu.edu/services/technology/bridge>.

RECOGNITION AND ACCREDITATION

Wake Forest University is accredited by the Southern Association of Colleges and Schools Commission on Colleges to award baccalaureate, masters, and doctorate degrees. Contact the Commission on Colleges at 1866 Southern Lane, Decatur, Georgia, 30033-4097 or call 404-679-4500 for questions about the accreditation of Wake Forest University.

The Wake Forest School of Medicine is a member of the Association of American Medical Colleges and is fully accredited by the Liaison Committee on Medical Education, the joint accrediting body of the Association of American Medical Colleges and the American Medical Association. The Wake Forest University Physician Assistant Program is accredited by the Accreditation Review Commission on Education for the Physician Assistant Inc. (ARC-PA). For more information on the accreditation status of

the program, visit the ARC-PA website (www.arc-pa.org/Acc_Programs/acc_programs.html) or the medical school website (www.wfubmc.edu/Academic-Programs/Physician-Assistant-Program/Accreditation.htm). The School of Law is a member of the Association of American Law Schools, the American Bar Association, and is listed as an approved school by the Council of the Section of Legal Education and Admissions to the Bar of the American Bar Association and by the Board of Law Examiners and the Council of the North Carolina State Bar. Wake Forest University Schools of Business are accredited by the Association to Advance Collegiate Schools of Business. The program in counseling leading to the master of arts in education degree is accredited by the Council for the Accreditation of Counseling and Related Educational Programs. The Divinity School is accredited by the Association of Theological Schools in the United States and Canada (ATS).

Wake Forest University is a member of many of the major institutional organizations and associations at the national, regional, and statewide levels, including the following: The American Council on Education, the Association of American Colleges, the National Association of Independent Colleges and Universities, the Council of Graduate Schools in the United States, the Commission on Colleges of the Southern Association of Colleges and Schools, Oak Ridge Associated Universities, Southern Universities Conference, the North Carolina Conference of Graduate Schools, the North Carolina Association of Colleges and Universities, the North Carolina Department of Public Instruction, and the North Carolina Independent Colleges and Universities. In addition, many offices of the University are members of associations which focus on particular aspects of university administration.

OAK RIDGE ASSOCIATED UNIVERSITIES

Since 1993, students and faculty of Wake Forest University have benefited from its membership in Oak Ridge Associated Universities (ORAU). ORAU is a consortium of ninety-eight

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 country; to keep its members informed about opportunities for fellowship, scholarship, and research appointments; and to organize research alliances among its members.

Through the Oak Ridge Institute for Science and Education (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 under-represented 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 at www.orau.gov/orise/educ.htm, or by calling the contact 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 Scholars 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 Monnie E. Champion, ORAU corporate secretary, at 865.576.3306; or visit the ORAU at www.orau.org.

The Graduate School

In accord with the prevailing custom among American colleges during the antebellum period, Wake Forest granted honorary master's degrees to selected alumni.

By 1862, when the College closed temporarily because of the Civil War, twenty-nine such degrees had been awarded. The first announcement of a program of study leading to an earned graduate degree at Wake Forest was made in 1866. Between 1871, when the first degrees earned under the plan were awarded to John Bruce Brewer (grandson of Samuel Wait) and Franklin Hobgood, and 1951, 383 master of arts and master of science degrees were granted. In 1949 the School of Arts and Sciences discontinued admitting applicants for the master of arts degree because the rapid increase in the size of the undergraduate student body following World War II had overloaded the faculty. The School of Medicine did not interrupt its graduate program. The first master of science degree conferred by the school after it moved to Winston-Salem was awarded in 1943, and the degree was offered regularly thereafter by the departments of anatomy, biochemistry, microbiology, pharmacology, and physiology.

During the fifteen years the College and the School of Medicine were located in different towns, the study of graduate education continued on both campuses. The self-study report adopted by the faculty of the School of Arts and Sciences immediately prior to its move to Winston-Salem recommended that graduate study leading to the master's degree be resumed as soon as practicable. In 1958 the administration of the School of Medicine, in view of an increasing demand for graduate instruction in basic medical and clinical sciences, appointed a Committee on Graduate Studies for the purpose of reorganizing the graduate program.

As a result of these two parallel studies and in recognition of the need for an institution-wide approach to graduate education, the trustees, on January 13, 1961, established the Division of Graduate Studies and authorized it to grant the master of arts degree in the School of Arts and Sciences and the master of science and doctor of

philosophy degrees in the School of Medicine. The first PhD degree was awarded in 1964. In 1967 the master of arts in education degree was added to the graduate program in arts and sciences. A program, leading to the master of arts in liberal studies, was begun in the summer of 1987. The first PhD program on the Reynolda campus was begun in 1970.

STATEMENT OF PURPOSE OF THE UNIVERSITY

Following is the official statement of the purposes and objectives of the University:

Wake Forest is a University dedicated to the pursuit of excellence in the liberal arts and in graduate and professional education. Its distinctiveness in its pursuit of its mission derives from its private, coeducational, and residential character; its size and location; and its Baptist affiliation. Each of these factors constitutes a significant aspect of the unique character of the institution.

The University is comprised of Wake Forest College, the Graduate School, the School of Law, the Wake Forest University School of Medicine, the School of Divinity and the Schools of Business. It seeks to honor the ideals of liberal learning, which entail commitment to transmission of cultural heritages; teaching the modes of learning in the basic disciplines of human knowledge; developing the critical appreciation of moral, aesthetic, and religious values; advancing the frontiers of knowledge through in-depth study and research; and applying and using knowledge in the service of humanity.

Wake Forest has been dedicated to the liberal arts for over a century and a half; this means education in the fundamental fields of human knowledge and achievement, as distinguished from education that is technical or narrowly vocational. It seeks to encourage habits of mind that ask "why," that evaluate evidence, that are

open to new ideas, that attempt to understand and appreciate the perspectives of others, that accept complexity and grapple with it, that admit error, and that pursue truth. Wake Forest College has by far the largest student body in the University, and its function is central to the University's larger life. The College and the Graduate School are most singularly focused on learning for its own sake; they, therefore, serve as exemplars of specific academic values in the life of the University.

Beginning as early as 1894, Wake Forest accepted an obligation to provide professional training in a number of fields as a complement to its primary mission of liberal arts education. This responsibility is fulfilled in the conviction that the humane values embodied in the liberal arts are also centrally relevant to the professions. Professional education at Wake Forest is characterized by a commitment to ethical and other professional ideals that transcend technical skills. Like the Graduate School, the professional schools are dedicated to the advancement of learning in their fields. In addition, they are specifically committed to the application of knowledge to solving concrete problems of human beings. They are strengthened by values and goals which they share with the College and Graduate School, and the professional schools enhance the work of these schools and the University as a whole by serving as models of service to humanity.

Wake Forest was founded by private initiative, and ultimate decision-making authority lies in a privately appointed Board of Trustees rather than in a public body. Funded to a large extent from private sources of support, Wake Forest is determined to chart its own course in the pursuit of its goals. As a coeducational institution it seeks to "educate together" persons of both sexes and from a wide range of backgrounds—racial, ethnic, religious, geographical, socioeconomic, and cultural. Its residential features are conducive to learning and to the pursuit of a wide range of co-curricular activities. It has made a conscious choice to remain small in overall size; it takes pride in being able to function as a community rather than a conglomerate. Its location in the

Piedmont area of North Carolina engenders an ethos that is distinctively Southern, and more specifically North Carolinian. As it seeks to broaden further its constituency and to receive national recognition, it is also finding ways to maintain the ethos associated with its regional roots.

Wake Forest is proud of its Baptist and Christian heritage. For more than a century and a half, it has provided the University an indispensable basis for its mission and purpose, enabling Wake Forest to educate thousands of ministers and lay people for enlightened leadership in their churches and communities. Far from being exclusive and parochial, this religious tradition gives the University roots that ensure its lasting identity and branches that provide a supportive environment for a wide variety of faiths. The Baptist insistence on both the separation of church and state and local autonomy has helped to protect the University from interference and domination by outside interests, whether these be commercial, governmental, or ecclesiastical. The Baptist emphasis upon revealed truth enables a strong religious critique of human reason, even as the claims of revelation are put under the scrutiny of reason. The character of intellectual life at Wake Forest encourages open and frank dialogue and provides assurance that the University will be ecumenical and not provincial in scope, and that it must encompass perspectives other than the Christian. Wake Forest thus seeks to maintain and invigorate what is noblest in its religious heritage.

MISSION OF THE GRADUATE SCHOOL

The mission of the WFU Graduate School of Arts and Sciences is to train and mentor future leaders in research, teaching and innovation for serving humanity. This embodies the Graduate School's vital role as an engine of discovery that fuels the nation's scholarly and creative enterprise. The Graduate School contributes to the academic reputation of the university by educating the next generation of teachers and scholars and by providing mentors and role models for

educating undergraduates. A strong graduate program also helps support faculty research and is critical for faculty recruitment and retention.

We seek to instill in our students a sense of professionalism, which includes the ethical behavior inherent in their professional role, as well as respect for their colleagues, their field, and for society as a whole. We want our students to be critical, independent thinkers and good citizens. They should be motivated to apply their scholastic efforts to enlighten and improve the wellbeing of society. Thus the Graduate School is a key link for collaboration between departments and schools and for achieving WFU's goal of becoming a collegiate university and major academic medical center.

Our values are steadfast and consist of critical thinking, service, diversity, discovery, mentoring, and ethics. These are integral to all our activities in the classroom, the laboratory or other research environments, the broader communities of which we are a part.

Our vision is for the Graduate School to be a diverse community of excellence. We achieve our vision and fulfill our mission through strategic activities that build pillars of excellence in:

- Student experience, to create an optimized learning and mentoring experience that prepares students to lead in any career path.
- Research, to provide high-quality research partnerships for promoting innovation, discovery and creation of value to the community.
- Faculty and staff support, to enable seamless, effective, aligned services for maximizing time and resources for instruction and research.
- Internal and external communication that celebrates the prominence and value of the Graduate School and the University.

ADMINISTRATION

The Graduate School is administered by two deans (one on each campus), and a Graduate Council composed of ex-officio administrative officials, twelve faculty members elected by the Graduate School faculty, and two graduate students elected by the Graduate Student Association. Six of the twelve are members of the College of Arts and Sciences (Reynolda campus) and six are members of the Wake Forest School of Medicine faculty (Bowman Gray campus).

Procedures

All students are responsible for familiarizing themselves with the portions of this bulletin that pertain to their course of study. Statements concerning courses and expenses are not to be regarded as irrevocable contracts between the student and the institution. The university reserves the right to change the schedule of classes and the cost of instruction at any time within the student's term of residence.

HOW TO APPLY

Information on the application process, as well as a link to the online application may be found on the Graduate School's website at <http://graduate.wfu.edu/admissions>.

FINANCIAL ASSISTANCE

REYNOLDA CAMPUS

On the Reynolda campus, full-tuition scholarships, partial-tuition scholarships, fellowships, graduate assistantships, teaching assistantships, and research assistantships are available to qualified students. Assistantships and fellowships include tuition scholarships as part of the grant. An assistantship includes tuition scholarship plus compensation for services rendered. Assistants work from 12 to 15 hours per week and carry a normal course load.

Acceptance of a teaching assistantship, or research assistantship carries with it the obligation to perform duties assigned by the student's department. Unsatisfactory performance or failure to complete these assigned duties will result in the withdrawal of all financial aid. In this case, students may be allowed to continue in the program by paying the remainder of their own tuition on a pro rata basis, provided they are in good academic standing, or they may be dropped from the program. Exceptions to this regulation may be made on an individual basis involving extraordinary circumstances and with the recommendation of the student's department.

Assistantships and fellowships are potentially renewable, but the total number of years a student working toward the master's degree may receive support may not exceed two. Information on financial aid awards will be included in the offer of admissions letter.

Some students who receive graduate

assistantships may be assigned duties outside the department of study.

The residence life and housing office on the Reynolda Campus has a limited number of hall director and compliance advisor positions available to qualified graduate students. Interested students are urged to contact the Office of Residence Life and Housing for more information by calling 336.758.5185; e-mailing housing@wfu.edu; or visiting the employment section of www.wfu.edu/housing.

The Barn, a venue for student gatherings of a social nature, has a small number of positions available for graduate students to assist with event and program management. Interested students are encouraged to contact campus life at 336.758.4070 or campuslife@wfu.edu.

The Graduate School may award educators teaching full-time in public schools or state-approved, non-public schools a one-half scholarship of the cost of part-time tuition. This policy covers only educators who have a current contract and teach either in grades kindergarten through 12th or in community college institutions.

BOWMAN GRAY CAMPUS

Financial support for students on the Bowman Gray campus is provided from various sources, including dean's fellowships, graduate fellowships, and tuition scholarships. In addition, many students are supported as research assistants from externally funded sources. Fellowships include tuition scholarships.

The Louis Argenta Physician-Scientists Scholar Award Scholarship seeks to develop leaders in translational science by providing funds to support MD/PhD students during their research years. The new calling for the physician-scientist is to lead these diverse teams. This scholarship will be awarded to incoming students that have

outstanding interpersonal skills, superior communication, and the potential to develop into a leader in translational science.

The Norman M. Sulkin Scholarship Fund provides scholarship assistance to students in the neurobiology and anatomy PhD program.

The Camillo Artom Scholarship provides annual scholarship grants to one or more students enrolled in programs leading to the MD or PhD degrees with special preference given to students seeking a degree in biochemistry and molecular biology.

Herbert C. Cheung PhD Award provides a cash award to recognize an outstanding graduate student in the Department of Biochemistry and to promote excellence in research in the broad field of biochemistry.

The Sandy Lee Cowgill Memorial Scholarship Fund provides scholarships to at least two students, the first of whom shall be enrolled in the MD program and the second of whom may be enrolled in the MD or PhD program, with preference given to a student in biochemistry and molecular biology.

The Mike and Lucy Robbins Fellowship Fund provides a stipend for a current graduate student conducting cancer-related research.

STUDENT LOANS

Reynolda graduate students who are interested in the Guaranteed/Insured Student Loan Program should request information from their state agency or the student financial aid office. **Bowman Gray campus students** may contact the financial aid office for information on federal student loans. North Carolinians may receive applications from College Foundation Inc., P.O. Box 12100, Raleigh, NC 27605-2100.

A student must be in good academic standing and must be making satisfactory progress toward the degree to be eligible for a student loan. Unclassified (non-degree seeking) and provisionally accepted students are not eligible for financial aid.

SATISFACTORY ACADEMIC PROGRESS

To determine continuing financial aid eligibility, the financial aid committee evaluates students' satisfactory academic progress at the end of each semester. The receipt of federally-controlled aid requires half-time enrollment (4.5 or more hours on the Reynolda Campus and 4.0 or more hours on the Bowman Gray Campus) in a degree seeking program during the fall and

spring semesters and a minimum cumulative grade point average of 2.5 on work attempted in the Wake Forest University Graduate School of Arts and Sciences. Certain programs have higher academic requirements, which are communicated directly to the students by the departments. The Dean may revoke institutionally-controlled financial aid for violation of University regulations, including its honor code, or for violation of federal, state, or local laws. The full policy may be found on the Graduate School's website (<http://graduate.wfu.edu/students/>).

ADMISSION

Eligibility. Undergraduate seniors and graduates of accredited U.S. colleges and universities or recognized foreign institutions may apply for admission to the Graduate School for study on the Reynolda campus or the Bowman Gray campus. Undergraduates must complete their degree requirements prior to entering the Graduate School. The Graduate School also accepts applications from holders of the MD, DDS, or DVM degrees, or from candidates for these degrees who will have satisfactorily completed the prescribed medical curriculum prior to matriculation in the Graduate School.

Whatever their previous academic training may have been, all applicants should have superior records. This requirement is usually interpreted as at least a B average or standing in the upper quarter of the class or both.

Transfer Students.

Transfer of graduate credits earned at other universities. A course that was completed at another college or university may be considered for transfer to a master's program provided that the course is classified as a graduate course; it was not taken as part of a previous master's degree program at another institution; the grade in the course is B or better (courses with grades of B- or lower will not be allowed to transfer). The maximum number of hours that may be transferred toward a master's degree is six. This limitation does not apply to applicants for the PhD degree. An official release letter is required from the applicant's current institution.

Transfer of graduate credits earned while enrolled in a previous graduate degree program at Wake Forest

University. A graduate course that was completed while the student was enrolled in a previous graduate program at Wake Forest University may be considered for transfer to a second program provided that the course was not counted toward the first degree and a grade is B or better was earned (courses with grades of B- or lower will not be allowed to transfer). The maximum number of hours that may be transferred toward a master's degree is six.

ADMISSION OF STUDENTS WITH DISABILITIES

Wake Forest University will consider the application of any qualified student, regardless of disability, on the basis of the selection criteria established by the University which includes personal and academic merit. Upon matriculation, all students will be required to meet the same standards for graduation.

The University endeavors to provide facilities which are in compliance with all laws and regulations regarding access for individuals with disabilities. Additionally, special services are available to reasonably accommodate students with disabilities. For more information on assistance for graduate students, please contact Van D. Westervelt, director of the Learning Assistance Center at 336.758.5929 or refer to Disability Services under Campus Life at the Wake Forest website.

ADMISSION CATEGORIES

Regular Status in a Degree Program. A person with a superior undergraduate record (at least a B average or upper quarter of the class and with the appropriate courses), satisfactory GRE scores, TOEFL or IELTS scores (for international students), and good recommendations may apply for regular admission.

Provisional Status in a Degree Program. Provisional admission may be granted in certain circumstances and is limited to not more than 1 semester of full time study or its equivalent in part-time study.

Unclassified Non-Degree Graduate Status. Applicants seeking courses for graduate credit but not wishing to work for a graduate degree may apply for admission as unclassified or

non-degree status. Applicants are required to complete an application, submit a \$75 application fee, meet the immunization requirements, and submit an official transcript showing a baccalaureate degree at least one month prior to matriculation. Instructor approval is required for each course prior to enrollment.

CLASSIFICATION OF STUDENTS

Full-Time Status. A student who devotes full-time to a graduate program as outlined by his or her faculty committee and is in full-time geographic residence with a minimum of nine semester hours of coursework, including thesis research, is considered a full-time student. Students registered as "thesis only" or "graduate fee only" may be considered full-time.

Part-Time Status. A student registered for less than the above amount of coursework is considered a part-time student. Each department will determine whether it is possible to pursue a degree on a part-time basis.

TUITION AND FEE SCHEDULE

Full-time Tuition	\$36,420
Fall 2015 and Spring 2016 (minimum 9 hours)	
Part-time Tuition (per hour)	1,300
On-line Campus (per hour)	1,300
Audit Fee per hour (part-time students)	110
Summer Session 2015	
Reynolda Campus (per hour)	1,000
On-line Campus (per hour)	1,300
Audit Fee per hour (part-time students)	110
Bowman Gray Campus (semester)	300
Thesis only (per semester)	\$40
Graduation Fee	\$55
RC Student Activity Fee (per semester, excludes On-line programs)	\$50
Application Fee	\$75

Cost of Attendance (Reynolda Campus) can be found at <http://grad.financialaid.wfu.edu/cost-of-attendance/>.

The statements concerning expenses are given as information to prospective students. They should not be regarded as forming a contract between the student and the University.

The costs of instruction and other services outlined here are those in effect on the date this material was printed. Wake Forest University may change the cost of instruction and other services at any time.

Students on either campus not enrolled in classes but using University facilities or faculty time for such projects as the completion of a thesis are required to register and pay a graduate student fee of \$40 per semester or \$20 for each term of the summer session. Students must be enrolled for the semester in which they graduate.

During both the academic year and the summer session, full-time graduate students on either campus may take graduate courses on the other campus without additional tuition.

Student Graduation Fees. All students on either campus pay a fee of \$55 at the time of graduation.

University Fees. A student health fee of \$376 is charged for all full-time Reynolda campus students. A student activity fee of \$100 is charged to all students, excluding on-line programs, on the Reynolda campus.

Past Due Balances. A student with past-due balances cannot:

- Register for future semesters
- Receive an official transcript of academic record
- Have academic credits certified
- Receive a diploma at graduation

In addition, a student with a past-due balance may be subject to cancellation from classes.

Tuition Concession. There is a tuition concession plan for faculty and staff of the University and for the spouses of faculty and eligible staff members. For further information, contact the appropriate human resources office.

Graduate students enrolled for full-time and part-time status are entitled to full privileges regarding libraries, laboratories, athletic contests, student publications, the Student Union, the University Theatre, the Secret Artists Series of

Wake Forest University, and the Student Health Service.

During the academic year, all students, full- and part-time, receive tuition refunds according to the following schedule. This policy applies to students dropping courses as well as to those withdrawing. Withdrawals must be official and students must turn in their identification cards and laptop computer before claiming refunds.

Graduate students who are recipients of Title 4 federal financial aid (Pell Grants, SEOG, FWS, Perkins Loans, Stafford Loans and PLUS Loans) should refer to the 2014-15 Wake Forest Undergraduate Bulletin for the Return of Program Funds policy.

Withdrawal/Course Drop (for on campus students). A student who withdraws from the University during a term or who drops a course before completing it may be entitled to a refund as follows:

Schedule of Adjustments for Withdrawal or Continuous Enrollment Start Date

FALL & SPRING SEMESTERS

Official Date	Tuition Refunded
Before classes begin	100% <i>less deposit</i>
First week of classes	90%
Second week of classes	75%
Third week of classes	50%
Fourth week of classes	30%
Fifth week of classes	20%
After fifth week of classes	0%

SUMMER SESSIONS

Class Days	Tuition Refunded
Days 1-3	100% <i>less deposit</i>
Days 4	75%
Days 5	50%
Days 6	25%
After Days 6	0%

Students are responsible for officially dropping courses to be eligible for a refund. Nonpayment for classes for which you are registered or non-attendance in a registered class does not release you from financial obligation and will not drop you from the class.

For more information, refer to the Refund

of Charges and Return of Financial Aid Funds Policy.

IMPORTANT: A withdrawal/course drop may affect financial aid eligibility.

A student using scholarships, grants, or loans to help pay educational expenses, whose account was paid-in-full prior to withdrawal, is likely to owe the University after withdrawal. Return of Title IV funds are handled in accordance with federal law. Please refer to Wake Forest's official Refund of Charges and Return of Financial Aid Funds Policy. Students should consult the Office of Student Financial Aid for more information.

Online Counseling and Human Services Programs are refunded according to the Refund Policy for Online Counseling & Human Services Programs. For more information please go to <http://finance.wfu.edu/sfs/student-refund-page>.

If the University deems it necessary to engage the services of a collection agency or attorney to collect or to settle any dispute in connection with an unpaid balance on a student account, the student will be liable for all collection agency and/or attorney's fees, reasonable expenses, and costs incurred.

STUDENT HEALTH SERVICE

BOWMAN GRAY CAMPUS

Students may be seen in the Department of Family and Community Medicine for provision of primary care services. Spouses and dependent children may request the services of the assigned physician.

Members of the medical faculty serve as student's physicians. Clinics are held Monday through Friday, by appointment, for preventive and therapeutic services. Physicians are available for emergencies twenty-four hours a day, seven days a week, through an answering service. The student's medical insurance company will be billed for *all* visits. A co-pay must be submitted at the time of service.

Students are *required* to have adequate health insurance. Any charges generated that are not covered by the student's insurance policy will be the personal responsibility of the student.

Students may enroll in the student injury and sickness insurance plan. Information on this plan will be provided by the Graduate School office.

Prior to matriculation, each student is *required* to complete a health assessment questionnaire, have a complete physical exam, and have updated immunizations at his/her expense.

The Medical Center Employee Health Services will have the responsibility for monitoring compliance with the below mentioned immunization requirements as well as being responsible for ongoing tuberculosis screening done on a yearly basis. Employee Health Services also will manage any blood and body fluid exposures, as well as provide acute care clinics at no charge.

Immunization Policy

Wake Forest University and North Carolina State law require that all new, transfer, readmit, unclassified, or visiting students, except those with a valid exemption, submit certification of certain immunizations PRIOR TO REGISTRATION. Documentation should be on or attached to the completed immunization form provided by the Medical Center Employee Health Services. Acceptable documentation is (1) the signature of the appropriate official(s) having custody of the immunization records, such as a physician or county health department official, or (2) a certificate from the student's former school containing the approved dates of immunizations, or (3) photocopies of the original records.

Diphtheria/Pertussis/Tetanus - Tdap is now preferred

- Tetanus/Diphtheria (TD or Td or Tdap) within past 10 years

Rubeola (Measles)

- Two doses live attenuated vaccine or two MMRs given after 12 months of age and at least one month apart, or
- Laboratory evidence of immunity (rubeola titer)

Mumps

- Two doses live attenuated mumps vaccine or two MMRs after 12 months of age, or
- Laboratory evidence of immunity (mumps titer)

Rubella (German Measles)

- One dose live attenuated rubella vaccine or one MMR after 12 months of age, or

- Laboratory evidence of immunity (rubella titer)
- Chickenpox (Varicella zoster) titer**
- Laboratory evidence of immunity to Varicella.
 - History of disease will not be accepted.
 - Varicella vaccines will be required for negative titer results as per recommendations (currently two doses).

RECOMMENDED IMMUNIZATIONS

Hepatitis B

- The series of three shots is highly recommended for medical and PA students. This is the only immunization not required before matriculation. Students who decline must sign a document of declination. All or part of the series may be received outside of Wake Forest School of Medicine, but documentation must be given to Employee Health. A blood titer determining immunity is recommended after the series is finished. Students will be billed for the vaccine and post-vaccine titer through the cashier's office.

Influenza

- Students should consider receiving the influenza vaccine annually.

MANDATORY SCREENING

Tuberculosis

- A TST is required within the 12 months prior to the matriculation date. Tine tests are NOT acceptable.
- A TST is not required if documentation of a positive TST is provided and includes millimeter measurement (m). When a prior TB test has been positive, you must provide a copy of your chest x-ray report made within the 12 months prior to the matriculation date and documentation of any treatment received.

The North Carolina requirements must be documented within thirty days following enrollment. After that time, unimmunized students cannot attend classes until their immunizations are documented. Please note that the Hepatitis B series requires several months for completion.

Questions regarding these requirements should be directed to Employee Health Services at 336.716.4801.

REYNOLDA CAMPUS

The Student Health Service promotes a healthy lifestyle through health education and health maintenance. A physician-directed medical staff offers urgent care, illness care, physical examinations, counseling, limited psychiatric

care, allergy injections, immunizations, gynecological services, pharmacy, laboratory, sports medicine clinic, referral to specialists, and medical information and vaccinations related to travel to international destinations. For more information go to www.wfu.edu/shs.

A full staff is available by appointment during clinic hours (fall and spring semesters): 8:30 a.m. to noon; 1:30 to 4 p.m., Monday–Friday and Monday–Thursday during the summer. A limited staff is available for urgent care and observation twenty-four hours a day, 7 days a week, when school is in session during the academic year. The services of the staff are covered by the student health fee. In addition, there are discounted “fee-for-service” charges for medications, laboratory tests, observation care, and some supplies and services (such as minor surgery). Payment can be made using cash, check, or Deacon Dollars. The charge can also be placed on the student's account in Financial and Accounting Services. A copy of the statement is given to the student to file with their insurance company.

Health Information Summary (on campus students). All new, transfer and readmit students are required to have on file in the Student Health Service the WFU Student Health Service Health Information Summary Form. It must be received by the Student Health Service before May 1 for summer session, June 30 for new students entering fall semester or before January 1 for new students entering spring semester. The form is available for download at <http://wfuf.edu/shs>. This form includes documentation of immunizations required by the University and the State of North Carolina.

Confidentiality. Student medical records are confidential. Medical records and information contained in the records may be shared with therapists and physicians who are involved in the student's care, and otherwise will not be released without the student's permission except as allowed by law. Students who wish to have their medical records or information released to other parties should complete a release of information form at the time of each office visit or service.

Class Excuses. The responsibility of excusing students from class rests with the faculty. Consequently the Student Health Service does not issue “excuses” for students. Students who are evaluated at the Student Health Service are encouraged to discuss their medical situations with their professors. A receipt documenting visits is available to students at checkout. Information concerning hospitalization and prolonged illnesses is sent, with the student's permission, to the appropriate dean.

Student Insurance Program Information.

Beginning in the fall of 2010, health insurance will be required as a condition of enrollment for full-time students. Students who demonstrate comparable coverage may waive the coverage provided by Wake Forest University. Information about the policy plan and process instructions can be found at <http://www.wfu.edu/sip>.

Inclement Weather. When the University is closed due to inclement weather, the Student Health Service will have limited staff and will be able to provide care only for injuries and urgent illnesses. Appointments will be rescheduled.

Retention of Medical Records. Student medical records are retained for ten years after the last treatment, after which time they are destroyed. Immunization records are kept longer.

Immunization Policy. Wake Forest University and North Carolina State law (G.S. 130A-152) requires documentation of certain immunizations for students attending a North Carolina college or university. Students must submit certification of these immunizations PRIOR TO REGISTRATION. Documentation should be on or attached to the completed WFU Student Health Service Information Summary Form in order to assure correct identification of the student. This form can be downloaded from the Wake Forest University Student Health Service website (www.wfu.edu/shs/docs/HIS.pdf). Acceptable documentation is a statement signed by the appropriate official(s) having custody of the records of immunization, such as a physician, county health department director or a

certificate from a student's high school containing the approved dates of immunizations. The State statute applies to all students except those registered in off-campus courses only, attending night or weekend classes only, or taking a course load of four credit hours or less.

The American College Health Association recommendations and North Carolina State law require certification in accordance with the following:

Required and Recommended Immunizations

A list of all REQUIRED and recommended immunizations can be found at <http://shs.wfu.edu/services/vaccines/>.

Immunizations required under North Carolina law must be documented within thirty days following registration. After that time, students with incomplete documentation of immunizations will not be permitted to attend classes. Please note that some series require several months for completion.

COUNSELING CENTERS

BOWMAN GRAY CAMPUS

The Student Wellness Center (SWC) is located on the 5th floor of the Gray Building, Room 5084 (same building as Carpenter Library). Paige Greason, Ph.D., MA.Ed., LPC-S RYT is the Director of Student Wellness and Marcia McCall, MBA, CMPE, RYT is a Counseling Intern. Both Dr. Greason and Ms. McCall provide counseling and consultation, as well as, oversee wellness activities to currently enrolled students on the health center campus. All counseling and consultation services are confidential, and no fees are charged to students.

The Center offers counseling for a variety of concerns including depression, anxiety, personal adjustment, disordered eating, managing stress, school/life balance, sexuality, and relationship issues.

Wellness activities include activities such as yoga, mindfulness meditation, fitness, dancing and facilitated discussions related to helping students manage the demands of graduate school.

Appointments are available to students from 9 am - 6 pm, Monday-Thursday and from 9 am - 5 pm on Friday. Wellness activities will be posted on the Student Wellness Center Website Calendar. There are presently no emergency, weekend, or after hours counseling services available to students. To make an appointment for counseling, please email studentwellness@wakehealth.edu. If you do not hear back from one of the counselors within two days of requesting an appointment, please contact Dr. Greason, directly at pgreason@wakehealth.edu.

REYNOLDA CAMPUS

The University Counseling Center, located in 118 Reynolda Hall (Reynolda Campus), provides short-term, time limited counseling and consultation to currently enrolled Reynolda Campus students. All services are confidential, and no fees are charged to students.

The Center offers counseling for a variety of concerns including depression, anxiety, personal adjustment, disordered eating, managing stress, sexuality, and relationship issues.

The Center is open Monday-Friday from 8:30 a.m. to 5 p.m. During the academic year when the undergraduate school is in session (excluding summer), and Student Health Service is open, after-hours psychological crises are handled by calling Student Health Service to reach the on-call counselor.

GRADING

Records of progress are kept by the institution on all students enrolled. Grade reports are furnished to students at the end of each semester or summer term.

Grade of I. The grade of I (Incomplete) may be assigned only when a student fails to complete the work of a course because of illness or some other emergency. If the work recorded as I is not completed within thirty days after the student enters for his or her next semester, not counting the summer session, the grade automatically becomes F. The instructor must report the final grade to the registrar within forty-five days after the beginning of that semester. In no case is a

graduate degree awarded to a student who has an I or NR on record. Incomplete grade forms are available on the Graduate School website.

Grade of NR. The grade of NR (Not Reported) must be resolved within forty-five days after the beginning of the next semester or the grade automatically becomes F or Unsatisfactory. In no case is a graduate degree awarded to a student who has an NR on record.

Grade of U (Unsatisfactory) in Thesis/Dissertation Research. A student who receives a U in research may be placed on academic probation even if the student's cumulative GPA is above 2.5.

A student who receives a grade of U in research in two semesters may be dismissed from the Graduate School by the dean upon recommendation of his or her department or program.

Minimum Grade Requirements. A student whose cumulative grade point average (GPA) falls below 2.5 (or below a program/department GPA standard) may be placed on academic probation. The student will have one semester to bring his/her GPA to 2.5 or greater; otherwise, the student may be dismissed from the Graduate School by the dean. The grade point average is obtained by dividing the total number of grade points earned by the total number of hours attempted for a grade, including hours for courses in which the grade is F. Satisfactory/unsatisfactory grades do not enter into the GPA.

GRADES ASSIGNED		GRADE POINTS
A	Excellent	4.00
A-		3.67
B+		3.33
B	Good	3.00
B-		2.67
C+		2.33
C	Low Pass	2.00
F	Failed	(counted as hours attempted)
I	Incomplete	(becomes passing grade or F)
P	Pass	
S	Satisfactory	
U	Unsatisfactory	
AUD	Audit	
DRP	Official Drop	

	(not counted as hours attempted)
NC	No credit
NR	Grade not reported
	(becomes passing grade or F)
RPT	Course repeated
	(see repeating a course)
WD	Withdrew
	(not counted as hours attempted)
WP	Withdrew passing
	(not counted as hours attempted)
WF	Withdrew failing
	(not counted as hours attempted)

Individual departments or programs may require a higher grade point average than 2.5 for continuation. If there is such a requirement, it is stated in the departmental or program policies. A student may be dismissed from the Graduate School by the dean upon recommendation of his or her department or program if he or she does not make adequate progress in research. Adequate progress is determined by the standards of the department or program in which the student is enrolled.

The minimum grade point average required for graduation is 3.0. PhD candidates must have a grade point average of 3.0 in graduate courses at the time of the preliminary examination. A 3.0 grade point average is also required to earn a graduate certificate.

Repeating a Course. Beginning with fall 1999 courses, a graduate student may repeat a course in which a B- or lower grade has been received. The course may be counted only one time for credit. The higher grade earned will be counted in calculation of grade point average. Both grades will appear on the transcript.

Dropping a Course. With the approval of the advisor and instructor, a student may drop a course during the first month of a semester or the equivalent period during a summer term without penalty or notation on the transcript.

A student who is permitted to drop a course after the first month, with the approval of the dean of the Graduate School and the department concerned, is assigned a Drop (DRP). Courses marked Drop are not counted in determining

the grade point average. Add/Drop forms may be accessed on the Graduate School website.

Auditing a Course. Auditing a course consists of participation in a course without receiving a letter grade or credit hours. When space is available after registration of students enrolled for credit, others may request permission of the instructor to enter the course as auditors. In no case may anyone register to audit a course before the first meeting of the class. No additional charge is made to full-time students in the Graduate School of Arts and Sciences; for others the fee is \$110 per hour. In addition to the permission of the course instructor, permission of the advisor is required for degree-seeking students. An auditor is subject to attendance regulations and to other requirements of performance established by the instructor. Although an auditor receives no credit, a notation of audit is made on the final grade report and entered on the record of enrolled students who have met the instructor's requirements.

Continuous Enrollment. Degree-seeking students must have continuous enrollment through the semester in which they graduate. Enrollment may be achieved by registering for courses, including research, or by registering as Thesis Only or Graduate Fee.

Leave of Absence. Students who are in good academic standing and wish to take a leave of absence must receive approval from their advisor and program director along with the dean of the Graduate School. Forms can be found at <http://graduate.wfu.edu/students/> under 'Student Forms'. The maximum time for a leave of absence is one academic year.

One month prior to the beginning of the semester in which the student plans to re-enter the Graduate School, a written reinstatement request must be sent to the dean of the Graduate School. The time spent during the leave of absence will not count in the maximum time allotted for the degree. If a student on an approved leave has not requested reinstatement after a year, the student will be considered to have withdrawn from Graduate School.

Wake Forest University does not have a leave of absence policy that would either exempt any student from the requirements of the Return of Title IV Funds policy, or extend federal student loan deferment benefits.

Transferring to a Different Program. This policy applies to students in the biomedical sciences (Bowman Gray Campus) **ONLY**.

A student who wishes to transfer from one program to another should be allowed to do so provided the standards of the new department or program are met. The student should contact the graduate director of the department or program to which he or she wishes to transfer. After consultation with the graduate director, the student should interview with one or more prospective advisors. If a prospective advisor is identified, the student's transfer request may be considered further.

Upon receipt of a written request from the student, the Graduate School will forward credentials from the student's file to the graduate director for evaluation and consideration of financial aid. At the conclusion of this process, the graduate director sends a transfer recommendation to the dean of the Graduate School for approval. The student is not required to withdraw from an existing program until the transfer request to the new department has been approved.

It is understood that the department or program from which the student is transferring would have no further financial responsibility for the student. The student must, however, complete the formal process of withdrawing from the original program by the end of the current semester.

Withdrawal from the University. Students who wish to withdraw from the Graduate School must complete the appropriate form, which requires approval from the department concerned and the dean of the Graduate School. Students who leave without following this procedure will receive a grade of F in each course in progress. Students on the Reynolda campus who were issued a Graduate School laptop computer are

required to return it to Information Systems. Students on the Bowman Gray campus are required to return their laptop computers to the Graduate School office.

Students who withdraw by the drop date, established by the academic calendar, of the semester will not have a grade recorded for courses in progress. Students who withdraw after the drop deadline will be assigned a grade of withdraw-passing or withdraw-failing for each course in progress.

The withdrawal date for students enrolled in an on-line program will be determined by the last time the student participated in an online discussion or made contact with a faculty member. Simply logging in to a course is not determinative of participation in the course.

Students who have withdrawn from the Graduate School and wish to return within one academic year must request reinstatement in writing to the dean of the Graduate School at least one month prior to the semester in which they wish to re-enter.

To be reinstated the student must be in good academic standing and receive approval from the graduate program and the dean of the Graduate School. The time spent during this one year of withdrawal will not count in the maximum time allotted for the degree.

Students who have withdrawn from the Graduate School and who wish to re-enter after one academic year must reapply for admission as stated in the Graduate Bulletin by the application deadline, and must be recommended by the program and accepted by the dean of the Graduate School.

If a student is approved for readmission to the Graduate School within a five-year period, previous coursework may count towards the degree requirements at the discretion of the dean of the Graduate School on the recommendation of the graduate program concerned. If the student re-enters Graduate School after a five-year period, previous courses will not count in the degree requirements.

POLICY OF EXTERNAL REMUNERATION

A student supported on a stipend from the graduate school, faculty grant, student fellowship or other sources may be allowed to engage in additional remunerative work with written permission from his or her advisor and as long as it does not delay or interfere with the duties required for timely completion of the degree.

ACCOMMODATION OF STUDENTS OF FACULTY WHO LEAVE THE INSTITUTION

In the event that a graduate faculty member leaves the institution prior to completion of the degree by his or her student(s), the Dissertation Committee (or Department Graduate Committee if there is no Dissertation Committee) is responsible for recommending an appropriate plan for the completion of the degree. The plan should address the following: support of stipend and research funding (including lab space), designation of a primary mentor, and designation of a manager to carry out the plan. This plan must be submitted within six weeks of the faculty member's resignation and approved by the dean.

STATEMENT ON STUDENT RIGHTS AND RESPONSIBILITIES

The graduate faculty has adopted a formal statement regarding student rights and responsibilities. The statement is a guideline to be used by students with respect to an honor code which applies to both teaching and research endeavors. It also includes clearly defined procedures for the handling of student grievances should they arise. This statement may be accessed on the Graduate School website.

HONOR CODE & GRIEVANCE PROCEDURES

The graduate faculty has adopted a formal honor code to provide guidance for student conduct with respect to academic pursuits. This policy may be accessed at the Graduate School website (<http://graduate.wfu.edu/students/>).

Faculty are appointed as liaisons on both campuses to facilitate faculty or students who seek to file a grievance. Graduate students

interested in filing a grievance are also encouraged to speak with the chair(s) of the Graduate Student Association or other of its officers to seek advice regarding the grievance procedure. The names and e-mail addresses of the faculty liaisons and GSA co-chairs can be obtained from the Graduate School office on either campus or the Graduate School website (<http://graduate.wfu.edu/faculty/graduate-council.html>).

PATENTS POLICY

Inventions and Patents. During a student's course of study, he or she may participate in research or other work which leads to an invention or discovery. These inventions or discoveries are the property of the University. The University's Inventions and Patent Policy is applicable to student inventions with respect to the definition of inventions covered, resolution of disputes, and the division of proceeds, including the determination of the inventor(s) share of any proceeds. Under this policy, a program exists to determine patentability and commercial value of each invention. Advice and guidance regarding this policy are available from the Office of Technology Asset Management.

COPYRIGHT POLICY

The Copyright Policy of Wake Forest University is intended to:

1. Encourage research and teaching by rewarding the authors of intellectual works, assisting them in implementing their ideas, and by providing a system for the encouragement of scholarship and creative activity;
2. Serve the public interest by providing means through which intellectual works may be made available to the public; and
3. Protect the rights of the University, its faculty, its staff, and its students with regard to intellectual works developed at the University.

Degree Requirements

DEGREES OFFERED

The Graduate School of Arts and Sciences offers graduate programs leading to the master of arts, master of arts in education, master of arts in liberal studies, master of arts in human services, master of fine arts, master of science, and doctor of philosophy degrees.

The following pages contain information on the three major degree requirements: MA, MS and PhD. Degree requirements for dual degree programs, certificate programs, and individual degrees (i.e. education and fine arts) requirements are found in the Programs & Certificates section of this publication.

For both the MA and MS degrees, the Graduate School requires a minimum of 24 hours of Course Requirements; however, the Course Requirements for the PhD degree are set by individual graduate program committees or student advisory committees. The MFA is only offered in Documentary Film.

REQUIREMENTS FOR THE MASTER OF ARTS

Programs of study leading to the master of arts degree are offered in bioethics, communication, English, liberal studies, mathematics and statistics, psychology, religious studies, and sustainability. The degree is awarded to candidates who complete a minimum of 24 semester-hours of faculty-approved coursework with an average grade of B or above on all courses attempted, meet any foreign language or special skills requirement, and write an acceptable thesis (if required) for which six hours of credit toward the 30 required for graduation are allotted. Students may earn additional credit for thesis research, but such hours may not be substituted for the 24 hours of coursework required. Some programs require more than 30 hours for graduation. These requirements are listed at the beginning of the program section.

Residence Requirements. The minimum residence requirement is one academic year or three summer sessions. The total allowable time for completion of the degree must not exceed six years.

Course Requirements. At least 12 of the 24 hours in coursework (not counting thesis research) required for the degree must be in courses numbered 700 or above. The remaining 12 hours may be in either 600-level, 700-level, or 800-level courses. All of the required 24 hours of coursework must be taken for a grade, although additional courses may be taken Pass/Fail if offered in that mode. Credit may be allowed for as many as six hours of graduate work transferred from another institution at the discretion of the program director and dean of the Graduate School, but the minimum residence requirement is not thereby reduced.

Foreign Language or Special Skills Requirement. Some departments may require students to demonstrate a reading knowledge of an appropriate foreign language or competency in a special skill. Refer to each program's statement to see if there is such a requirement and how it may be satisfied.

Admission to Degree Candidacy. A student is admitted to degree candidacy by the dean of the Graduate School after recommendation by the major department. The student must have satisfactorily met any foreign language or special skills requirement and is expected to complete the master's degree requirements within one semester.

Thesis Requirement. Some of the departments granting a master of arts degree require a thesis; the student should check with the individual department. If required, six of the 30 hours required for the MA degree are allotted for the thesis. Thesis courses are graded S (Satisfactory) or U (Unsatisfactory). If a U is assigned, the

course must be repeated and an S earned before the degree can be awarded.

Theses are written under the supervision of the student's advisory committee (an advisor from the department, a second reader from within the department, and a third reader either from outside the department or the student's area of concentration). All members of the advisory committee should be members of the graduate faculty. The committee will be appointed by the dean of the Graduate School. With the approval of his or her advisor, a student may recommend a person who is not on the graduate faculty to serve on the examining committee as a voting member; however, the committee must have a minimum of two members from the graduate faculty. The thesis advisor must justify the participation of this person on the basis of research, publications, and/or professional activities in a letter to the dean requesting approval.

Final Examination. Requirements for thesis submission and format are posted on the WFU Graduate School website. (<http://graduate.wfu.edu>) The examination covers the thesis and knowledge in related areas. The possible committee decisions are unconditional pass, pass upon rectifying minor deficiencies, pass upon rectifying major deficiencies, and fail. If a student fails, he/she may be reexamined only once. The defense must take place by the deadline on the academic calendar.

Pass. If all committee members agree that the student has passed unconditionally, there is consensus to pass the examination. The committee chair will sign the ballot, submit the ballot to the Graduate School, and the student shall be recommended for award of the degree.

Pass Upon Rectifying Minor Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the thesis is

modified to meet the committee's reservations. When the thesis has been modified, the student passes the examination, and the student will be recommended for award of the degree.

Pass Upon Rectifying Major Deficiencies.

If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the thesis is modified to meet the committee's reservations. When the thesis has been modified, the student passes the examination, and the student will be recommended for award of the degree.

Fail. If, in the opinion of more than one member of the thesis committee, the student has failed the examination, there is no consensus to pass. The chair of the committee will advise the student that the thesis fails to meet the requirements of the Graduate School. The chair will ensure that the student knows the reason(s) for failure and will submit the ballot to the Graduate School. If the student resubmits or submits a new thesis for consideration by the Graduate School, at least three members for the thesis will be drawn from the original committee. If the modified or new thesis fails to meet the requirements of the Graduate School, the student shall be dismissed.

REQUIREMENTS FOR MASTER OF FINE ARTS

Requirements: The MFA requires 57 hours. Students take four courses in documentary storytelling that address the core principles of research, theory, non-fiction writing, direction, and production design as well as courses in cinematography and sound and editing. Students receive nine credit hours for their creative thesis film, which they defend in the fall semester of their third year. The opportunity to create transmedia work is offered through The Imagination Project and courses in entrepreneurship and pedagogy prepare students for careers as entrepreneurial

artists and academicians. Students may also take elective courses in an area of special interest.

REQUIREMENTS FOR THE MASTER OF SCIENCE

The master of science degree is offered on the Reynolda campus in biology, chemistry, computer science, health and exercise science, and physics. On the Bowman Gray campus, this degree is offered in biomedical engineering, biomedical science, comparative medicine, clinical and population translational sciences, and molecular medicine and translational science.

Residence Requirement. In general, a minimum of 12 months of full-time work or its equivalent in residence is required for the master's degree. The total allowable time for completion of the degree must not exceed six years.

Course Requirements. A master of science degree candidate must have a minimum of 30 semester-hours of graduate credit. The minimum requirement is six hours of thesis research. For the Reynolda Campus, at least 12 of the 24 hours in coursework (not counting thesis re-search or GRD classes) required for the degree must be in courses numbered 700 or above. The remaining 12 hours may be in either 600-level, 700-level or 800-level courses. All of the required 24 hours of coursework must be taken for a grade, although additional courses may be taken Pass/Fail if offered in that mode. Some programs require more than 30 hours for graduation. These requirements are listed at the beginning of the program section.

The course of study consisting of classes, seminars, and research is compiled by the student, the student's advisor, and the chair of the department of the major field of interest. It is recommended that, when possible, such programs include courses in fields other than that of major interest. Credit may be allowed for as many as six hours of graduate work transferred from another institution at the discretion of the program director and dean of the Graduate School, but the minimum residence requirement is not thereby reduced.

Foreign Language or Special Skills

Requirement. Some departments may require students to demonstrate either a reading knowledge of an appropriate foreign language, or competence in a special skill. See each department's statement to determine if there is such a requirement and how it may be satisfied.

Scientific Integrity and Responsible Conduct in Research. (Bowman Gray campus) The successful completion of a program in scientific ethics is required prior to admission to degree candidacy. This requirement is fulfilled either by participating in the courses designated by the Graduate School or by satisfactory completion of approved departmental electives that incorporate extensive discussion of scientific ethics.

Admission to Degree Candidacy. A student is admitted to degree candidacy by the dean of the Graduate School after recommendation by the major department. The student must have met satisfactorily any foreign language, special skills, or ethics requirement and is expected to complete the master's degree requirements within one semester.

Thesis Requirement. Some of the departments granting a master of science degree require a thesis; the student should check with the individual department. If a thesis is required, six of the 30 hours required for the MS degree are for thesis research. Thesis research courses are graded S (Satisfactory) or U (Unsatisfactory). If a U is assigned, the course must be repeated and an S earned before the degree can be awarded.

Theses are written under the supervision of the student's advisory committee (an advisor from the department, a second reader from within the department, and a third reader either from outside the department or the student's area of concentration). All members of the advisory committee should be members of the graduate faculty. The committee will be appointed by the dean of the Graduate School. With the approval of his or her advisor, a student may recommend a person who is not on the graduate faculty to serve on the examining committee as a voting member; however, the committee must have a minimum of two members

from the Graduate Faculty. The thesis advisor must justify the participation of this person on the basis of research, publications, and/or professional activities in a letter to the dean requesting approval.

Final Examination. The examination covers the thesis and knowledge in related areas. Requirements for thesis submission and format are posted on the Graduate School website (<http://graduate.wfu.edu>). The possible committee decisions are unconditional pass, pass upon rectifying minor deficiencies, pass upon rectifying major deficiencies, and fail. If a student fails, he/she may be reexamined only once. For the biomedical sciences, a final copy of the thesis must be submitted by the candidate to the dean of the Graduate School at least four weeks before the proposed date of the final examination and distributed to the examining committee at least three weeks before the final examination. The committee is polled by the chair of the examining committee at least ten days before the proposed date of the examination to determine the acceptability of the thesis. For the Reynolda Campus, the defense must take place by the deadline on the academic calendar.

Pass. If all committee members agree that the student has passed unconditionally, there is consensus to pass the examination. The committee chair will sign the ballot, submit the ballot to the Graduate School, and the student shall be recommended for award of the degree.

Pass Upon Rectifying Minor Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the thesis is modified to meet the committee's reservations. When the thesis has been modified, the student passes the examination and the student will be recommended for award of the degree.

Pass Upon Rectifying Major Deficiencies.

If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the thesis is modified to meet the committee's reservations. When the thesis has been modified, the student passes the examination and the student will be recommended for award of the degree.

Fail. If, in the opinion of more than one member of the thesis or thesis committee, the student has failed the examination, there is no consensus to pass. The chair of the committee will advise the student that the thesis fails to meet the requirements of the Graduate School. The chair will ensure that the student knows the reason(s) for failure and will submit the ballot to the Graduate School. If the student resubmits or submits a new thesis for consideration by the Graduate School, at least three members for the thesis will be drawn from the original committee. If the modified or new thesis fails to meet the requirements of the Graduate School, the student shall be dismissed.

REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY

Programs of study leading to the doctor of philosophy degree are offered in biochemistry and molecular biology, biology, biomedical engineering, cancer biology, chemistry, microbiology and immunology, molecular genetics and genomics, molecular medicine and translational science, neuroscience, physics, and integrative physiology and pharmacology.

Residence Requirement. A minimum of three years of full-time study, of which at least two must be in full-time residence at the University. The total allowable time for completion of the degree must not exceed seven years.

Course Requirements and Advisory Committee. The number of required courses are not prescribed by the Graduate School, although

certain programs have required courses. In other programs coursework is arranged by the students advisory committee with the approval of the departmental or program graduate committee to provide mastery of appropriate elds of con- centration. Courses required by programs cannot be taken as Pass/Fail, and graduate committees may designate that certain courses may not be taken Pass/Fail. The advisory committee is appointed by the chair of the department or the program director and consists of the students advisor and two other members of the department or program.

Foreign Language or Special Skills Requirement. Some departments may require students to demonstrate either a reading knowledge of one or more appropriate foreign languages, or competence in one or more special skills. See each department's statement to see if there is such a requirement and how it may be satisfied.

Scientific Integrity and Responsible Conduct of Research. The successful completion of a program in scientific ethics is required prior to admission to degree candidacy. This requirement is fulfilled either by participating in the courses designated by the Graduate School or by satisfactory completion of approved departmental electives that incorporate extensive discussion of scientific ethics.

Professional Development Requirement for Biomedical Sciences (Bowman Gray campus). The successful completion of a program in professional development is required prior to admission to degree candidacy. This requirement is fulfilled by participating in the course Introduction to Professional Development in the Biomedical Sciences which is taken during the first year.

Preliminary Examination. This examination is conducted by the major department. The examining committee selected by the department includes at least three members, one of whom represents a related concentration area. A single written examination or a series of written examinations should cover all areas of concentration

and collateral studies. There may also be an oral examination in which any faculty member invited by the examining committee may participate. The examining committee passes or fails the student and notifies the Graduate School of the results. In case of failure, the committee can recommend that the candidate be dropped or that reexamination be allowed no earlier than six months from the date of the first examination. A student may be reexamined only once. The preliminary examination is normally given near the end of the student's second year of graduate study and must be passed at least twelve months prior to the date of the awarding of the degree.

Admission to Degree Candidacy. A student is admitted to degree candidacy by the dean of the Graduate School after recommendation by the chair of the major department or program director. Each candidate must have passed the preliminary examination, satisfied any foreign language or special skills requirements, and is expected to complete the degree requirements within one semester.

Dissertation Requirement. Dissertation research courses are graded S (Satisfactory) or U (Unsatisfactory). If a U is assigned, the course must be repeated and an S earned before the degree can be awarded.

Under the supervision of an advisor committee, the candidate prepares a dissertation embodying the results of investigative efforts in the field of concentration.

The examining committee for the dissertation, which is appointed by the dean of the Graduate School, consists of at least the following five members of the graduate faculty: the chair of the major department/program or a faculty member chosen by the chair, the student's advisor, another member of the major department/program, a representative from a related area from within or outside the department/program and a member from outside the major department (or in the case of programs, outside of the student's area of concentration) who represents the Graduate Council and who serves as chair of the committee. With the approval of

his or her advisor, a student may recommend a person who is not on the graduate faculty to serve on the examining committee as a voting member. The dissertation advisor must justify the participation of this person on the basis of research, publications and/or professional activities in a letter to the dean. Other faculty members may attend the final examination and participate in the questioning.

Final Examination. Requirements for dissertation submission and format are posted on the Graduate School website (<http://graduate.wfu.edu>).

Students on the Bowman Gray campus must submit a copy of the dissertation to the dean of the Graduate School at least four weeks prior to the proposed date of the final examination and copies distributed to the examining committee at least three weeks before the final examination. The committee is polled by the chair of the examining committee at least ten days before the proposed date of the examination to determine the acceptability of the dissertation.

For both the Bowman Gray and Reynolda Campuses the examination covering the student's major field of concentration and the dissertation is held no later than the final day to defend as noted on the academic calendar. After the examination of the degree candidate, the chair will ask each of the members of the examining committee whether the candidate has passed unconditionally, passed upon rectifying minor deficiencies, passed upon rectifying major deficiencies, or failed.

Pass. If all committee members agree that the student has passed unconditionally, there is consensus to pass the examination. The committee chair will sign the ballot, submit the ballot to the Graduate School, and the student shall be recommended for award of the degree.

Pass Upon Rectifying Minor Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the

Graduate School. The student and the advisor are jointly responsible for ensuring that the dissertation is modified to meet the committee's reservations. When the dissertation has been modified, the student passes the examination and the student will be recommended for award of the degree.

Pass Upon Rectifying Major Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the dissertation is modified to meet the committee's reservations. When the dissertation has been modified, the student passes the examination and the student will be recommended for award of the degree.

Fail. If, in the opinion of more than one member of the dissertation committee, the student has failed the examination, there is no consensus to pass. The chair of the committee will advise the student that the dissertation fails to meet the requirements of the Graduate School. The chair will ensure that the student knows the reason(s) for failure and will submit the ballot to the Graduate School. If the student resubmits or submits a new dissertation for consideration by the Graduate School, at least three members for the dissertation will be drawn from the original committee. If the modified or new dissertation fails to meet the requirements of the Graduate School, the student shall be dismissed.

Degree Programs & Certificates

Semester hours of credit are shown by numerals immediately after the course title—for example, (3) or (3, 3). Some laboratory courses have numerals after the course descriptions showing hours of recitation and laboratory per week—for example, (2-4). The symbols P— and C— followed by course numbers or titles are used to show prerequisites and corequisites in the department. POI indicates permission of instructor is required. Because graduate study occurs at a level of complexity and specialization exceeding that of undergraduate education, the work required of graduate students in any course in which instruction is combined with undergraduate students will reflect this difference.

Biochemistry and Molecular Biology (BICM)

Bowman Gray Campus

Program Director

Chair

Professors

Rebecca Alexander, Donald W. Bowden, H. Alexander Claiborne,
Larry W. Daniel, Douglas S. Lyles, John Parks, Fred W. Perrino, Leslie Poole,
Lawrence L. Rudel, Peter B. Smith

Associate Professors

Cristina Furdui, Thomas Hollis, Todd Lowther, Jed Macosko

Assistant Professors

Nichollette Allred, Derek Parsonage, Susan Sergeant

Instructors

Kim Nelson

Overview

The graduate training program in Biochemistry and Molecular Biology of the Department of Biochemistry is designed to prepare students for careers of investigation and teaching in biochemistry, molecular biology, and in related sciences that involve biochemical, structural and molecular approaches and techniques. Although the programs of study are individually planned, all students are expected to possess competence in certain basic areas of biochemistry and related sciences. Programs leading to the PhD degree in biochemistry and molecular biology are offered.

Students enter the program through the Molecular and Cellular Biosciences Track and participate in the MCB common curriculum in the first year. Curriculum in subsequent years includes participation in Scientific Communication, Topics in Biochemical Literature and electives of the student's choice. The student also participates in the department's program of research seminars.

Dissertation research under the supervision of a faculty member may be pursued in various areas of biochemistry, including enzymology, NMR and X-ray structure determination of macromolecules, virus assembly, relation of lipid and protein metabolism and of protein-lipid association to membrane structure and function, biological oxidations and bioenergetics, molecular genetics and nucleic acid function, biophysics, biochemical pharmacology of anticancer agents, leukocyte metabolism and function, signal transduction mechanisms in normal and cancerous cells, and molecular mechanisms of blood coagulation. The department has specialized equipment and facilities to support training and investigation in these areas.

The biochemistry program participates in the Interdisciplinary Graduate Track in Structural and Computational Biophysics. For more information, refer to the pages in this bulletin regarding the program. The graduate program was begun in 1941, and the PhD degree has been offered since 1962.

Degree Requirements: please see "Requirements for Degrees" beginning on page 25.

MCB Track Electives

MCB 711. Biological Systems and Structures. (2) In depth study of macromolecular assembly and interactions, as well as the application of structural biology and proteomics technology. Contemporary concepts of the principles of protein and nucleic acid structure are discussed. Other topics include methods for structure determination such as X-ray diffraction, NMR spectrometry, and molecular modeling.

MCB 712. Biological Spectroscopy. (2) Principles and practicalities of the study of biomolecules using spectroscopic techniques such as absorbance, fluorescence and circular dichroism analyses. Other biophysical approaches such as mass spectrometry and sedimentation analysis will be included. Topics in the study of enzymes utilizing these techniques will be discussed.

MCB 713. Large Experimental Datasets and Analysis. (2) Conducted as a combination of lectures, reading assignments, and student-led discussions. Lectures detail experimental methods that generate large-scale datasets. Topics include genotyping, expression profiling, metabolomics, high-content cellular imaging techniques and practical examples of bioinformatic software and statistical analyses.

MCB 714. Experimental Approaches to Cell Biology and Disease. (2) Conducted as a combination of lectures, reading assignments, and student-led discussions. With an emphasis on cellular functions involved in disease, lectures detail common techniques used in cell biology experimentation. Practical examples and issues of functional genomic approaches are discussed, including design of appropriate cell biology models.

BICM Advanced Courses

700, 701. Scientific Communication. (1, 1) Instruction and practice in oral and written scientific communication. Meets weekly.

704. Preparatory Biochemistry. (3) Conducted as a combination of lectures, case studies, reading assignments, course notes, and group conferences. The sequence of topics is: a. protein structure, b. enzyme mechanisms, c. bioenergetics, d. signal transduction, e. intermediary metabolism and f. interorgan metabolism. The principles of each topic are discussed in relation to clinical disease entities, e.g. protein structure: hemoglobin/sickle cell anemia/sickle cell hemoglobin/sickle cell disease due to abnormal hemoglobin structure. *P—POI*

706. Intracellular Signaling. (3) Advanced study of the biochemical mechanisms involved in intracellular signaling of normal and malignant cells, including 1) growth factor and G protein-coupled receptors 2) second messengers, 3) protein kinase cascades, 4) gene regulation, and 5) oncogenes. Lectures and discussions provide in-depth coverage of each topic with emphasis on recent advances and current literature.

709, 710. Special Topics in Biochemical Literature. (2) Critical reading and interpretation of the recent literature in biochemistry. Emphasis is decided by students and staff. Meets weekly. Required of second and third year graduate students in the biochemistry and molecular biology program.

711. Advanced Topics in Protein Structure Determination. (2) Emphasizes methods for modern structure determination using X-ray crystallographic methods. Students are exposed to practical techniques in growth of protein crystals, collection and processing of X-ray diffraction data, phase determination, model building and refinement. Students are also expected to develop an in-depth understanding of the latest instrumentation and programs used in protein structure determination.

713. Large Experimental Datasets and Analysis - Advanced. (3) Conducted as a combination of lectures, reading assignments, and student-led discussions. Lectures detail experimental methods

that generate large-scale datasets. Topics will include genotyping, expression profiling, metabolomics, high-content cellular imaging techniques and practical examples of bioinformatic software and statistical analyses.

714. Instrumental Techniques. (3) Theoretical and technical aspects of instrumentation currently employed in the biological sciences. Experience is provided on a variety of instruments including high performance liquid chromatographs; gas chromatographs; gas chromatograph/mass spectrometer; nuclear magnetic resonance spectrometer; electron paramagnetic resonance spectrometer; ultraviolet, visible, and infrared spectrophotometers; spectrofluorimeters; and cell sorter/cytofluorograph. P—Chemistry through physical chemistry and two semesters of physics or POI. Offered in odd-numbered years.

715, 716. Special Topics in Biochemistry. (1-9) Advanced conference course that considers various areas of current interest or rapid development. Topics are developed depending on the interests of students and staff.

717, 718. Principles and Practice of Teaching Biochemistry. (2) Structured participation of students as mentors in existing biochemistry classes. Under the supervision of biochemistry faculty, students create laboratory demonstrations, field questions, write and grade exam questions, conduct review sessions and participate in one-on-one instruction.

719, 720. Research. The department offers opportunities for investigation in a wide variety of biochemical subjects under the guidance of staff members. *Satisfactory/Unsatisfactory*

734. Human Molecular Genetics. (2) Combined lecture/seminar course providing an overview of current theoretical and technical approaches for locating, identifying, and cloning human genes using molecular genetic methods. Emphasis is on the search for genes that contribute to simple single-gene disorders and common complex diseases. Topics include genetic mapping in humans, construction of physical maps of chromosomes, identification of coding sequences and disease susceptibility genes, and functional analysis of gene products.

740. Drug Discovery, Design, and Development—Molecules to Medicines. (3) Conducted as a combination of lectures, reading assignments, and student-led discussions. Examines drug discovery and development pathways from target and lead compound identification through metabolic and toxicology studies, clinical trials, FDA approval, and marketing. Regulatory processes, intellectual property, and ethical issues are also considered. Taught by WFU faculty from both the Reynolda and Bowman Gray campuses and colleagues in the pharmaceutical and biotechnology industries, students work in teams to present case studies on the discovery, development, and marketing of recently approved pharmaceuticals. Also listed as CHM 740. P—*Organic chemistry and biochemistry*.

745. Drug Discovery VirtualLaboratory. (1) Interactive laboratory course complements Seminars in Drug Discovery, Design, and Development—Molecules to Medicines by providing students with hands-on experience with state-of-the-art software used by the pharmaceutical industry to discover new drugs and refine their target interactions *in silico*. Following an introduction to structure-based drug design principles, students will complete tutorials; guided by WFU faculty from both the Reynolda and Bowman Gray campuses, they will develop and present exercises that examine how structure-based drug design has contributed to recently approved pharmaceuticals. C—BICM 740

Bioethics (BIE)

Bowman Gray and Reynolda Campuses

Program Co-Directors

Nancy King and Mark Hall

Overview

The Master of Arts in Bioethics provides an educational opportunity at the graduate level for current and future professionals and others throughout the country interested in bioethics, including health care providers, researchers in biomedicine and the life sciences, lawyers, and professionals in religion, health and research administration, and the biotechnology industry. The goal of the Master of Arts in Bioethics is to equip graduates to practice and teach about bioethics as integral to the work of medicine and biotechnology, health care, and the basic sciences, and to undertake exemplary bioethics-related research and scholarship. The program encompasses clinical ethics, research ethics, and health policy and administration.

The program has two characteristic emphases: *bioethics in social context*, and *bioethics and biotechnology*. First, a general emphasis on the social, cultural, and policy contexts that shape all bioethics questions and issues is visible throughout the curriculum. Although the importance of incorporating the humanities, the social sciences, and even the arts may seem obvious, this is not a component of most bioethics education elsewhere. Second, a focus on bioethics and biotechnology takes advantage of Wake Forest University's strong and growing presence in this area. Research and clinical practice in nanomedicine, genomics, pharmacogenetics, molecular and cell therapies, and the like is ongoing not only here at Wake Forest University but elsewhere in North Carolina.

The program has particular emphases without declaring particular specializations. This is in part because bioethics education is by its nature fundamentally generalist: Students receive broad exposure to ideas, discussion, scholarly literature, and experience, as well as a set of intellectual skills to be developed and practiced widely before being turned to special areas of interest. Visit www.wfu.edu/bioethics for more information.

The Master of Arts in Bioethics requires 30 credit hours of work; 24 hours of coursework with an average grade of B or above plus 6 hours of thesis research. At least 12 of the 24 hours of coursework must be in courses numbered 700 or above (graduate students only). The remaining 12 hours may be in either 600 or 700 level courses. All work must be completed within six years of the date of initial enrollment in the graduate program.

Students are required to follow the student handbook of the school(s) through which he/she is enrolled. To continue in a dual or joint degree program, a student must remain in good academic standing with the respective School (Wake Forest College, Divinity, Law or Medicine) and the Graduate School of Arts and Sciences.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Courses of Instruction

619. Concepts of Health and Disease. (2 or 3) Concepts of health and disease shape discussions in bioethics and health policy. This course examines and critically evaluates competing conceptions of health and disease. The implications of adopting different understandings of health and disease for bioethics and health policy will be explored. P—POI

670: Communication Ethics and Bioethics: An Interface (3) This course explores: 1) how the phenomena of the call of conscience, acknowledgment, and our metaphysical desire for perfection inform the ontological status of communication ethics; 2) how communication ethics is a necessary

concern for bioethics scholars, policy makers, researchers, and others interested in assessing the ongoing debate over the benefits and burdens of biotechnology; and 3) how biotechnology affects our collective understanding of human dignity. Students will also be involved as role-players in a Wake Radio program where an actual case study in communication and bioethics is broadcast to the University community. Also listed as COM 670. *P—POI*

701. Historical Foundation of Bioethics. (2 or 3) Explores the origins of bioethics thought, through examination of core concepts in philosophy, moral theory, social and cultural studies, and law and policy. Topics may include, for instance: the ancient Greeks, Confucius, and key religious teaching on health; the civil rights movement; the history of scientific medicine; and the legal conceptualization of medical practice. This course expands and extends students' knowledge of the contemporary history of bioethics as incorporated in to various aspects of their required courses. *P—POI*

702. Biomedical Research Ethics. (3) A historical and conceptual survey of ethics and policy issues in biomedical research. Emphasis is on research involving human subjects; translational research, including oversight of novel biotechnologies; and the ethical implications of research design and funding decisions. Topics include the regulatory structure of research and proposals for reform; genomics and biospecimen research; and the relationship between medical research and medical treatment. Students are required to successfully complete two of the following courses: BIE 702, 704, or 705. *P—POI*

703. Bioethics Theory. (3) An investigation of the main theoretical approaches to contemporary bioethics and their philosophical foundations. The course begins with the principles of beneficence, autonomy, and justice first propounded in the Belmont Report. Criticisms of and alternatives to what has come to be called the "principlist approach to bioethics" will be critically reviewed. *P—POI*

704. Public Policy, Medicine, and Justice. (3) An examination of the organization of medicine and biomedical science in the U.S. today. The relationships between scientific and medical institutions and the implementation of public policies are critically analyzed in light of the requirements of the principle of justice. Topics include conflicts of interest, broadly understood, within and between institutional and professional actors; the regulation of medical practice; access to health care; and the balance between the public good and market forces. Students are required to successfully complete two of the following courses: BIE 702, 704, or 705. *P—POI*

705. Clinical Ethics. (3) Focuses on "ethics at the bedside" and makes extensive use of case studies. Emphasis is on patient-provider relationships, broadly understood, and on problems of communication and the social, cultural, and institutional contexts in which they arise. Clinical decision making in a wide range of contexts is examined. Questions of organizational ethics are also considered. Students are required to successfully complete two of the following courses: BIE 702, 704, or 705. *P—POI*

706/707. Bioethics Seminar. (1-3) A seminar on bioethics topics of interest featuring Wake Forest University and invited external faculty, with additional student presentations. Participants engage with presenters and scholarly literature on a variety of aspects of bioethics, including, but not limited to, the scholarly and professional practice of bioethics, the role of empirical scholarship in bioethics and related disciplines, the relationship of bioethics to advocacy and policy, and bioethics communication and mediation. May be repeated for credit up to a maximum of 6 hours. *P—POI*

708. Research Methods. (2) An introduction to the methods, concepts, and tools used in quantitative and qualitative empirical research in bioethics. Students develop skills in design, conduct, interpretation, and evaluation of bioethics research. *P—POI*

709. Ethics of Health Communication. (3) Topics may include: communication with patients,

including truth-telling, confidentiality, and techniques for effective communication; communication within and between institutions, including portable advance directives, access to patient records, and the prevention of medical errors; and communication with the public, including issues arising from the presentation of bioethical issues in news media, film, and television. *P—POI*

710. Global Bioethics. (2 or 3) A comparison of American bioethics with the views of other societies and cultures, including western and non-western perspectives. Topics may include: individualism vs. the community, reproductive freedom, organ transplantation, definitions and views of death, access to medical advances, and the use of human subjects in medical research. Other issues include health disparities, justice in research, and the role of humanitarian aid in promotion of global health. *P—POI*

711. Current Topics in Clinical and Biomedical Research Ethics. (2 or 3) An in-depth critical examination of selected topics of current interest in clinical and research ethics. Topics are identified by staff and students. Examples of pertinent topics include human pluripotent stem cell research; assisted-reproduction; research without consent; the sale of human organs; pandemic and biodefense preparedness; synthetic body parts and transhumanism; genetic enhancement; regenerative medicine and biogerontology. May be repeated for credit up to a maximum of 6 hours. *P—POI*

713. Law, Medicine, and Ethics. (2 or 3) Examination of the relationships between law and medicine, including the legal regulation of medical practice, concepts of medical malpractice, medical neglect, informed consent and legal competence, confidentiality and privacy, and definitions of death. The ethical implications of the intersection of law and medicine are critically analyzed. *P—POI*

715. Bioethics and Religion. (3) Explores fundamental themes, methods, and issues in religious bioethics. Seeks to determine the ways that religious approaches offer distinctive, complementary, or overlapping perspectives with secular approaches. Specific topics will include assisted reproductive technologies, family planning and abortion, genetic therapy and enhancement, withholding and withdrawing life-sustaining treatment, suicide and euthanasia, and justice issues in the allocation of health care resources. Combines lectures and discussions with case analysis. *P—POI*

717. Ethics, Economics, and Health Policy. (3) Examines ethical and justice aspects of social decision-making and market allocation mechanisms in the context of health care, health policy, and population health. *P—POI*

721, 722. Research/Independent Study. (1-3) Students may work with a faculty member on a project of mutual interest. May be repeated for credit up to a maximum of 6 hours. *P—POI*

723. Bioethics at the Movies. (2) A critical examination of the bioethical issues raised in selected full length feature films. The goal of this course is to increase students' ability to think critically about complex issues, paying close attention to relevant details. *P—POI*

725. Health Care Law and Policy. (2 or 3) Introduces students to the structure, financing, and regulation of the health care system and proposals for its reform. Topics include Medicare, medical staff disputes, health care antitrust, HMOs and insurance regulation. Also listed as Law 525. *P—POI*

727. Performable Case Studies in Bioethics. (2 or 3) Students will develop a bioethics case study and present it as a dramatic reading with audience discussion at semester's end. From an initial prompt (e.g. subject matter, situation, incident) and associated readings, the work will be implemented in three phases of approximately equal length: 1) discussion and analysis of the prompt and readings; 2) student presentations of additional research, either individually or in teams, and concomitant discussion and analysis from ethical, social, legal, and, policy perspectives; and 3) script (case) development during in-class writing sessions. The over-arching goal is to exploit the unique ability of dramatic art to engage complex, multifaceted issues in ways that are neither nebulous nor

propagandistic, and to highlight the relationship between process, close analysis, art, and scholarship in bioethics. *P—POI*

729: Bioethics as a Profession. (2) A critical examination of the scholarly literature both in and about bioethics. Topics may include the ethics of the profession of bioethics, controversies concerning the role of bioethics professionals, and the standards and evaluation of practitioners of bioethics. *P—POI*

731. Bioethics at Work: The IRB. (1-3) Provides students with the opportunity to experience and understand human research oversight by attending Institutional Review Board (IRB) meetings, reviewing submitted protocols, and considering the ethical issues arising therein. Students assigned to a single IRB for a single semester will receive 1credit They will attend monthly meetings, meet periodically with course faculty and staff, and meet with IRB senior staff at the beginning and end of the semester. Students are also required to maintain and submit a journal of commentary on meetings and protocols and the ethical issues arising therein and an end of semester paper. Initial enrollment must be concurrent with enrollment in BIE 702: Biomedical Research Ethics or LAW 677/BIE 777: Health-Related Research. Additional credits may be earned by students who attend the meetings of more than one IRB or who continue attendance during the summer terms andfor in the fall semester. Course may be repeated up to a maximum of 3 hours. *Co-Requisite BIE 702 or LAW 677/BIE 777 POI.* .

733. Bioethics at Work: The Clinical Context. (1-3) Provides students with the opportunity to experience and understand clinical ethics activities in the academic medical center setting, through attendance at Clinical Ethics Committee and Subcommittee meetings and other ethics-related events. Students attend meetings of the WFBMC Clinical Ethics Committee, the Consultation, Policy, and Organizational Ethics Subcommittees, and educational sessions organized by the Education Subcommittee. Monthly 2-hour meetings with faculty will explore the application of bioethics theory to cases, topics, and issues encountered in clinical settings. Students may also be able to attend ethics consultations by arrangement. Course may be repeated up to a maximum of 4 hours. *P—BIE 705 and POI.*

737: Bioethics & Genetics (3) An exploration of some of the ethical issues generated by the acquisition and application of knowledge about the human genome. Topics include eugenics, confidentiality, gene therapy, genetic testing of minors, genetic testing of adults, and ownership of genetic information. *P—POI*

739. Neuroethics. (3) This course introduces students to basic philosophical and ethical issues in neuroethics. In this course we explore two branches of neuroethics: the ethics of neuroscience and the neuroscience of ethics. The ethics of neuroscience investigates the ethical implications of the application of neurotechnology for individuals and society, and the neuroscience of ethics attempts to answer traditional ethical questions through neuroscience. In the first half of the course, we study issues related to the ethics of neuroscience such as brain privacy (mind reading), brain manipulation, and cognitive enhancement, and in the second half we review contemporary neuroscientific results bearing on ethical issues like personal identity, free will, and the nature of normative judgments.

741. Narrative and Bioethics. (3) This team-taught course provides bioethics students with an overview of the different ways in which narratives of diverse types are instrumental to bioethics thinking. Four to six faculty will teach individual course units of 2-3 sessions, addressing topics including but not limited to: illness narratives; bioethics in fiction and film; performable case studies addressing bioethics issues; the voice of the medical case presentation; narrative reading and narrative writing; bioethics in the news; and the ethics of “thick description.” Involvement of multiple

faculty enables critical reflection on narrative from a variety of disciplinary perspectives common to bioethics. *P—POI. Staff.*

757. Biotechnology Law and Policy. (2 or 3) Surveys a range of legal and public policy topics in biotechnology, such as: FDA regulation of drugs and devices, regulation of medical research, product liability, insurance coverage of pharmaceuticals, intellectual property and genetics. Also listed as Law 657. *P—POI*

777. Health Related Research: Law, Regulation and Policy. (2) The course explores the regulatory framework and the policy issues that animate health-related research. Topics include public health and quality improvement research, genetic research, health related behavioral and social science research, first-in-human trials, and international considerations. This course is cross-listed at LAW 677.

790. Biotechnology and Ethics. (3) With the convergence of medicine, nanotechnology, computer science, molecular biology, genetic engineering, and business, biotechnologies are emerging not only as an important provider of life-saving and life-enhancing treatments but also a fast-growing and very profitable industry. This course explores some of the major ethical issues related to the current and proposed uses of biotechnologies with particular attention to the reasons and arguments that are often used to support various views on the use of biotechnology. Also listed as THS 790. *P—POI*

791, 792. Thesis Research. (1-6) Research directed toward fulfilling the thesis requirement. May be repeated for credit up to a maximum of 6 hours. *P—POI. Satisfactory/Unsatisfactory*

794. Bioethics and Law. (2 or 3) Students act as a court or administrative agency and write opinions addressing emerging legal and ethical issues created by society’s advancements in medicine and biotechnology, including genetic testing, biomedical experimentation, reproductive rights and end-of-life decisions. Also listed as Law 594. *P—POI*

Biology (BIO)

Reynolda Campus

**Program Director
Chair**

Reynolds Professor

Thurman D. Kitchin Professor of Biology

Charles M. Allen Professor of Biology

Wake Forest Bell Professor of Biology

William L. Poteat Professor of Biology

Charles H. Babcock Chair of Botany

Professors

David J. Anderson, Carole L. Browne, Robert A. Browne, William E. Conner,
James F. Curran, Herman E. Eure, Kathleen A. Kron, Hugo C. Lane,
Gloria K. Muday, Wayne L. Silver

Associate Professors

Miriam A. Ashley-Ross, Erik C. Johnson, Brian W. Tague,
Clifford W. Zeyl

Assistant Professor

T. Michael Anderson, Ke Zhang

Research Professors

Terry L. Erwin, J. Whitfield Gibbons, Terry C. Hazen, Peter D. Weigl

Research Associate Professor

A. Dennis Lemly

Adjunct Assistant Professors

Scott Dobrin, Daniel Lewis, Terri Maness

Teacher-Scholar Postdoctoral Fellow

Overview

The Department of Biology offers programs of study leading to the MS and PhD degrees. For admission to graduate work, the department requires an undergraduate major in the biological sciences or the equivalent, plus at least four semesters of courses in the physical sciences. Any deficiencies in these areas must be removed prior to admission to candidacy for a graduate degree.

At the master's level, the department emphasizes broad biological training rather than narrow specialization. Current research opportunities include physiological ecology, animal physiology, plant physiology, sensory biology, biomechanics, behavioral ecology, plant and animal systematics, immunology, plant and animal cell biology, developmental biology, microbiology, molecular and population genetics, biochemistry and molecular biology, evolution, parasitology, and population and community ecology. It should be noted that graduate students desiring to use work taken in biology for graduate teacher certification should consult the Department of Education before applying for candidacy.

At the doctoral level, few specific requirements are prescribed. Under the guidance of the student's faculty adviser and advisory committee and with the approval of the departmental graduate committee, individual programs are designed for each student. As a supplement to the formal course work, the department has established a special tutorial program. This program brings to campus each year three outstanding biologists to direct and participate in a series of seminars and discussion sessions with doctoral candidates and selected MS students. The areas covered by the tutorial program vary from year to year.

Enrollment in the PhD program is open only to students whose interests are reflected by the areas of expertise represented by the faculty. Thus, prospective PhD students are encouraged to correspond with staff members whose areas of research interest seem compatible with their own. Additional information is available from the chair of the departmental graduate committee.

Graduate study often requires the use of special research tools and skills such as computer work or foreign languages. Candidates for the MS degree must demonstrate proficiency with one such special skill; PhD candidates must be competent with two skills. The student's advisory committee determines, in consultation with the student and with the approval of the departmental graduate committee, the specific areas and demonstrations of competence associated with these skills requirements. Specific coursework in areas such as biometrics and electron microscopy may be used to satisfy a skill requirement, if approved by the advisory committee.

At least one year of teaching, e.g. as a teaching assistant, is required of all PhD students during their tenure.

In order to remain a bona fide graduate student in the department, the student must maintain an overall B average in all courses attempted. Any time this condition is not met the student will lose all financial support and must reapply for acceptance into the program.

Wake Forest is an institutional member of the Highlands Biological Station, which offers research facilities in a high mountain area rich in transitional flora and fauna. The department has a field station situated on Belews Lake, about twenty miles from the Reynolda campus. Additional opportunities for research are available at the Savannah River Ecology Laboratory.

Study leading to the MS degree was inaugurated in 1961. The PhD degree program began in September 1970. A departmental graduate committee consisting of five members of the biology department, four faculty and one graduate student, oversees all aspects of the graduate program from

application review to acceptance to matriculation.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Courses of Instruction

601-605. Topics in Biology. (1-4) Seminar and/or lecture courses in selected topics, some involving laboratory instruction. May be repeated for credit.

607. Biophysics. (3) Introduction to the structure, dynamic behavior, and function of DNA and proteins, and a survey of membrane biophysics. The physical principles of structure determination by X-ray, NMR, and optical methods are emphasized.

611. Ecology & Conservation Biology of Coral Reefs. (3) In-depth study of the various biotic and abiotic components that come together to structure ecosystem function and biodiversity at all spatial scales. In one of Earth's most productive and diverse environments, yet one most threatened by human use and climate change.

612. Ecology & Conservation Biology of Coral Reefs. (4) In-depth study of the various biotic and abiotic components that come together to structure ecosystem function and biodiversity at all spatial scales. In one of Earth's most productive and diverse environments, yet one most threatened by human use and climate change. Lab component is a one-week field trip over spring break.

613. Herpetology. (3) Lecture course on the biology of reptiles and amphibians, emphasizing the unique morphological, physiological, and behavioral adaptations of both groups, and their evolutionary histories and relationships. Two local field trips are planned.

614. Evolution. (3) Analysis of the theories, evidences, and mechanisms of evolution.

615. Population Genetics. (4) Study of the amount and distribution of genetic variation in populations of organisms, and of how processes such as mutation, recombination, and selection affect genetic variation. Lectures present both an introduction to theoretical studies and discussion of molecular and phenotypic variation in natural populations.

617. Plant Physiology and Development. (3) Lecture course examining the growth, development, and physiological processes of plants. The control of these processes are examined on genetic, biochemical, and whole plant levels.

618. Plant Physiology and Development. (4) Lecture course examining the growth, development, and physiological processes of plants. The control of these processes are examined on genetic, biochemical, and whole plant levels. Labs consist of structured experiments and an independently designed research project.

620. Comparative Anatomy. (4) Study of the vertebrate body from an evolutionary, functional, and developmental perspective. Labs emphasize structure and function, primarily through the dissection of representative vertebrates.

621. Parasitology. (4) Survey of protozoan, helminth, and arthropod parasites from the standpoint of morphology, taxonomy, life histories, and host/parasite relationships.

622. Biomechanics. (4) Analysis of the relationship between organismal form and function using principles from physics and engineering. Solid and fluid mechanics are employed to study design in living systems, especially vertebrates.

623. Animal Behavior. (4) Survey of laboratory and field research on animal behavior.

624. Hormones and Behavior. (3) Introduction to the hormonal regulation of behavior in a broad range of animals, including humans and invertebrates. Topics include reproductive behavior,

parental behavior, social behavior, sex differences, aggressive behavior, stress, mood, and the regulations of molting in insects.

625. Chronobiology. (3) Introduction to the field of biological rhythms, covering different types of rhythms, their evolution, and the mechanisms by which such rhythms are generated and regulated at the molecular, cellular, and system levels.

626. Microbiology. (4) The structure, function, and taxonomy of microorganisms with emphasis on bacteria. Topics include microbial ecology, industrial microbiology, and medical microbiology. Labs emphasize microbial diversity through characterizations of isolates from nature.

627. Epigenetics. (3) An introduction to the concepts of epigenetics. This course involves the study of molecular level of how chromatin structure affects DNA template processes including transcription, DNA replication and DNA repair. Topics will cover the mechanisms of chromatin modifications, the role of non-coding RNA in epigenetics, how epigenetic modifications affect phenotypic expression, the environmental impact on the epigenome, heritability of epigenetic modifications, and the role of epigenetics in health and diseases.

628. Biology of Aging. (3) Explores mechanisms of aging, and effects of aging on cellular and physiological processes in a range of organisms.

630. Land and Natural-Resource Management. (3) Provides a fundamental understanding of land and resource management. The major focus is on federal oversight and policies but state, local, non-profit, and international aspects are included.

631. Invertebrates. (4) Systematic study of invertebrates, with emphasis on functional morphology, behavior, ecology, and phylogeny.

633. Vertebrates. (4) Systematic study of vertebrates, with emphasis on evolution, physiology, behavior, and ecology. Laboratory devoted to systematic, field, and experimental studies.

635. Insect Biology. (4) Study of the diversity, structure, development, physiology, behavior, and ecology of insects.

635S. Insect Biology. (4) A five-week course taught during the summer. A study of the diversity, structure, development, physiology, behavior, and ecology of one of the most diverse taxa on earth. Course location and field trip destinations to be announced each summer. *P—POI*

636. Development. (3) A study of the molecular, cellular, and anatomical aspects of embryonic development or invertebrate and vertebrate organisms.

637. Development. (4) Lecture and laboratory study of the molecular, cellular, and anatomical aspects of embryonic development of invertebrate and vertebrate organisms.

638. Plant Systematics. (4) Study of the diversity and evolution of flowering plants. Lectures emphasize the comparative study of selected plant families, their relationships, and the use of new information and techniques to enhance our understanding of plant evolution. Labs emphasize more practical aspects of plant systematics such as the use of identification keys, recognition of common local plants, molecular techniques, and basic phylogenetic analysis.

639. Principles of Biosystematics. (4) Exploration of the current theoretical and practical approaches to the study of macroevolution in plants and animals. Topics include theory and methods of constructing evolutionary trees, sources of data, and cladistic biogeography.

640. Ecology. (4) Interrelationships among living systems and their environments, structure and dynamics of major ecosystem types, contemporary problems in ecology.

641. Marine Biology. (4) Introduction to the physical, chemical, and biological parameters affecting the distribution of marine organisms.

642. Aquatic Ecology. (4) Designed to cover the general principles and concepts of limnology and aquatic biology as they apply to lentic and lotic habitats. A major portion of the field studies centered at the Charles M. Allen Biological Station.

643. Tropical Ecology. (3) Exploration of the ecology, biodiversity, history, and future of tropical ecosystems. Lectures emphasize ecological principles and rely heavily on the primary literature.

644S. Tropical Marine Ecology. (4) Intensive field-oriented course focusing on tropical marine ecosystems and their biological communities. Emphasis is on biodiversity, the ecology of dominant taxa, the interaction between physical and biological processes, and the structure and function of representative communities. Includes 2.5 weeks at the Hofstra University Maine Laboratory, Jamaica. Offered during summer school only. (First term/Special term)

646. Neurobiology. (4) Introduction to the structure and function of the nervous system with emphasis on neurophysiology. The labs emphasize traditional electrophysiological techniques with experiments from the cellular to the behavioral level.

647. Physiological Plant Ecology. (3) Designed to provide a fundamental understanding of how plants have adapted to the stresses of their habitats, particularly in harsh or extreme environments such as deserts, the alpine, the arctic tundra, and tropical rain forests.

648. Physiological Plant Ecology. (4) Designed to provide a fundamental understanding of how plants have adapted to the stresses of their habitats, particularly in harsh or extreme environments such as deserts, the alpine, the arctic tundra, and tropical rain forests. The labs introduce students to a broad array of field instrumentation.

649S. Tropical Biodiversity. (4) Intensive field course in tropical biodiversity. Students travel to major tropical biomes, including deserts, glaciated peaks and rain forests. Lectures emphasize the basic ecological principles important in each ecosystem; labs consist of student-designed field projects. Course location varies yearly.

650. Conservation Biology. (3) Lectures, readings, and discussions examining biological resources, their limitations and methods for sustainability. Genetic, aquatic, terrestrial, and ecosystem resources are examined.

650L. Conservation Biology Lab. (1) Taught using the case study approach with an in-depth field study of the ecology and conservation of a particular ecosystem. Includes an extended field trip.

651. Vertebrate Physiology. (4) Lecture and laboratory course that examines the functional systems that sustain life in vertebrate animals.

652. Developmental Neuroscience. (4) Focuses on the development of neural structures and the plasticity of the mature nervous system. Special attention is given to experimental model systems, particularly *Drosophila melanogaster*. The labs feature molecular, immunocytochemical, and cell culture techniques for the study of neurons.

653. Functional Neuroanatomy. (3) An Introduction to the gross and cellular anatomical organization of the vertebrate central nervous system. Attention is given to relating structure to function, the anatomical basis of neuropathologies, and modern approaches on neuroanatomy and imaging.

654. Endocrinology. (3) Lecture course that explores the evolution of hormones and endocrine glands, and the physiology of the main hormonal pathways of vertebrates.

655. Avian Biology. (4) A lecture and lab course emphasizing ecological and evolutionary

influences on the physiology, behavior, and population biology of birds. Includes taxonomy of the world's major bird groups.

656. Ecology and Resource Management of Southeast Australia. (4) Intensive field-oriented course focusing on ecosystems, natural resource management and environmental conservation of southeastern Australia. Students travel to major biomes including sub-tropical rainforests, coral reefs and the Australian urban environment. Labs are field-based with some consisting of study-designed field projects. *Taught only in summers in Australia.*

657. Bioinspiration and Biomimetics. (3) Explores the way in which biological mechanisms can inspire new technologies, products, and businesses. The course combines basic biological and entrepreneurial principles. Also listed as ESE 657.

659. Genomics. (3) Introduction to the acquisition, analysis, and utility of DNA sequence information. Topics covered include structural, comparative, and functional genomics, genetic mapping, bioinformatics, and proteomics.

660. Development. (4) A description of the major events and processes of animal development, with an analysis of the causal factors underlying them. Special attention is given to the embryonic development of vertebrates, but consideration is also given to other types of development and other organisms. Topics include fertilization, early development, growth and cell division, cell differentiation, the role of genes in development, cell interaction, morphogenesis, regeneration, birth defects, and cancer.

661. Microbial Pathogenesis. (3) Explores the molecular mechanisms by which microorganisms attack hosts, how hosts defend against pathogens, and how these interactions cause disease.

662. Immunology. (3) Study of the components and protective mechanisms of the immune system.

663. Sensory Biology. (3) Lecture course that examines a variety of sensory systems. Emphasis is on sensory physiology, although other aspects of sensory systems, e.g. molecular biology and anatomy, are also covered.

664. Sensory Biology. (4) Lecture and lab course that examines a variety of sensory systems. The emphasis is on sensory physiology, although other aspects of sensory systems, e.g. molecular biology and anatomy, are also covered. In the laboratory, students learn several different procedures which they use to conduct assigned experiments. A final project is required in which students design and carry out their own experiments.

665. Biology of the Cell. (4) Lecture and lab course on recent advances in cell biology. Lectures emphasize analysis and interpretation of experimental data in the primary literature, focusing on topics such as the large scale architecture of the cell, targeting of macromolecules, cell-cell communication, cell signaling, and the control of cell division. The labs introduce basic techniques in cell biology and leads to an independent project.

667. Virology. (3) Designed to introduce students to viruses, viral/host interactions, pathogenicity, methods of control and their use in molecular biology, including gene therapy.

668. The Cell Biological Basis of Disease. (3) Examines some of the defects in basic cellular mechanisms that are responsible for many diseases.

669. The Cell Biological Basis of Disease. (4) Examines some of the defects in basic cellular mechanisms that are responsible for many diseases. The labs use advanced microscopic and histological techniques to investigate basic properties of cells.

670. Biochemistry: Macromolecules and Metabolism. (3) Lecture course introducing the

principles of biochemistry, with an emphasis on the experimental approaches that elucidated these principles. Major topics include structure, function, and biosynthesis of biological molecules, analysis of enzyme function and activity, bioenergetics, and regulation of metabolic pathways.

671. Biochemistry Macromolecules and Metabolism. (4) Lecture and lab course introducing the principles of biochemistry, with an emphasis on the experimental approaches that elucidated these principles. Major topics include structure, function, and biosynthesis of biological molecules, analysis of enzyme function and activity, bio-energetics, and regulation of metabolic pathways. The labs emphasize approaches for isolation of proteins and enzymes.

672. Molecular Biology. (4) Analysis of the molecular mechanisms by which stored information directs cellular development. Emphasis is on storage and transmission of genetic information, regulation of gene expression, and the role of these processes in development. The labs focus on modern techniques of recombinant DNA analysis.

673. Cancer Biology. (3) Analysis of molecular and cellular mechanisms that transform normal cells, trigger abnormal proliferation, and lead to tumor formation. Emphasis is on the biological basis of cancer, with some exploration of clinical and social consequences.

674. Neuropsychopharmacology. (3) An introduction to how pharmacological agents affect cellular and molecular functions in the nervous system of normal and disease states. Lecture and case studies will be used to examine topics including drugs targeting mood and emotion, memory and dementia, and movement disorders. Drugs of abuse and the neurological basis of addiction will also be evaluated.

675. Great Neglected Diseases of Mankind. (3) This course will examine various diseases and, particularly, those found in developing countries. Students will research these diseases, prepare a Power Point presentation on them, and write a comprehensive paper of each disease that will include clinical aspects of the diseases, treatments (if any), social and political aspects of the diseases, and evaluate why these diseases remain threats to mankind.

676. Biology of Fishes. (4) Comparative study of the structure/function, classification, and phylogeny of fish.

677. Community Ecology. (4) An advanced ecology course covering mechanisms that determine the dynamics and distribution of plant and animal assemblages: life-history, competition, predation, geology, climate, soils, and history. Lectures focus on ecological principles and theory. Labs include local field trips and discussion of primary literature. Several weekend field trips.

678. Biogeography. (3) Study of geographical, historical, and ecological influences on the distribution, movements, and diversity of organisms. The seminar relies on extensive reading, film, and map work as a basis for class discussions.

679. Introduction to Geographic Information systems (GIS). (4) Lecture and laboratory course that introduces the concepts and uses of GIS as a mapping and analytical tool. Lectures cover the history of GIS, GIS data structures and sources of data, map projections, GIS tools, applications, and resources. Exercises include examples of GIS applications in environmental modeling, socio-demographic change and site suitability analyses.

680. Biostatistics. (3) Introduction to statistical methods used by biologists, including descriptive statistics, hypothesis testing, analysis of variance, and regression and correlation.

681. Biostatistics Laboratory. (1) Application of computer-based statistical software. Optional laboratory available only to students who have taken or are currently enrolled in BIO 680.

691, 692, 693, 694. Research in Biology. (1, 1, 1, 1) Independent library and laboratory investigation carried out under the supervision of a member of the staff. May be repeated for credit. *P—POI*

701-708. Topics in Biology. (1-4) Seminar courses in selected topics, some involving laboratory instruction. At least one offered each semester. May be repeated for credit.

711, 712. Directed Study in Biology. (1, 1) Reading and/or laboratory problems carried out under and by permission of a faculty member. May be repeated for credit if topic varies.

715. Foundations of Physiology. (1-4) Covers classical and current topics and techniques in comparative physiology. Format varies from seminar to a full laboratory course.

716. Signal Transduction. (2) Focuses on the mechanisms of inter- and intracellular communication. Topics range from receptors to signaling molecules to physiological responses. Largely based on the primary literature and requires student presentation of primary research articles. *C. Browne, Muday, Tague*

717. Developmental Mechanisms. (2) Seminar course examining the molecular, biochemical, and cellular mechanisms of animal and/or plant development. Relevant topics selected from the current literature are discussed in lecture and presentation formats.

718. Gene Expression. (2) Seminar covers gene expression in eukaryotic and prokaryotic systems. Topics range from transcription to translation to other aspects of gene regulation. Emphasis is on the experimental basis for understanding the mechanisms of gene expression. Students present, in seminar format, appropriate papers from literature. All students participate in discussion and evaluation of presentations.

725. Plant Genetics. (1,2) Covers various aspects of plant genetics in a seminar format. Topics range from classical Mendelian genetics to genomics and bioinformatics, depending on the interests of the students. Students present the results, conclusions, and significance of appropriate papers from the literature. All students participate in discussion and evaluation of presentations.

726. Plant Physiology. (1, 2) Covers various aspects of plant physiology and hormones in a seminar format. Topics range from auxin transport to properties of light within the leaf. Students present the results, conclusions, and significance of appropriate papers from the literature. All students participate in discussion and evaluation of presentations.

727. Plant Evolution. (1,2) Covers various aspects of plant evolution in a seminar format. Topics range from problems in phylogeny reconstruction and patterns of diversity to major evolutionary innovations in various plant groups. Students present the results, conclusions, and significance of appropriate papers from the literature. All students participate in discussion and evaluation of presentations.

728. Plant Ecology. (1,2) Covers various aspects of plant ecology in a seminar format. Topics vary depending on graduate student interest. Students present the results, conclusions, and significance of appropriate papers from the literature. All students participate in discussion and evaluation of presentations.

730. Invertebrate Zoology. (4) Emphasis on the physiology and ecology of invertebrate animals.

736. Bioacoustics. (4) Analysis of the mechanisms of sound production, transmission, and reception and their relevance to animal orientation and communication.

740. Physiological Ecology. (4) Introduction to evolutionary/ecological physiology, with emphasis on the interactions between organisms and major abiotic factors of the environment including, water balance—hydration, gaseous exchange—respiration, temperature tolerance—thermal

physiology.

757. Techniques in Mathematical Biology. (3) Offers students a framework for understanding the use of mathematics in both biological theory and empirical research. Emphasis is on practical applications of mathematical techniques, and learning by doing. A central goal is to give students tools to use in their own research. Topics covered include continuous and discrete population models, matrix models, stochastic models, life-history theory, and fitting models for data. Mathematical skills are taught and refreshed, but knowledge of basic calculus is required.

762. Immunology. (4) Humoral and cellular immune responses are examined to understand the basic immunobiology of vertebrates with special emphasis on cell-cell interactions and immunoregulation. Labs introduce students to basic methods in immunological research.

763. Cellular and Molecular Interactions Between Hosts and Parasites. (3) Examines the responses of animal hosts in attempting to immunologically and non-immunologically reject/control both endo- and ecto-parasites and responses of these parasites to the host environment. Consists of lectures and student presentations and requires a comprehensive review article by students.

764. Sensory Biology. (4) Lecture and lab course involving a study of energy in the environment and how it is absorbed and transduced in sensory systems. Anatomical, physiological, biochemical, and biophysical approaches are integrated in the study of sensory mechanisms in plants and animals. A lab project implementing the scientific method and designed to produce new knowledge is required.

767. Foundations of Ecology. (3) A graduate seminar focusing on understanding the seminal developments in the field of ecology and then tracing their intellectual impacts on the modern literature.

775. Microscopy for the Biological Sciences. (4) Introduction to the various types of light, confocal, and electron microscopy. Students learn technical and theoretical aspects of microscopy, methods of sample preparation, digital image acquisition and analysis, and the preparation of publication quality images. Emphasizes practical applications of microscopy, microscopy experimental design, and hands-on use of microscopes and digital imaging systems. Students are expected to design and conduct a microscopy project and present their results to the class. Additionally, students are expected to participate in class discussions regarding newly emerging microscopy techniques in various biological disciplines.

777. Biophysical Ecology. (4) Designed to introduce students to the interactions of the organism with the physical environment. Sunlight, temperature, water availability and humidity, wind, and longwave radiation (greenhouse effect) strongly influence an organism's growth and reproductive potential. Differences in heat and mass transfer to and from the organism, plus corresponding organism responses in structure, physiology, and behavior to changes in the local environment, are addressed. These same principles are also important to the design of energy-efficient homes (passive solar), clothing design (Gortex), outdoor survival and gardening, to name only a few of humankind's everyday activities.

778. Advanced Ecology. (4) Covers current research in the field of ecology with a focus at the community level. Experimental design, data analysis, and interpretation are emphasized.

779. Molecular Techniques in Evolution and Systematics. (4) Lecture and lab course that explores molecular methods that are basic to many disciplines within biology, especially ecology, evolution, and systematics. Labs focus on the acquisition of molecular techniques, including allozyme electrophoresis, mitochondrial plasmid, and nuclear DNA restriction fragment length polymorphism analyses, gene amplification, PCR (polymerase chain reaction), direct and/or cycle sequencing, and RAPDS (randomly amplified polymorphic DNAs).

780. Advanced Systematics. (3) Literature-based course that covers various subdisciplines within systematics including cladistic biogeography, history and theory of systematics, analytical techniques and database management of systematic data.

782. Behavioral Ecology. (3) Lecture course analyzing behavioral solutions to challenges faced by animals in nature, emphasizing the role of natural selection in shaping behavior. Topics include mating systems, optimal foraging, sociobiology, parental care, and evolution of sexual reproduction.

783. Teaching Skills and Instructional Development. (3) Introduction to teaching college-level science courses. Emphasis is on: defining and achieving realistic course goals; mechanics of selecting, developing and refining topics for lecture or laboratory; effective presentation strategies; and creating an active learning environment. Students develop a teaching portfolio containing course syllabi, lecture outlines, and student-ready laboratory materials. Format combines didactic lectures, individual projects, and group discussions and critiques. Course meets for two, 2-hour periods each week.

791, 792. Thesis Research. (1-9) May be repeated for credit. *Satisfactory/Unsatisfactory*

891, 892. Dissertation Research. (1-9) May be repeated for credit. *Satisfactory/Unsatisfactory*

Biomedical Engineering (BMES) Track 7

Bowman Gray Campus

Track Director	Emmanuel Opara
Chair	Joel D. Stitzel
Professor	Craig A. Hamilton
Associate Professors	Satoru Hayasaka, Boris Pasche, Christopher Porada, Alexander Powers, Christopher Whitlow
Assistant Professors	Scott Gayzik, Jillian Urban Hobson, Robert A. Kraft, Adam R. Hall, Elaheh Rahbar, Ashley Weaver
Associate Faculty Members	Anthony Atala, Graca Almeida-Porada, Khalil Bitar, J. Daniel Bourland, Kerry Danelson, Dwayne Godwin, Satoru Hayasaka, Youngkyoo Jung, Paul Laurienti, Sang Jin Lee, Michael Morykwass, Michael Munley, Emmanuel Opara, Boris Pasche, Christopher Porada, Alexander Powers, Thomas Smith, Shay Soker, Thad Wadas, William Wagner, Christopher Whitlow, James Yoo

Overview

The Department of Biomedical Engineering offers PhD and MS degrees in biomedical engineering in conjunction with the joint degree program in the Virginia Tech–Wake Forest University School of Biomedical Engineering and Sciences (SBES). The program emphasizes medical applications, particularly in image and signal processing and analysis, regenerative medicine/tissue engineering, biomechanics, and medical physics. Qualified applicants should have undergraduate degrees in technical fields, including engineering, computer science, mathematics and physics. Additional training in life sciences is desirable but not essential.

The program consists of traditional classroom instruction, independent research with a mentoring team, and clinical experience. For the MS degree, students must take a minimum of 21-23 course credit hours and 7-9 hours in research for a minimum of 30 credit hours. For the PhD degree, 90 credit hours must be taken, of which 40-54 hours are dissertation research. Courses for

both degrees come from engineering and life science core courses and selected electives in engineering, life sciences, and related physical sciences. The program is very flexible, and selection of elective courses can be individualized to complement the student's background and interests; and offerings include courses in the physics, mathematics, and computer science departments.

A clinical rotation is offered to PhD students following their first year of study. Students are exposed to technical equipment with medical applications; and to patient care and procedures used in medical centers, thus providing relevance and context for their classroom studies and research.

Office and laboratory space are located throughout the Medical Center and include the Image Analysis Lab, the Movement Biomechanics Lab, the Tissue Mechanics Lab, the Center for Injury Biomechanics, the Wake Forest Institute for Regenerative Medicine, Radiation Oncology, Plastic and Reconstructive Surgery, and others. Facilities also include a chemistry lab and a machine shop with associated instrumentation and tools. Academic space is provided in the Magnetic Resonance Imaging Building. Computer and network facilities are state of the art, and several projects utilize the cluster computer facility, the DEAC Cluster. Associated labs in clinical and basic science departments also provide equipment for student research.

More information is available on the website, www.sbes.vt.edu. Prospective students are encouraged to contact individual faculty members or schedule a visit to the department.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Courses of Instruction

600. Mammalian Physiology. (4) Topics include cell biology, neurological and muscle physiology, autonomic nervous system, cardiovascular system, cardiac function and hormonal regulation, pulmonary system, renal system, endocrinology, gastrointestinal system, glucose and lipid storage.

602. Biomedical Engineering and Human Disease. (3) Comprehensive overview of a variety of human diseases, including neurological disorders, cardiovascular disease, infectious disease, and cancer, designed primarily for graduate students majoring in engineering and other related areas who have a long-term academic and professional goal in the field of biomedical engineering and life sciences. Introduction to state-of-the-art biomedical engineering approaches used for the study of early detection/diagnosis, treatment, and prevention of human disease. *P—BMES 600*

605. Quantitative Cell Physiology. (3) This course in mathematical modeling and simulation will include the following: quantitative descriptions of cell physiology and control pathways; numerical simulations of cellular physiologic processes such as, reaction kinetics, inhibition and cooperatively, passive transport, facilitated and carrier-mediated reaction kinetics; cell membrane resting potential in nerve and muscle tissue. Additionally, the course will cover modeling of neuronal processes such as voltage-gated channels, neurotransmitter release and uptake kinetics, and postsynaptic membrane potentials.

606. Quantitative Organ Systems Physiology (3) Mathematical modeling, simulation, quantitative description of organ physiology and control. Numerical simulation of cardiovascular physiologic processes including regulation of cardiac output, the baroreceptor - stroke volume model, venous return, and closed-loop control. Respiratory ventilation mechanics, gas exchange, pulmonary circulation, alveolar-capillary diffusion, and respiratory ventilation control. Nephron countercurrent mechanism and hemodialysis. Modeling of endocrine system functions. For SBES graduate students only. *P—MATH 5495/ESM 5725/BMES 5044 or equivalent.*

610. Engineering Analysis of Physiologic Systems I. (3) Engineering analysis of human physiology. Physiologic systems are treated as engineering systems with emphasis on input-output

considerations, system interrelationships and engineering analogs. Also studied are mass and electrolyte transfer, nerves, muscles and renal system. *P—POI*

611. Engineering Analysis of Physiologic Systems II. (3) Engineering analysis of human physiology. Physiologic systems are treated as engineering systems with emphasis on input-output considerations, system interrelationships and engineering analogs. Also studied are cardiovascular mechanics, respiratory system, digestive systems, and senses. *P—POI*

612. Musculoskeletal Biomechanics and Biologic Control. (3) Static and dynamic forces in the musculoskeletal system, joint reactions, and prosthetic joint design and replacement. Soft and hard tissue response to force loads. Muscle mechanics. Biomechanical lumped parameter systems: modeling and frequency response. Spatially distributed biomechanical models. Feedback control (closed-loop control) of biomechanical systems. *P—POI*

613. Biomechanics and Simulation of Movement I. (3) Key topics in movement biomechanics, including muscle physiology and mechanics, neural control, kinematic and dynamic modeling, and dynamic simulation. Discussion of real-life applications in medicine and sports, and practical experience using engineering equipment (motion capture and EMG) and software used in research and industry to analyze human movement.

614. Biomechanics and Simulation of Movement II. (3) Advanced topics in movement biomechanics and computational analyses of human movement, including advanced muscle modeling, motor control theories, dynamic simulation and optimization, and neural interfaces. Discussion of fundamental research underpinnings and clinical applications. Practical simulation labs and project-based explorations of dynamic analyses. *P—Graduate Standing (3H, 3C).*

616. Advanced Impact Biomechanics. (3) Review of impact biomechanics and critical investigation of the impact response of the human body. Participants study the dynamic response of the head, neck, chest, abdomen, upper and lower extremities. Real-world examples from automobile safety, military applications, and sport biomechanics. *P—POI.*

617. Biomechanics of Crash Injury Prevention. (3) Presents an introduction to the design and analysis of crash injury prevention methods in vehicle crashes. Encompasses three major focus areas: crash energy absorption in (1) the vehicle structure, (2) the occupant, and (3) the occupant restraints.

618. Injury Physiology. (3) Presents an introduction to the physiology of injury. Focuses on the pathophysiology, mechanisms, and outcomes of injury in mammalian tissues. Explores injury physiology at the organ, tissue, and cellular level. Topics include physiology of injury to tissues of the peripheral and central nervous systems, the musculoskeletal system, the pulmonary system, the abdomen, the pregnant female, and the eye.

620. Work Physiology. (3) Anthropometry, skeletal systems, biomechanics, sensorimotor control, muscles, respiration, circulation, metabolism, climate. Ergonomic design of task, equipment, and environment. *P—POI*

621. Human Physical Capabilities. (3) Examination of human physical attributes in human-technology systems, with emphasis on models of anthropometry and biomechanics, on intero- and exteroceptors, and on the work environment; force fields (transitory and sustained), sound, light, and climate. *P—POI*

624. Biofluids. (3) Fluid dynamics of physiological systems with focus on cardiovascular and respiratory systems. Addresses the heart, arterial blood vessels, airways; cardiac and pulmonary circulation; anatomy and function of the heart and respiratory systems; mechanics of soft tissues; basic

fluid mechanics; continuum mechanics and constitutive modeling; rheology of blood, Newtonian and non-Newtonian; viscous flow in vessels, Navier-Stokes; mathematical analysis of pulsatile flow; pulse-wave propagation through vessels; particulate flows and particle transport on airways. *P—POI*

630. Biological Transport Phenomena. (3) The fundamental principles of mass transport phenomena are introduced and applied to the characterization of transport behavior in biological systems (e.g. cell, tissues, organs, people). Topics include active, passive, and convective molecular transport mechanism. These fundamentals will be used to develop analytical and predictive models and describe phenomena such as oxygen transport, kidney function, systemic drug delivery, and design of extracorporeal devices. *P—Undergraduate courses in fluid mechanics and transport phenomena.*

631. Introduction to Regenerative Medicine I. (3) The course explores the current state of the field of regenerative medicine with specific emphasis on the technological challenges that limit the efficacy and clinical translation of engineered tissues and therapies. Course content will be presented from both the life science (e.g., cell biology, organ physiology, biochemical methods) and engineering perspective (e.g. transport phenomena, materials engineering) to compare and evaluate alternative approaches and strategies that are being developed and tested. Emphasis is placed on the promising roles of stem cells, biologically-inspired materials, and gene therapies. *P—Graduate standing or consent of instructor. Undergraduate biology and calculus are suggested.*

641. Biomaterials. (3) Lectures and problems dealing with materials used to mimic/replace body functions. Topics include basic material types and possible functions, tissue response mechanisms, and considerations for long-term usage. Issues of multicomponent materials design in prosthetic devices for hard and soft tissues are discussed.

642. Fundamentals of Tissue Structure, Function, and Replacement. (2) Descriptions of the structures of tissues such as skin, bone, ligament, cartilage, and blood vessels. Relationships between the structures of these tissues and their functions. Descriptions of the components of these tissues and their mechanical properties. Introduction to tissue mechanics and mathematical modeling of tissue behavior. Introduction to mechanical testing methods of hard and soft tissues. Methods for tissue replacement.

643. Polymeric Biomaterials. (3) The major objective of this course is to introduce principles and concepts critical to the successful design of polymer-based biomaterials, drug-delivery devices, and bio-implants. The course will be broken down into the following four areas, polymer design and processing, inflammatory responses to polymers, interaction of blood with polymeric materials, and the effect of mechanical, chemical, and surface properties of polymers on cells.

651. Digital Signal Processing. (3) The fundamentals of digital signal processing of data experimentally obtained from mechanical systems is covered. Attention is given to data acquisition, A/D conversion, aliasing, anti-aliasing filtering, sampling rates, valid frequency ranges, windowing functions, leakage, and various transform methods. Special attention is given to random, transient, and harmonic function data processing. Various methods of estimation of frequency response function (FRF) are explored. The estimation methods are assessed as to their impact on FRF estimation errors.

652. Stochastic Signals and Systems. (3) Engineering applications of probability theory, random variables and random processes. Time and frequency response of linear systems to random inputs using both classical transform and modern state space techniques.

655. Biomedical Signal and Image Processing. (3) The mathematical theory underlying the processing of one and two dimensional signals, including Fourier transforms, sampling, quantization, correlation, and filtering. For images, the topics of segmentation, restoration, enhancement, color,

and registration will be explored. Matlab projects will be utilized extensively, with an emphasis on biomedical signals and images.

671. Biomedical Microdevices. (3) Builds the foundation necessary for engineering research in micro- and nano- biotechnology. Covers micro- and nano-fabrication techniques; the fundamentals of microfluidics; micro- and nano-particle manipulation; and engineering aspects of cells and their membranes. Provides students with the knowledge required to create biomedical micro- and nano-devices with a focus on the unique physics, biology and design aspects at these scales. Students are expected to know undergraduate engineering, physics, and calculus.

693. Mathematica-A Hands On Course for Science and Engineering Students. (1) Mathematica is a high-level computer language and programming environment that allows one to perform a variety of tasks essential for a successful career in science and engineering. This course will provide students with a fundamental understanding of Mathematica and how to leverage its capabilities to accomplish a variety of tasks in their courses and research. For example, students will learn how to create figures in Mathematica suitable for publication, perform data analysis with Mathematica's built-in statistical functions, and create interactive documents and animations that can be shared with anyone. For more information on the capabilities of Mathematica students are encouraged to visit <http://www.wolfram.com/mathematica/>.

694. Seminar. (1) The focus of this course is on presentation of scientific work. Attendance at all SBES-sponsored, invited lectures is required. A minimum of 5 invited talks (i.e. no VT or WFU speaker affiliation) are to be attended by each student every semester, although these may not all be SBES-sponsored. Prior permission from the Course Director is required for all non-SBES talks to be applied to the 5 lecture requirement. First year graduate students are required to attend additional lectures aimed toward presentation skills, grant writing, and other special topics. Development of a grant application by all first year graduate students is also required.

697. Independent Study. (3) Opportunity to pursue a topic covered in a regular course in greater depth. Usually involves extensive reading and tutorial sessions with a faculty supervisor. Written papers may be required.

698. Special Study. (3) Designed for a group of students. It may be used to study a timely topic—one in which there is current, but not necessarily lasting interest. It also may be used to launch an experimental course before the course is incorporated into the regular curriculum.

706. Clinical Rotation. (2) Offers both a broad view of the use of engineering principles in medicine and general clinical care, together with an in-depth study of a particular aspect of medicine under the direct supervision of a physician. The student sees the operation and maintenance of various clinical modalities, systems, and devices under the guidance of a working engineer or technician. Students participate in clinical rounds and in image reading sessions to gain insight into the actual operation and needs of departments using medical imaging modalities.

708. Topics in Biomedical Engineering. (1-6) Topics in biomedical engineering that are not considered in regular courses. Content varies.

716. Computational Modeling in Impact Biomechanics. (3) Dynamic modeling of the human body subjected to impact loading. A combination of finite element analysis and multi-body simulation techniques. Utilizes software packages with dynamic solvers. Applications include computer-aided design for automobile safety, sports, biomechanics, and military restraint systems.

717. Advanced Human Modeling: Injury and Tissue Biomechanics. (3) Serves as a continuation of BMES 616 and BMES 716. It covers the basics of the finite element method as it applies to high-rate phenomenon. Focus is on practical problems and the use of commercial codes for solving

vehicle crash-worthiness and biomechanics problems. Real-world examples from biomedical engineering, automobile safety, military applications, and sport biomechanics are used to augment lecture material. *P—BMES 616 and 716.*

750. Medical Imaging I. (3) First part of a two-semester sequence that covers medical imaging modalities from an engineering and signal processing viewpoint. Included, however, is much of the underlying physics of the modalities. The course covers MR imaging, X-ray, and X-ray physics, and an introduction to computerized tomography. Topics include underlying physical processes, data acquisitions, sampling and quantization, and clinical applications. Each modality is reviewed in the context of its underlying physical processors as well as a common model describing such basic imaging parameters as resolution, contrast, and noise.

751. Medical Imaging II. (3) Study of several medical image modalities, including magnetic resonance (MR) imaging, positron emission tomography (PET), single photon emission computed tomography (SPECT), computer tomography (CT), and ultrasound; taught from signal processing point of view. Topics include an overview of the underlying physical processes, data acquisition, sampling, and quantization; image reconstruction techniques; relationships between the various modalities; and clinical and industrial applications.

759. Advanced Image Analysis. (3) An overview of current trends in image analysis with in-depth studies of topics particularly relevant to medical imaging. Students analyze and report on current literature. Computer-oriented projects allow students to implement several analysis algorithms. Topics include statistical parameter mapping, expectation maximization, Markov random fields, fuzzy set methods, and methods which incorporate prior knowledge. Emphasis is on defining image analysis problems in a cost minimization/optimization setting. Experience with an appropriate programming tool such as Matlab or IDL is required. A prior course in optimization is useful. *P—BMES 652.*

770. Radiation Therapy Physics. (3) The physics of radiation treatment including: radiation producing equipment, character of photon and electron radiation beams, radiation dose functions, computerized radiation treatment planning, brachytherapy, special radiation treatment procedures, quality assurance, and radiation shielding for high energy facilities.

771. Radiological Physics. (3) The nature and fundamental concepts of ionizing radiation including: ionizing radiation, radiation quantities, attenuation and stopping power, charged particle and radiation equilibria, radioactive decay, photon interactions, charged and uncharged particle interactions, x-ray production and quality, dosimetry concepts, Ionization cavity theory, and calibration of ionizing radiation beams. *P—POI*

773. Radiation Therapy Physics. (3) The physics of radiation treatment including: radiation producing equipment, character of photon and electron radiation beams, radiation dose functions, computerized radiation treatment planning, brachytherapy, special radiation treatment procedures, quality assurance, and radiation shielding for high energy facilities. *P—POI*

797, 798. Research. (1-9) *Satisfactory/Unsatisfactory*

Biomedical Informatics (BMI)

Bowman Gray Campus

Program Directors

Ralph D'Agostino and William Turkett

Degree Requirements

All students take a minimum of 34 semester hour credits in the analytical sciences. All students will be required to take 16 hours of core courses – 6 hours in biomedical informatics, 6 hours in statistics, and 4 hours of coursework in scientific professionalism and the responsible conduct of research.

These core courses include:

- BMI 701, 702 – Biomedical Informatics I and II
- MTH 657, 658 – Probability, Mathematical Statistics
- CPTS 703/704 or GRAD 713/714 – Ethics and Responsibility/Scientific Professionalism and Integrity

In addition to the core courses, an additional 12 hours of elective credit are required by all students. Students completing the project or thesis option will enroll in at least 6 hours of research credit, accumulating a minimum of 34 total credit hours. Students completing the coursework option will enroll in an additional 8 hours of elective coursework, accumulating a minimum of 36 total credit hours.

At least half of all coursework must be at the 700-level. Electives are offered in a variety of disciplines, including biomedical engineering, clinical and population translational science, computer science, mathematics and statistics, and molecular and cellular biosciences.

For Wake Forest undergraduate students pursuing the 4+1 variant, students begin the research or project aspects of the program during their senior undergraduate year and/or make use of excess hours beyond the 120 required for graduation with a Bachelor's degree to pursue courses applicable to the MS degree. The courses that students are suggested to take, if excess credit hours are available, are:

- Mathematics 657 or Mathematics 658: These courses fulfill the core conceptual material in the area of statistics and are taught on the Wake Forest University Reynolda campus.
- CSC 621, CSC 646, or any BMI approved Computer Science or Mathematics and Statistics courses. These courses work towards the elective and/concentration requirements for the degree and are taught on the Wake Forest University Reynolda campus.

Overview

The Master of Science in Biomedical Informatics degree is a full-time, graduate degree option that is designed to train and mentor students to become well qualified scientists and researchers within the domain of informatics as applied to biomedical data. Students learn in an interdisciplinary environment the quantitative and analytical methods necessary for understanding, evaluating, implementing, and using biomedical data and information. These methods can be applied to a variety of biomedical fields including imaging, genomics, clinical informatics, and public health informatics. Graduates from the program will be well positioned to work in the biotechnology, device, and pharmaceutical industries, private and government research labs, and academia.

A 4+1 option allows undergraduate Wake Forest University students to complete an undergraduate degree and the MS in Biomedical Informatics within five years through the incorporation of

research and coursework during the student's senior year.

Four areas of specialization, implemented via formal concentrations, are expected:

- Bioinformatics
- Clinical informatics
- Imaging informatics
- Public health informatics

Biomedical Science

Bowman Gray Campus

Faculty Members

The faculty of the program are graduate faculty members from Track 4 (Molecular and Cellular Biosciences), Track 5 (Integrative Physiology and Pharmacology), Track 6 (Neuroscience) and Track 7 (Biomedical Engineering). Students who enter directly into the MS in Biomedical Science outside of the track structure will be managed within the Graduate School under the direction of the Dean or program director appointed by the Dean.

Overview

The graduate program in Biomedical Science offers a program of study leading to the MS degree. This program is a full-time, graduate degree option that is designed to help students with a bachelor's degree, preferably with a major in the sciences, improve their academic foundation in the biomedical sciences and augment their credentials for admission into health professional programs, medical school, doctoral study in the sciences or entrance to the workforce. All students take a minimum of 30-36 semester hour credits in the basic sciences. Courses are in disciplines including: biochemistry, molecular cell biology, neuroscience, biomedical engineering, genetics, human physiology, microbiology, immunology, pharmacology, scientific professionalism and the responsible conduct of research. Elective credits, offered in a variety of disciplines, include other biomedical science courses. These electives improve critical thinking skills, study skills, and enhance the student's preparation for professional school application or entrance to the workforce.

Requirements for the MS Degree

- **Option 1 - MS Degree with Thesis:** requires 30 semester hours including 6 hours of thesis research in the student's chosen area of specialty and a successfully completed thesis.
- **Option 2 - MS Degree with Research Internship:** requires 30 semester hours including 4 - 6 hours of research under an advisor and a written report that summarizes the research. The report will be evaluated by the advisor, the Track Director in the student's area of specialty, and one other faculty member.
- **Option 3 - MS Degree with Project:** requires 30 semester hours and a written review of a topic agreed upon by the advisor and student. The review will be evaluated by the advisor, Track Director in the student's area of specialty, and one other faculty member.
- **Option 4 - MS Degree without Thesis, Internship or Project:** 36 course hours are required.

Students will select an area of specialization in either Track 4, 5, 6 or the pre-medical post-baccalaureate program. Students will be advised under the direction of the faculty director in their chosen area of concentration or specialization.

Area of Concentration:

- Neuroscience (Track 6)

Areas of Specialization:

- Molecular and Cellular Biosciences (Track 4)
- Integrative Physiology and Pharmacology (Track 5)
- Pre-medical post-baccalaureate

Courses of Instruction

701. Medical Career Path I (1) This course is designed for individualized career exploration, serve as an adjunct to career mentoring and provide students with a reasonable path/map for career goals. They will learn about professionalism, explore real life opportunities for building their professional portfolio and pathway to medical licensure and practice of medicine. *Satisfactory/Unsatisfactory*

702. Medical Career Path II (1) This course is designed as a continuation of individualized career exploration, serve as an adjunct to career mentoring and provide students with a reasonable path/map for career goals. They will learn about professionalism, explore real life opportunities for building their professional portfolio and pathway to medical licensure and practice of medicine. *Satisfactory/Unsatisfactory*

707, 708. Topics in Biomedical Science (1-6) This course will consider current topics in Biomedical Science that are not considered in regular courses. Course requirements and grading may be based on participation written assignments or hands-on projects. Content will vary.

795. Project. (1-6) A written review of a scholarly topic or project in biomedical sciences, developed in consultation with the student's advisor. *Satisfactory/Unsatisfactory*

Cancer Biology (CABI)

Bowman Gray Campus

Program Director	Steven Kridel
Chair	Boris Pasche
Professors	Yong Chen, William H. Gmeiner, Boris Pasche
Associate Professors	Steven Kridel, George Kulik, Hui-Wen Lo, Lance Miller,
Assistant Professors	Ravi N. Singh, Thad Wadas
Associate Faculty Members	Rebecca Alexander, Ulrich Bierbach, David Carroll,
	Waldemar Debinski, Purnima Dubey, Cristina Furdui, Patricia Gallagher,
	Martin Guthold, Karen Haas, Paul B. Jones, S. Bruce King, Gregory L. Kucera,
	King Li, Frank Marini, Linda Metheny-Barlow, Akiva Mintz, Aaron Mohs,
	David A. Ornelles, Timothy S. Pardee, Freddie Salsbury, Shay Soker, Ann Tallant,
	Pierre Triozzi, Mark Welker, Siqun Lilly Zheng, Xiaobo Zhou

Overview

The cancer biology graduate program was established in 1997. The graduate training program of the Department of Cancer Biology is designed to prepare students for future research careers focused on the issues relevant to human cancer. All applicants are required to have taken the general Graduate Record Exams prior to admission to the cancer biology graduate program. Subject tests are not required. Applicants must have completed college-level fundamental courses in biology, and general and organic chemistry. Courses in physics and mathematics through calculus are encouraged, but not required.

Students enter the Cancer Biology training program through the Molecular and Cellular

Biosciences (MCB) track. During the first year, in addition to the MCB common curriculum, students considering the Cancer Biology training program should consider taking one or more of the following electives: MCB721 *Carcinogenesis, DNA Damage and Repair*, MCB722 *Molecular Pathogenesis of Cancer*, and MCB723 *Topics in Cancer Biology*. If not taken as electives in Year 1, students matriculating in the Cancer Biology training program will be required to complete these courses in subsequent years. Additional course work in subsequent years will include *Advanced Topics in Cancer Biology*, *Statistical Experimental Design*, *Cancer Cell Biology*, *Tutorials in Cancer Biology*, and an elective course of the students' choice. Students also participate in the Cancer Biology seminar series.

Degree Requirements: please see "Requirements for Degrees" beginning on page 25.

MCB Track Electives

MCB721. Carcinogenesis, DNA Damage and Repair. (2) This course will cover the identification and reaction mechanisms of environmental carcinogens, DNA damage and mutagenesis by endogenous and exogenous agents, and the mechanisms of DNA repair. Offered fall.

MCB722. Molecular Pathogenesis of Cancer. (2) Fundamental molecular changes in cells and tissues that contribute to the malignant phenotype are discussed. Topics include alterations in genes and chromatin, signaling pathways, tumor cell metabolism, and the tumor microenvironment. Offered spring.

MCB725. Topics in Cancer Biology. (2) Teaches students how to evaluate and communicate scientifically in the area of cell biology and cancer. Examples are taken from all areas of cancer in this advanced course. Uses current peer-reviewed journal articles to teach fundamental concepts and act as a medium for allowing the students to communicate ideas with an emphasis on presentation skills. Offered spring.

CABI Advanced Courses

701, 702. Cancer Biology Seminar Series (1) The course will consist of weekly student and post-doctoral presentations to the Cancer Biology faculty and their peers based on their ongoing research projects. Required of all students who matriculate in Cancer Biology starting in their second years and continuing throughout their training period. Students and postdoctoral fellows will be expected to present at least once per year. Emphasis will be based on developing presentation skills and learning to critique colleagues in a professional manner. *Satisfactory/Unsatisfactory*

705. Cancer Cell Biology. (3) This is an intensive treatment to learn how to critically review the literature and requires the writing of a proposal that is critically reviewed. The course covers apoptosis, cell-cycle, angiogenesis, cancer genomics, metastasis, cancer immunology, and tumor suppressor genes. The translational aspects of research are emphasized.

707, 708. Topics in Cancer Lecture Series. (1) A weekly lecture series taken during the second year. Each week throughout the fall and spring semesters, a different topic in the clinical presentation, course, and treatment of human malignancies is presented. Designed to be a comprehensive overview of clinical oncology for clinical medical and radiation oncology fellows and cancer biology graduate students. *Satisfactory/Unsatisfactory*

711, 712. Advanced Topics in Cancer Biology. (1) Focuses on new and important aspects of research in cancer biology with an emphasis on the current literature. Themes are chosen by the course director and the students. A topic is selected for presentation by each student; with the help of the course director, the student prepares a short lecture to introduce the topic, assigns two key papers for participants to read, and provides a supplemental reading list. The following week, the

student leads a discussion of key experimental findings. Broad participation from faculty, postdoctoral fellows, and graduate students is encouraged. *Satisfactory/Unsatisfactory*

713, 714. Cancer Biology Tutorials. (2) Focuses on specific topics related to cancer predisposition, development, progression, and treatment. Topics include, but are not limited to, DNA damage and repair, damage signaling, cell death response, cell cycle checkpoint control, animal models and cancer treatment. The purpose of the tutorial is to provide an opportunity to discuss one of the above-mentioned topics in more detail than is possible in an overview-based lecture. The topic for upcoming semesters will be determined by the faculty. The class is a combination of lectures providing background information and student presentations introducing specific topics and related research articles in the field, followed by group discussions. Attendance and at least one full length presentation are mandatory to obtain credit.

716. Special Topics: Teaching in the Small Group Setting. (2) Teaches students how to use a problem-based interactive approach to facilitate student self-learning. Introduces students to general methods of teaching with a focus on teaching in the small group setting of a literature-based course. Topics covered include teaching skills for reading scientific papers, oral presentation techniques, and scientific writing. Each student facilitates two weeks (4 class sessions) of the course including in-class participation as well as assisting with the written evaluation portion of the class.

718. Introduction to Radiation Biology. (3) Focuses on the biological changes which follow the interaction of ionizing and non-ionizing radiation with living matter. Emphasis is on the role of ionizing radiation in the treatment of cancer, mechanisms of radiation-induced carcinogenesis, and changes in normal and tumor cells at the molecular, cellular and tissue levels.

723, 724. Research in Cancer Biology. Opportunities for investigation in a variety of the facets of cancer biology under the guidance of staff members. *Satisfactory/Unsatisfactory*

Chemistry (CHM)

Reynolda Campus

Program Director	Patricia C. Dos Santos
William L. Poteat Professor of Chemistry and Chair	Mark E. Welker
John B. White Professor of Chemistry	Willie L. Hinze
Ranlet and Frank Bell Jr. Faculty Fellow and Thurman D. Kitchin	
Professor of Chemistry	Dilip K. Kondepudi
Professors	Rebecca W. Alexander, Uli Bierbach, Christa L. Colyer, Bradley T. Jones, Abdessadek Lachgar, Akbar Salam
Associate Professors	Lindsay R. Comstock, Paul B. Jones, Patricia C. Dos Santos
Assistant Professors	Michael Gross, Scott Geyer, Amanda C. Jones

Overview

The Department of Chemistry offers programs of study leading to the MS and PhD degrees. Opportunities for study in courses and through research are available in analytical, biological, inorganic, organic, and physical chemistry. Research plays a major role in the graduate program. Since the number of graduate students is limited, the research program of the individual student is enhanced by close daily contact with the faculty.

All applicants for graduate work in the department are expected to offer as preparation college-level fundamental courses in general, analytical, organic, inorganic, and physical chemistry; physics;

and mathematics through one year of calculus. During registration all new graduate students take qualifier examinations covering the fields of analytical, biological, inorganic, organic, and physical chemistry. Programs of study are in part determined by the results of these examinations, and deficiencies are to be remedied during the student's first academic year.

For the MS degree, the student is expected to undertake a broad program of coursework at an advanced level and to complete successfully an original investigation. This investigation must be of the highest quality but necessarily limited in scope. Students who hold assistantships normally spend two years in residence for the completion of this degree.

For the PhD degree, individual programs are designed for each student under the guidance of the student's faculty adviser and advisory committee and with the approval of the graduate committee.

The University preliminary examination requirement is satisfied by successful completion of a series of written cumulative examinations and by presentation of two research proposals, one of which is the dissertation research project. Each student is to present two departmental seminars, one of which will be on the results of his or her dissertation research. The student must present a dissertation and pass an examination on it as prescribed by the Graduate School, and other University requirements must be satisfied.

The chemistry program participates in the Interdisciplinary Graduate Track in Structural and Computational Biophysics. For more information, refer to the pages in this bulletin regarding the program.

The original graduate program, which led to the MS degree, was discontinued in 1949. The present MS program was begun in 1961, the PhD in 1972.

Graduate courses offered by the Department of Chemistry are from the following list. Not all courses are offered every year.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Courses of Instruction

623. Organic Analysis. (4) The systematic identification of organic compounds.

625, 626. Organic Synthesis. (4, 4) Reagents for and design of synthetic routes to organic molecules.

634. Chemical Analysis. (3 or 4) Theoretical and practical applications of modern methods of chemical analysis. *C—CHM 641*

641, 642, 644. Physical Chemistry. (3 or 4) Fundamentals of physical chemistry.

648. Electronic Structure Theory and Computational Chemistry I. (3) Introduction to quantum mechanical foundation of electronic structure theory and its application to problems in computational chemistry.

651. Special Topics in Biochemistry. (3) Fundamentals of biochemistry, with particular emphasis on mechanistic analysis of metabolic pathways, enzymatic activity, and drug action.

656, 657. Chemical Spectroscopy. (1.5, 1.5) Fundamental aspects of the theory and application of chemical spectroscopy, as found in the areas of analytical, inorganic, organic, and physical chemistry. Emphasis varies. Seven week courses. *P—CHM 642 or 644, 661, or POI. May be repeated for a maximum of 3 hours each.*

661. Inorganic Chemistry. (3 or 4) Principles and reactions of inorganic chemistry. *C—CHM 641*

666. Chemistry and Physics of Solid State Materials. (3) Describes basic principles of solid state

chemistry. Focuses on the design, synthesis, structure, chemical, and physical properties and the application of solid state materials. The relationships between electronic structure, chemical bonding, and crystal structure are developed. Case studies are drawn from materials for energy generation and storage, e.g. batteries and fuel cells, and from emerging technologies, e.g., nano- and biomaterials.

664, 664L. Materials Chemistry. (3, 1) A survey of inorganic-, organic-, bio-, and nano-materials, including hybrid materials and applications. *P—CHM 641 or POI*

670. Biochemistry: Macromolecules and Metabolism. (3) A lecture course introducing the principles of biochemistry, with emphasis on the experimental approaches that elucidated these principles. Major topics include structure, function, and biosynthesis of biological molecules, analysis of enzyme function and activity, bioenergetics, and regulation of metabolic pathways.

673. Biochemistry: Protein and Nucleic Acid Structure and Function. (3) Special topics in biochemistry, including catalytic mechanisms of enzymes and ribozymes, use of sequence and structure databases, and molecular basis of disease and drug action. *P—CHM 670 or POI*

681, 682. Chemistry Seminar and Literature. (.5, .5) Discussions of contemporary research and introduction to the chemical literature and acquisition of chemical information. *Pass/Fail*

701. Advanced Physical Chemistry. (3) An accelerated survey of classical and statistical thermodynamics, chemical kinetics, and quantum chemistry.

711, 712. Directed Study in Chemistry. (1 or 2, 1 or 2) Reading and/or lab problems carried out under supervision of a faculty member. *P—Permission of graduate committee. May be repeated for credit if topic varies.*

721. Advanced Organic Chemistry. (3) An accelerated survey of organic reactions and mechanisms.

722. Physical Organic Chemistry. (3) Physical methods for determining structure-activity correlations and reaction.

723. Transition-Metal Organic Chemistry. (3) Introduction to principles of bonding in organo-metallic chemistry and organometallic reaction mechanisms. Uses of transition-metal complexes in organic synthesis.

724. Organic Synthesis. (3) Modern principles of organic synthesis and retrosynthetic analysis. Stereoselective synthesis of complex natural products.

725. Structure Identification in Organic Chemistry. (3) Theory and use of spectroscopic techniques for structural identification of organic compounds.

726. Reactive Intermediates. (3) Mechanistic and preparative photochemistry. Structure and chemistry of excited states, free radicals, carbenes, and selected ions.

735. Spectrochemical Analysis. (3) Principles of atomic and molecular spectrometric methods; discussion of instrumentation, methodology, and applications.

736. Chemical Separations. (3) Theory and practice of modern separation methods with emphasis on gas and liquid chromatographic techniques.

737. Electrochemical Processes. (3) Principles of electrochemical methods, ionic solutions, and electrochemical kinetics.

738. Statistics for Analytical Chemistry. (3) Practical investigation of the statistical procedures employed in modern analytical chemistry.

739. Special Topics in Analytical Chemistry. (3) The study of topical fields of research in analytical chemistry, with a focus on one or more specialties, such as ICP-MS; fluorescence; LIBS; Raman spectroscopy; nanoparticles in analysis; biosensors; or others. May be repeated for credit if course content differs.

740. Drug Discovery, Design, and Development—Molecules to Medicines. (3) Conducted as a combination of lectures, reading assignments, and student-led discussions. Examines drug discovery and development pathways from target and lead compound identification through metabolic and toxicology studies, clinical trials, FDA approval, and marketing. Regulatory processes, intellectual property, and ethical issues are also considered. Taught by WFU faculty from both the Reynolda and Bowman Gray campuses and colleagues in the pharmaceutical and biotechnology industries, students work in teams to present case studies on the discovery, development, and marketing of recently approved pharmaceuticals. Also listed as BICM 740. *P—Organic chemistry and biochemistry.*

745. Statistical Thermodynamics. (3) The application of statistical mechanics to chemistry to understand and predict the thermodynamic properties.

746. Chemical Kinetics. (3) Kinetics and mechanisms of chemical reactions; theories of reaction rates.

747. Self-Organization in Nonequilibrium Chemistry. (3) Study of the phenomena of self-organization, such as oscillations, multistability, propagating waves, and formation of spatial patterns. Kinetic systems with autocatalysis will be studied using bifurcation theory and other methods of non-linear systems.

751. Biochemistry of Nucleic Acids. (1.5-3) Advanced survey of the structure, reactivity, and catalytic properties of RNA and DNA, including modern experimental techniques. Current literature will be presented and critically evaluated.

752. Protein Chemistry. (1.5-3) Advanced survey of the structure, reactivity, and catalytic properties of RNA and DNA, including modern experimental techniques. Current literature will be presented and critically evaluated.

753. Chemical Biology. (3) Survey of the origins and emerging frontiers of chemical biology, with a focus on the impact of chemical methods on our understanding of biology. Topics include protein design, chemical genetics, and methods in genomics and proteomics research.

755 Biomolecular Mass Spectrometry: Fundamentals and Applications. (1.5-3) Designed for graduate and advanced undergraduates focusing on the principles of mass spectrometry and use in the analysis of small molecules, peptides, proteins, and nucleic acids. Covers sample preparation, data acquisition and interpretation, database searching, and quantification of molecules using a variety of techniques. *P—Biochemistry*

756. Biomolecular NMR. (1.5) One-half semester course designed for graduate and advanced undergraduates focusing on NMR of small oligonucleotides and proteins. Covers sample preparation, data acquisition and processing as well as generating solution structures from NMR data. A student should have command of 1D acquisition and processing as well as experience with 2D acquisition and processing before taking this class. All computational exercises involve some familiarity with the UNIX operating system. *P—POI*

757. Macromolecular Crystallography. (1.5) One-half semester course designed for graduate and advanced undergraduates focusing on structural characterization of macromolecules utilizing X-ray crystallography. Covers sample preparation, diffraction theory, data acquisition and processing as well as structure solution and refinement techniques. *P—CHM 656 highly recommended.*

761. Chemistry of the Main Group Elements. (3) Principles of bonding, structure, spectroscopy, and reactivity of compounds of the main group elements. Synthesis and applications of organometallic compounds of the main group.

762. Coordination Chemistry. (3) Theory, structure, properties, and selected reaction mechanisms of transition metal complexes. Design and synthesis of ligands and their applications in bioinorganic chemistry.

764. Chemical Applications of Group Theory and Symmetry. (3) Symmetry, group theory, bonding, and spectroscopy. Applications to structure, stereoisomers, multicenter bonding and symmetry-controlled reactions.

765. Bioinorganic Chemistry. (3) The inorganic chemistry of life. a) Metals in biocatalysis: elucidation of structure and function of metalloenzymes by various spectroscopic and molecular biology methods; biomimetic ligands; synthetic models of active sites. b) Metals and toxicity. c) Inorganic compounds in therapy and diagnosis.

771. Quantum Chemistry. (3) The quantum theory and its application to the structure, properties, and interactions of atoms and molecules. Theoretical and computational approaches.

791, 792. Thesis Research. (1-9, 1-9). *Satisfactory/Unsatisfactory*

829. Tutorial in Organic Chemistry. (3)

830. Heterocyclic Chemistry. (3) Survey of the major groups of heterocyclic compounds. Modern applications of heterocycles.

831. Principles of Chemical Carcinogenesis. (3) Fundamental chemistry of carcinogenesis. Survey of the chemistry and structure of carcinogenic compounds. Defense and chemotherapeutics.

832. Theoretical Organic Chemistry. (3) Molecular orbital treatment of structure and reactivity of organic molecules with emphasis on the applications of MO theory in pericyclic and photochemical reactions.

833. Advanced Reaction Mechanisms. (3) Detailed analysis of mechanisms with emphasis on characterization of transition state structure.

838. Advances in Analytical Chemistry—Luminescence Spectroscopy. (3) Instrumentation, methods, and applications of molecular luminescence spectroscopy.

839. Tutorial in Analytical Chemistry. (2 or 3)

843. Tutorial in Advanced Kinetics. (3)

844. Tutorial in Thermodynamics/Statistical Mechanics. (3)

848. Lasers in Physical Chemistry. (3) Survey of lasers and their use to study physical-chemical processes. Topics include types of lasers, range of spectral and temporal operation, methods of detection, and application to specific chemical problems.

849. Tutorial in Chiral Asymmetry in Chemistry and Physics. (3) Chiral asymmetry in nuclear, atomic, and molecular interactions. General group theoretic approach to spontaneous chiral symmetry breaking and the study of specific mechanisms.

861. Applications of Electrochemistry. (3) Determination of inorganic and organic reaction mechanisms, electrochemical synthesis, applications to materials science.

862. Special Topics in Coordination Chemistry. (3) Selected applications of transition metal chemistry such as in paramagnetic resonance (NMR, EPR), bioinorganic chemistry, and industrial

processes.

863. Crystallography. (3) Crystal structure determination using powder and single crystal X-ray diffraction.

864. Modern Chemical Spectroscopy. (3) Applications of vibrational, rotational, electronic, and nuclear spectroscopy to current problems in chemistry.

865. Metallopharmaceuticals. (3) Design and mechanism of metal-containing pharmaceuticals in cancer therapy and diagnosis.

869. Tutorial in Inorganic Chemistry. (3)

871. Advanced Quantum Chemistry. (3) Advanced quantum mechanical methods for the investigation of electronic structure and radiation-molecule interaction.

879. Tutorials in Theoretical Chemistry. (3)

888. Dependent Proposal. Course requires a written document detailing the Ph.D. project and an oral exam covering the basic chemical principles, foundation of the plan and experimental design. Pass/Fail. Must be taken before the 6th semester of residence.

891, 892. Dissertation Research. (1-9, 1-9). May be repeated for credit. *Satisfactory/Unsatisfactory*

Clinical and Population Translational Sciences (CPTS)

Bowman Gray Campus

Program Co-Directors

Bob Byington and Kathryn Weaver

Division Director

Gregory L. Burke

Professors

Walter Ambrosius, William Applegate, Nancy E. Avis, Ronny A. Bell, Michael Berry, Alain G. Bertoni, Donald Bowden, Gregory L. Burke, Robert P. Byington, L. Douglas Case, Ralph B. D'Agostino Jr., Debra Diz, Douglas Easterling, Mark A. Espeland, Mark A. Hall, David Herrington, William G. Hundley, Nancy King, Dalane Kitzman, Stephen Kritchevsky, Carl Langefeld, Paul Laurienti, Yongmei Liu, Michael E. Miller, Timothy M. Morgan, Barbara Nicklas, Mary Claire O'Brien, Michael O'Shea, Katherine Poehling, Sara A. Quandt, Steve Rapp, Beth A. Reboussin, David M. Reboussin, Scott Rhodes, Sally A. Shumaker, Beverly Snively, John Spangler, Mara Vitolins, Lynne E. Wagenknecht, Jeff Williamson, Mark Wolfson, Jianfeng Xu

Associate Professors

Sharon Castellino, G. Haiying Chen, Laura H. Coker, Suzanne Danhauer, Jasmin Divers, Matthew Edwards, Gregory Evans, Emily Gower, Kathleen Hayden, Jason Hoth, Denise K. Houston, Tim Howard, Fang-Chi Hsu, Wei Lang, Iris Leng, Shannon Mihalko, David Miller, Carlos Rodriguez, Kaycee Sink, Joseph Skelton, Elsayed Soliman, Erin Sutfin, Janet Tooze, Kathryn Weaver

Assistant Professors

Daniel Beavers, Teresa Cutts, Capri Foy, Sabina Gesell, Wei Lang, Iris Leng, Michael McCrory, Nicholas Pajewski, Joseph Yeboah

Overview

The master of science degree in Clinical and Population Translational Sciences is administered through the Division of Public Health Sciences and the Translational Science Institute. The CPTS Program is open to individuals who already hold or are pursuing advanced degrees, such as the MD, DVM, ScD, PhD, DDS, DSN, MMS (Physician Assistant), or MSN who are seeking training in the

clinical and population aspects of translational research. The program also may be appropriate for qualified applicants with at least a BA or BS in a social science, public health, or other health-related field, although additional post-baccalaureate coursework may be required. For applicants without an advanced degree, previous experience in a health-related field is required.

The purpose of this program is to assist students in developing competencies (theoretical/conceptual, methodology, statistics) required for the conduct of clinical and population research and the translation of knowledge gained from such research into improved human health. Developing translational research skills is vital for the future success of researchers in the basic science and health professions. Translational research includes two areas of translation. One is the process of applying discoveries generated during laboratory research, and in preclinical studies, to the development of trials and studies in humans. The second area of translation concerns research aimed at enhancing the adoption of best practices in health care settings and the community. This program focuses on clinical research and the second area of translational research described above. (Of note, the graduate program in Molecular Medicine focuses on the first area of translation described above.)

Clinical and population research comprises studies and trials in human subjects including:

- Patient-oriented research. Research conducted with human subjects (or on material of human origin such as tissues, specimens and cognitive phenomena) for which an investigator (or colleague) directly interacts with human subjects;
- Epidemiologic and behavioral studies; and
- Outcomes research and health services research.

While a minimum of twelve months of full-time work or its equivalent in residence is required for the master's degree, this program normally requires two years. In addition to coursework, all students complete a thesis project under the direction of a thesis committee. Students may initiate original data collection or analyze existing data sets. It is feasible to extend the program from two to three years. Students may matriculate only at the beginning of the fall semester each year.

The master of science degree in clinical and population translation science was initiated in the fall of 2008. It is one of a small number of similarly structured master's degree programs in the U.S., placing it on the cutting edge of graduate education.

In addition to the master of science degree, an abbreviated CPTS Certificate is also available for students who do not have time to complete a thesis. The purpose and entrance requirements are identical to the master's program. Although a thesis is not required, students will need to complete at least 15 hours of CPTS coursework, complete ethics training requirements and demonstrate competency in basic biostatistics.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Courses of Instruction

703. Ethics and Responsibility in Clinical and Population Translational Science I. (1) Provides students with an overview of topics related to ethics and the responsible conduct of human subjects research. Students utilize a case-based format to address such topics as: study oversight and research design, informed consent, selection of subjects, conflicts of interest, the social effects of research, the use of embryos, fetuses and children in research, genetic research, and authorship and publication of study findings. Students are required to complete the Collaborative Institutional Training Initiative (CITI) Human Research On-Line Curriculum as part of this course. *P—POI; Satisfactory/Unsatisfactory*

704. Ethics and Responsibility in Clinical and Population Translational Science II. (1) Provides

students with an overview of topics related to ethics and the responsible conduct of human subjects research. Students utilize a case-based format to address such topics as: study oversight and research design, informed consent, selection of subjects, conflicts of interest, the social effects of research, the use of embryos, fetuses and children in research, genetic research, and authorship and publication of study findings. Students are required to complete the Collaborative Institutional Training Initiative (CITI) Human Research On-Line Curriculum as part of this course. *P—CPTS 703 or POI; Satisfactory/Unsatisfactory*

705. Team Science Practicum in Clinical Translational Science. (3) Provides students with practical hands-on experience working on a collaborative, multidisciplinary translational study. Students from the molecular medicine and the clinical and population translational science programs work together in teams assigned to ongoing projects in the Translational Science Institute. Students become familiar with the study protocol and procedures, including mechanisms for protection of animals or human subjects. Students participate in study conduct, review and interpretation of study data, and prepare a written report and oral presentation describing the practicum experience. *P—POI*

720. Epidemiology. (4) Provides students with a foundation in the history, concepts, and methods of epidemiology. Topics include measurement of exposure to disease, prevalence, incidence, association, and sensitivity/specificity analyses. Measurement error, bias, confounding, effect modification, causality, and policy implications are discussed. The following observational study designs are reviewed: cross-sectional, cohort, ecological, and meta-analysis. Includes a weekly 1h problem solving laboratory. *P—POI*

730. Introduction to Statistics. (4) The course is an introduction to statistical concepts and basic methodologies that are prevalent in biomedical literature. It includes discussion topics such as descriptive statistics, probability, sampling distributions, hypothesis testing, simple linear regression, correlation, one-way analysis of variance, categorical data analysis, survival analysis, sample size and power analysis, and nonparametric methods. Access to SAS Enterprise Guide required. *P—POI*

732. Applied Linear Models. (4) The topics of the course include statistical concepts and basic methodologies related to the general linear model and its extensions. The basic statistical procedures discussed in the course include simple and multiple linear regression, analysis of variance and covariance, logistical regression, and repeated measures analysis. Emphasis is given to proper application and interpretation of statistical methods and results. Access to SAS Enterprise Guide required. *P—CPTS 730 or POI*

741. Research Grant Preparation. (3) Provides students with the knowledge and skills to develop grant proposals to pursue funding in their areas of interest. Topics covered include: the role of external funding in biomedical research; how to identify public and private sources of funding; required components of grant submission; and human subjects and budgeting considerations. Students develop a research proposal for peer review and critical discussion. *P—POI*

742. Clinical Trial Methods. (3) Provides students with knowledge of clinical trials methodology from Phase I through Phase IV and beyond. Topics include: why trials are needed; specification of the trial question(s); basic trial designs; identification of the appropriate study population, interventions, and response variables; the randomization process; masking; sample size; data analysis; recruitment/retention/adherence; trial monitoring and interim analyses; assessing/reporting adverse effects; interpreting trial results; meta-analyses; and post marketing surveillance. *P—POI*

747. Topics in Cancer Survivorship Research. (1) Provides students with an overview of topics related to cancer survivorship. Topics include: epidemiology of cancer survivorship, quality of life

issues, cancer and the family, disparities in morbidity and mortality, late effects of cancer treatment, ethical issues, complementary and alternative medicine, symptom management, behavioral and lifestyle issues post-treatment, health services research, and special populations. Course may be repeated for credit. *P—POI*

748. Population Research Methods I (2) The course will focus on the development of integrated aims, literature reviews, and conceptual frameworks that provide the necessary foundation for successful community and health delivery translational research. To provide students with the opportunity to expand their ability to develop and communicate research concepts, the course will include numerous in-class activities and several written assignments.

749. Population Research Methods II. (4) The course explores how study designs are selected and examines specific application of these designs within the community and health delivery settings. The latter part of the course focuses on measurement, with emphasis on the development of data collection forms and surveys. To provide students with the opportunity to expand their ability to develop and communicate research concepts, the course will include in-class activities plus a presentation and written assignments.

760. Topics in Clinical and Population Translational Sciences. (1-6) Seminar and/or lecture course on selected topics of current interest in clinical and population translational sciences not currently covered in the same depth in other courses.

766. Individual Study in Clinical and Population Translational Science. (1-4) Provides students with opportunities to pursue advanced topics in their individual areas of interest with guidance from expert faculty. May be repeated for credit. *P—POI*

Communication (COM)

Reynolda Campus

Program Director	Alessandra Von Burg
Chair	Allan D. Louden
University Distinguished Professor of Communication Ethics	Michael J. Hyde
Professors	Mary Dalton, Sandra Dickson, Michael David Hazen, Woodrow Hood, Marina Krcmar, Ananda Mitra, Randall G. Rogan
Associate Professors	Steven Giles, John Llewellyn, Alessandra Von Burg (Director of Graduate Studies), Margaret D. Zulick
Assistant Professors	Jarrod Atchison (Director of Debate), Mollie Canzona, Jennifer Priem, Ron Von Burg
Professor of Practice	Peter Gilbert (Documentary Film)
Associate Teaching Professors	Cindy Hill and Cara Pilson (Documentary Film)
Assistant Teaching Professor	David Stokes Piercy
Associate Professor of Practice and Head Debate Coach	Justin Green
Associate Debate Coach	Ken Strangel
Senior Lecturer	Dee Oseroff-Varnell
Lecturer	T. Nathaniel French
Manager of Communication/Media Laboratory	Ernest S. Jarrett
Adjunct Professor of Practice (Bio-Ethics)	Richard Robeson

Overview

The Department of Communication offers graduate study leading to the MA degree. Students who enroll for the master's degree are expected to have a strong undergraduate background and rationale for graduate work in communication. The program is designed as a PhD preparation program. Most students will require two academic years to complete the program. The graduate program is associated with the Bioethics and Documentary Film graduate programs. Students have the opportunity to take classes in those areas as well. The program began in 1969.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Thesis Option

The minimum requirement is 33 semester hours of work, six of which are allotted for the thesis. The program requires a core of courses in research methodology and then allows students to take courses in context areas such as health communication, intercultural communication, interpersonal communication, mass communication, organizational communication, and public communication. In addition, the department provides work in communication ethics, communication technologies, and argumentation. A program of study should include 6 hours of thesis work and a minimum of 27 hours of coursework, of which 6 hours may be in electives outside the department. At least 18 of the 27 hours of coursework must be in courses numbered 700 or above. Credits for up to 6 hours of graduate work can be transferred from another institution.

All students must demonstrate competence in a research skill relevant to their thesis and/or professional goals. Most students demonstrate their competency in empirical methodology or critical methodology; however, a foreign language also may be elected.

Comprehensive Examination Option

Students are required to complete 33 semester hours of coursework. At least 24 of the 33 hours required for the degree must be in courses numbered 700 or above. The remaining 9 hours may be in either 600-level or 700-level courses. A program of study can include 6 hours of coursework in electives outside the department. This includes credit for as many as 6 hours of graduate work transferred from another institution. Students will be required to successfully complete a comprehensive examination at the end of completing the 33 hours of coursework. Students are required to indicate their desire to take a comprehensive examination by the end of the first year of graduate work.

Courses of Instruction

600. Classical Rhetoric. (3) Study of major writings in Greek and Roman rhetorical theory from the Sophists to Augustine. Offered in alternate years.

601. Semantics and Language in Communication. (3) Study of how meaning is created by sign processes. Among the topics studied are language theory, semiotics, speech act theory, and pragmatics.

602. Argumentation Theory. (3) Examination of argumentation theory and criticism; emphasis on both theoretical issues and social practices.

604. Freedom of Speech. (3) Examination of the philosophical and historical traditions, significant cases, and contemporary controversies concerning freedom of expression.

605. Communication and Ethics. (3) A study of the role of communication in ethical controversies.

606. Burke & Bakhtin Seminar. (3) Examines the language theories of Kenneth Burke and Mikhail Bakhtin in relation to contemporary rhetorical theory.

610. Advanced Media Production. (3) Special projects in audio and video production for students with previous media production experience. *P—POI*

612. Film History to 1945. (3) Survey of the developments of motion pictures to 1945; includes lectures, readings, reports, and screenings.

613. Film History since 1945. (3) Survey of the development of motion pictures from 1946 to present day; includes lectures, readings, reports, and screenings.

614. Media Effects. (3) Theoretical approaches to the role of communication in reaching mass audiences and its relationship to other levels of communication.

615. Communication and Technology. (3) Exploration of how communication technologies influence the social, political, and organizational practices of everyday life.

616. Screenwriting. (3) Introduction to narrative theory as well as examination of the role of the screenwriter in the motion picture industry, the influence of genre on screenwriting, and exploration of nontraditional narrative structures. Students complete and original, feature-length screenplay.

617. Communication and Popular Culture. (3) Explores the relationship between contemporary media and popular culture from a cultural studies perspective using examples from media texts.

619. Media Ethics. (3) Examines historical and contemporary ethical issues in the media professions within the context of selected major ethical theories while covering, among other areas, issues relevant to: journalism, advertising, public relations, filmmaking, and media management.

620. Media Theory and Criticism. (3) Critical study of media including a survey of major theoretical frameworks.

630. Communication and Conflict. (3) Review of the various theoretical perspectives on conflict and negotiation as well as methods for managing relational conflict.

635. Survey of Organizational Communication. (3) Overview of the role of communication in constituting and maintaining the pattern of activities that sustain the modern organization.

636. Organizational Rhetoric. (3) Explores the persuasive nature of organizational messages—those exchanged between organizational members and those presented on behalf of the organization as a whole.

637. Rhetoric of Institutions. (3) A study of the communication practices of institutions as they seek to gain and maintain social legitimacy.

638. 20th-Century African-American Rhetoric. (3) Explores how African Americans have invented a public voice in the 20th century. Focuses on how artistic cultural expression, in particular, has shaped black public speech.

639. Practices of Citizenship. (3) Explores the history and theory of citizenship as a deliberative practice linked to the rhetorical tradition of communication with an emphasis on participatory and deliberative skills as part of the process in which communities are formed and citizens emerge as members.

640. Public Discourse I. (3) Examines the interrelation of American rhetorical movements through the 19th century by reading and analyzing original speeches and documents, with emphasis on antislavery and women's rights.

641. Public Discourse II. (3) Examines the interrelation of American rhetorical movements in the 20th century by reading and analyzing original speeches and documents. Among the movements addressed are labor, civil rights, student radicals, and women's liberation.

642. Political Communication. (3) Study of electoral communication including candidate and media influences on campaign speeches, debates, and advertising. Offered in alternate years.

643. Presidential Rhetoric. (3) Examines theory and practice of speechmaking and mediated presidential communication. Offered in alternate years.

650. Intercultural Communication. (3) Introduction to the study of communication phenomena between individuals and groups with different cultural backgrounds. Offered in alternate years.

651. Comparative Communication. (1.5, 3) Comparison of communicative and rhetorical processes in the U.S. with one or more other national cultures with an emphasis on both historical and contemporary phenomena. a) Japan; b) Russia; c) Great Britain; d) Multiple countries. Offered in alternate years.

654. International Communication. (3) In-depth look at the role of mass media in shaping communication between and about cultures using examples from traditional and emerging media systems.

655. Health Communication. (3) Examination of theories, research, and processes of health communication in contemporary society. May be repeated for credit.

656. Health Communication: Patient-Provider. (3) Explores contemporary issues related to communication in health care contexts, notably theories and research on patient-provider communication.

657. Health Communication Campaigns. (3) Examination of the principles behind designing, implementing, and evaluating a health campaign, including message design and application of media theories for behavior change.

670. Special Topics. (1-4) Examination of topics not covered in the regular curriculum.

680. Great Teachers. (3) Intensive study of the ideas of three noted scholars and teachers in the field of communication. Students interact with visiting scholars during visits to Wake Forest.

719. Theory and Research Design in Communication Science. (3) Examination of communication science theory with a focus on critiquing and utilizing theory in research, accompanied by an overview of quantitative research design and methodology.

720. Quantitative Analysis in Communication Science. (3) Overview of statistical data analysis, interpretation, and reporting for communication research. *P—COM 719*

753. Seminar in Persuasion. (3) Study of contemporary social science approaches to persuasion theory and research. Influence is examined with interpersonal, social, and mass media contexts.

758. Rhetorical Theory. (3) Introduction to primary texts in the theory of rhetoric including classical theories, dramatism, semiotics, and critical/cultural studies.

759. Rhetorical Criticism. (3) The critical application of rhetorical theories aligning with the traditions covered in Communications 758. *P—COM 758*

763, 764. Proseminar in Communication. (1.5, 1.5) Introduction to graduate study in communication.

773. Seminar in Interpersonal Communication. (3) Study of recent research and theoretical developments in dyadic communication. Methodology examined includes conversational analysis, field, and experimental approaches.

774. Research and Theory of Organizational Communication. (3) Advanced study of theoretical approaches to the role of communication in organizations and empirical application of such

theories.

780. Special Seminar. (1-3) Intensive study of selected topics in communication. Topics may be drawn from any theory or content area of communication and offer a wide variety of special topics across a two year program. May be repeated for credit for a maximum of 12 hours.

781, 782. Readings and Research in Speech Communication. (1-3, 1-3) Students may receive credit for a special reading project in an area not covered by regular courses or for a special research project not related to the master's thesis. May be repeated for credit for a maximum of 16 hours.

791, 792. Thesis Research. (1-9). May be repeated for credit. *Satisfactory/Unsatisfactory*

Comparative Medicine (COMD)

Bowman Gray Campus, Friedberg Campus

PATHOLOGY (SECTION ON COMPARATIVE MEDICINE)

Program Director	J. Mark Cline
Section Head	Jay R. Kaplan
Professors	J. Mark Cline, Christopher Jerome, Jay R. Kaplan, Nancy D. Kock, Thomas C. Register, Carol A. Shively Matthew J. Jorgensen
Associate Professor	
Assistant Professors	David I. Caudell, Kylie Kavanagh,

Overview

The section on comparative medicine in the Department of Pathology offers a program leading to the MS degree in Comparative Medicine for individuals with a professional degree (DVM or MD). The MS degree has been offered since 1964.

Research is an important facet of departmental activities, and research training is emphasized in its educational programs. Investigative efforts focus on animals as models of human disease and the use of animals in biomedical research. Major interests include cardiovascular disease (especially atherosclerosis), cancer biology and risk assessment, diabetes and obesity, behavioral biology such as depression and anxiety, women's health/reproductive medicine, nutrition, comparative pathology, radiation countermeasures, and substance abuse.

There is an active interest in the biology and diseases of nonhuman primates as translational surrogates for the study of human diseases. A colony of approximately 1,000 nonhuman primates of several species is maintained to provide ample opportunity for students interested in nonhuman primate biology. In addition, specialized colonies of rodents and other species are also used in conjunction with other biomedical research programs at Wake Forest University. A full description of research interests may be found by linking to the Center for Comparative Medicine Research, which is supported by the Medical School and serves as an institution-wide research resource that develops and applies animal models – especially nonhuman primates – to diseases of human relevance.

Degree Requirements: please see “Requirements for Degrees” beginning on page 25.

Courses of Instruction

703. Diseases of Laboratory Animals. (3) Naturally occurring diseases of laboratory animals are considered in depth. Lectures are organized by animal species and are designed to emphasize the prevalence and physiological and pathological expression of both infectious and metabolic/

degenerative diseases. Additional emphasis is on the diagnosis and management of these diseases in the laboratory animal facility. Special topics, including disease surveillance, zoonoses, and strain differences in disease susceptibility, are also presented. Offered in even-numbered years. *P—DVM or MD degree or POI.*

706. Animal Models in Biomedical Research. (3) Designed to provide the student with the current knowledge about animal models used in biomedical research. The major disease problems of man are discussed by organ system. For each disease problem, the advantages and disadvantages of animal models in current use are discussed. Both experimentally induced and naturally occurring diseases of animals are considered. Offered in odd-numbered years. *P—POI*

708. Medical Primatology. (3) Acquaints the student with the biology, laboratory management, behavior, and diseases of the nonhuman primates of biomedical interest. Emphasis is on both: a) the clinical manifestations, diagnosis, and management of diseases that are the principal causes of morbidity and mortality in laboratory primates; and b) those aspects of social structure and colony management that contribute to susceptibility and resistance to such diseases. Course considers issues relating to the psychological well-being of laboratory primates. *P—POI*

709, 710. Advanced Topics in Comparative Medicine. (Credit to be arranged, 1-5) An advanced lecture and student participation course dealing with areas of new knowledge in comparative medicine. *P—General biochemistry, general pathology, or equivalents.*

711, 712. Comparative Pathology Conference. (1, 1) Necropsy cases are presented and discussed by postdoctoral fellows and staff. Management of current medical problems and the comparative aspects of the materials presented are emphasized.

713, 714. Research. Research in a variety of topics in comparative medicine, including research in preparation for the master's thesis and the doctoral dissertation. *Satisfactory/Unsatisfactory*

Computer Science (CSC)

Reynolda Campus

Program Director	William Turkett
Chair	Peter Santago
Emeritus Reynolds Professor	Robert J. Plemmons
Professors	Jennifer J. Burg, Errin W. Fulp, David J. John, Peter Santago
Associate Professors	Daniel A. Cañas, V. Paúl Paca, Stan J. Thomas, Todd C. Torgersen, William H. Turkett Jr.
Assistant Professor	Samuel S. Cho

Overview

The department offers a program of study leading to the Master of Science degree in computer science. The program is designed to accommodate students seeking a terminal MS degree or preparation for entering a PhD program.

In addition to the graduate school admission requirements, students entering the graduate program must have completed computer science coursework in the areas of: 1) programming in a modern high-level language, 2) basic computer organization and architecture, 3) data structures and algorithms, and 4) principles of operating systems and networks. Students should also have completed mathematics courses equivalent to: 1) differential and integral calculus including infinite series, 2) discrete mathematics, 3) linear algebra, and 4) probability and statistics.

The courses CSC 631, 641, 702, and 721 are identified as the core courses for the MS degree and are required of all students. The complete requirements for the MS degree may be fulfilled in one of three ways.

The MS degree with thesis requires thirty semester hours including six hours of thesis research (CSC 791, 792) and a successfully completed thesis. The coursework must include the twelve-hour core. The remaining twelve hours are selected from computer science courses with at least six of these hours from 700-level courses other than CSC 791, 792, and 795.

The MS degree with project requires thirty-six semester hours including three hours of project research (CSC 795) and a successfully completed project. The coursework must include the twelve-hour core. The remaining twenty-one hours are selected from computer science courses with at least six of these hours from 700-level courses other than CSC 791, 792 and 795.

For the MS degree without thesis or project, thirty-six semester hours are required. The coursework must include the twelve-hour core. The remaining hours are selected from computer science courses with at least six of these hours from 700-level courses other than CSC 791, 792 and 795.

With the approval of the graduate adviser, graduate courses may be taken outside of the department to fulfill requirements; however, no more than six such hours may count toward the degree.

Students in the program may apply to participate in the Interdisciplinary Graduate Track in Structural and Computational Biophysics. The specific requirements are found in this bulletin under the courses of instruction. On successful completion of this track, a student will earn an MS degree in computer science (thesis option) with a Certificate in Structural and Computational Biophysics.

Current information on the program and links to faculty interests can be accessed on the Web at <http://college.wfu.edu/cs/>.

Degree Requirements: *please see “Requirements for Degrees” beginning on page 25.*

Courses of Instruction

611. Computer Architecture. (3) In-depth study of computer systems and architecture design. Topics include processor design, memory hierarchy, external storage devices, interface design, and parallel architectures.

621. Database Management Systems. (3) Introduction to database management systems. Topics include data independence, database models, query languages, security, integrity, and transactions.

622. Database Management and Analytics. (3) Management, analysis, and visualization of large-scale data sets. Topics include key-value databases, distributed file systems, map-reduce techniques, similarity measures, link analysis, and clustering. *P—CSC 621.*

631. Software Engineering. (3) Study of fundamental topics in software engineering including software processes, agile software development and project management, requirements engineering, system modeling, design patterns and implementation, and software testing. Students practice software engineering principles through team projects.

632. Mobile and Pervasive Computing. (3) Study of the fundamental design concepts and software principles underlying mobile and pervasive computing, including mobile interface design, data management, mobile networks, location aware computing, and mobile security. Involves significant programming on modern mobile platforms.

633. Principles of Translators for Compilers and Interpreters. (3) Study of techniques for translating high-level programming languages to a target language. Typical target languages include Java

bytecode and assembly language. Topics include lexical analysis, parsing, intermediate representations, language semantics, code generation, and optimization.

641. Operating Systems. (3) Study of the different modules that compose a modern operating system. In-depth study of concurrency, processor management, memory management, file management, and security.

643. Internet Protocols. (3) Study of wide area connectivity through interconnection networks. Emphasis is on Internet architecture and protocols. Topics include addressing, routing, multicasting, quality of service, and network security.

646. Parallel Computation. (3) Study of techniques for parallel and high performance computing. Topics include an overview of modern high-performance computer design, pipelining, concurrency, data dependency, shared memory, message passing, and graphics processors. Select parallel algorithms and methods for asymptotic scalability analysis are also presented. Assignments may include coding with OpenMP, MPI, and the CUDA library.

648. Computer Security. (3) Introduction to computer security concepts and associated theory. Detailed coverage of the core concepts of access control, cryptography, trusted computing bases, digital signatures, authentication, network security, and secure architectures. Legal issues, security policies, risk management, certification and accreditation are covered in their supporting roles. Students will learn to analyze, design, and build secure systems of moderate complexity.

652. Numerical Linear Algebra. (3) Numerical methods for solving matrix and related problems in science and engineering using a high-level matrix-oriented language such as MATLAB. Topics include systems of linear equations, least squares methods, and eigenvalue computations. Special emphasis given to applications. Credit not allowed for both CSC 652 and MTH 626.

655. Introduction to Numerical Methods. (3) An introduction to numerical computations on modern computer architectures; floating point arithmetic and round-off error including programming in a scientific/engineering language such as MATLAB, Cor Fortran. Topics include algorithms and computer techniques for the solution of problems such as roots of functions, approximations, integration, systems of linear equations and least squares methods. Credit not allowed for both MTH 655 and CSC 655.

661. Digital Media. (3) Study of the mathematics and algorithms underlying digital sound, image, and video manipulation. Topics may include sampling and quantization, resolution, filters, transforms, data encoding and compression, multimedia files types and transmission, 3D printing, and digital media in multimedia and web programming.

663. Computer Graphics. (3) Study of software and hardware techniques in computer graphics. Topics include line and polygon drawing, hidden line and surface techniques, transformations, and ray tracing.

665. Image Processing Fundamentals. (3) Study of the basic theory and algorithms for image enhancement, restoration, segmentation, and analysis.

671. Artificial Intelligence. (3) Introduction to problems in artificial intelligence. Topics may include knowledge representation, heuristic search, formal logic, planning, robotics, machine learning, intelligent agents, and pattern recognition.

685. Bioinformatics. (3) Introduction to bioinformatics and computing techniques essential to current biomedical research. Primary focus is gene and protein sequence and structure databases and algorithms for sequence and structure analysis. Emphasizes interdisciplinary interaction and communication. Also listed as PHY 685.

687. Computational Systems Biology. (3) Introduction of concepts and development of skills for comprehension of modern systems biology research problems, including both biological and computational aspects. Topics may include microarrays, protein interaction networks, large-scale proteomics experiments, and algorithms and computational approaches for modeling, storing, and analyzing the resulting data sets. Emphasizes interdisciplinary interaction and communication.

691. Selected Topics. (1, 2, 3) Topics in computer science that are not studied in regular courses or which further examine topics begun in regular courses. *P—POI*

693. Individual Study. (1 or 2) Independent study directed by a faculty adviser. By prearrangement. May be repeated for credit.

702. Theory of Computation. (3) Basic theoretical principles of computer science. Topics include the relationship between automata and grammars, Church's thesis, unsolvability, and computational complexity.

721. Theory of Algorithms. (3) Design and analysis of algorithms. Topics may include time and space complexity analysis, divide-and-conquer algorithms, the fast Fourier transform, NP-complete problems, and efficient algorithms for operations on lists, trees, graphs, and matrices.

726. Parallel Algorithms. (3) A thorough, current treatment of parallel processing and supercomputing. Modern high-performance commercial architectures, parallel programming, and various supercomputing applications are discussed. Hands-on experience is emphasized. Students are given access to a variety of machines.

731. Compiler Optimization. (3) Design and implementation of optimizing compilers. Optimization techniques, parallelizing transforms, and comparative examples from the literature. *P—CSC 633*

743. Topics in Operating Systems. (3) Issues in operating system development; resource management, queuing theory, concurrent processing, and languages for operating system development. *P—CSC 641*

753. Nonlinear Optimization. (3) The problem of finding global minimums of functions is addressed in the context of problems in which many local minima exist. Numerical techniques are emphasized, including gradient descent and quasi-Newton methods. Current literature is examined and a comparison made of various techniques for both unconstrained and constrained optimization problems. Credit not allowed for both MTH 753 and CSC 753. *P—CSC or MTH 655*

754. Numerical Methods for Partial Differential Equations. (3) Numerical techniques for solving partial differential equations (including elliptic, parabolic and hyperbolic) are studied along with applications to science and engineering. Theoretical foundations are described and emphasis is on algorithm design and implementation using either C, FORTRAN or MATLAB. Also listed as MTH 754. Credit not allowed for both MTH 754 and CSC 754. *P—CSC 655 or MTH 655.*

765. Image Processing. (3) Advanced techniques in image processing including image formation and corruption models, digitization, Fourier domain methods, enhancement, restoration, and tomographic reconstruction. *P—CSC 721*

766. Pattern Recognition. (3) Study of statistical pattern recognition techniques and computer-based methods for decision-making, including discriminant functions, feature extraction, and classification strategies. Emphasis is on applications to medical image analysis. *P—POI*

767. Computer Vision. (3) Techniques for extracting features from images: optimal thresholding, 2D and 3D feature measurement, graph isomorphism and graph matching methods. *P—CSC 766*

775. Neural Networks. (3) Design of artificial neural networks. Introduction to the relevant

neurophysiology, feedforward networks, recurrent networks, and applications to pattern recognition and optimization.

779. Topics in Artificial Intelligence. (3) Advanced topics in artificial intelligence. Individual projects are assigned. *P—CSC 671.*

781. Computer Science Seminar. (0) Discussions of contemporary research. No credit.

790. Advanced Topics in Computer Science. (3) Advanced topics of current interest in computer science not covered by existing courses. *P—POI*

791, 792. Thesis Research. (1-9). May be repeated for a maximum of 18 hours each. *Satisfactory/Unsatisfactory*

795. Project. (3). *Satisfactory/Unsatisfactory*

Counseling (CNS)

Reynolda Campus

Program Director

Donna A. Henderson

Professors

Samuel T. Gladding, Donna A. Henderson, Jose A. Villalba

Associate Professors

Debbie W. Newsome, Mark B. Scholl

Assistant Professors

Erin E. Binkley, Philip B. Clarke, Jamie Crockett, Seth C.W. Hayden,

Nathaniel N. Ivers, Jennifer L. Rogers, Katherine Ziff

Assistant Teaching Professors

Cheyenne Carter, Tammy H. Cashwell, Allison Forte,

J. Robert Nations, Shannon P. Warden

Clinical Program Manager

Carla Emerson

Overview

The master of arts in counseling degree is awarded to candidates who successfully complete a minimum of sixty semester hours in a planned and directed program of study. The program consists of a common core of courses to provide knowledge in eight areas: human growth and development, social and cultural foundations, helping relationships, group work, career and lifestyle development, appraisal, research and program evaluation, and professional orientation. The program also supplies clinical instruction with practicum and internship experiences. In addition, students must select a program specialty area-school counseling or clinical mental health counseling-in which they complete their internships and take courses that assure at least entry-level competence.

Admission to the Programs. Admissions decisions are based on consideration of a combination of criteria: college grade-point average, Graduate Record Examination scores, recommendations, professional commitment, work or volunteer experience in the human services field, and suitability for the profession. Applicants being considered for admission are required to have a personal interview with program faculty. Candidates for the counseling programs are not required to have a specific undergraduate major or minor. Candidates for the MAHS program are not required to have a specific undergraduate major or minor.

Criminal Background Check. Acceptance to the program will be contingent on the successful completion of a criminal background check. The background check is standardized and mandatory for all students. Any student who has a criminal offense documented through this procedure will have to address this on a case-by-case basis with the Program Director and Department Chair. Areas of concern may include, but are not limited to, felony convictions, especially those involving harm to others, theft or fraud convictions, and patterns of misdemeanors other than moving traffic

violations.

Continuance in the program and admission to candidacy are based on success in academic courses and on personal, ethical, and performance considerations.

Graduates are eligible to sit for the National Certified Counselor examination. Those who complete the school counseling program are eligible to apply for licensure with the public schools of North Carolina.

On Campus and On-line Programs

There are two counseling programs offered through the Department of Counseling: the school counseling program and the clinical mental health counseling program. Both programs are offered on campus and via online delivery systems. The Department of Counseling also offers a masters of arts in human services which is offered via the online delivery system only. The campus programs are for full-time students and take two years to complete. Applications are accepted for entry into the on campus programs for the fall semester only. The online programs are for part-time students and take three years to complete. Applications are accepted for entry in the online programs for the fall, spring and summer semesters. Course and admissions requirements for on campus and online students are the same.

Course Requirements

The master of arts degree in counseling is awarded to candidates to successfully complete a minimum of 60 hours in a planned and directed program of study. Courses required by the program cannot be taken as Pass/Fail.

MASTER OF ARTS IN COUNSELING - SCHOOL COUNSELING

The school counseling program provides prospective school counselors with the knowledge, skills, and competence necessary to establish and conduct effective developmental guidance and counseling programs in schools, kindergarten through the 12th grade. The course of study which leads to a license in school counseling in North Carolina is based on the requirements of the North Carolina Department of Public Instruction and is accredited by the National Council for Accreditation of Teacher Education and by the Council on Accreditation of Counseling and Related Educational Programs (CACREP). School counseling students are not required to hold a teacher's license to enter the program.

MASTER OF ARTS IN COUNSELING - CLINICAL MENTAL HEALTH

In the clinical mental health program, students are prepared for counseling in a wide variety of community settings and agencies. The course of study is accredited by the Council on Accreditation of Counseling and Related Educational Programs (CACREP).

MASTER OF ARTS IN HUMAN SERVICES (ONLINE ONLY)

The Masters of Arts in Human Services degree is offered by the Department of Counseling via online delivery only. The degree will be awarded to candidates who successfully complete a minimum of 39 semester hours in a planned and directed program of study. The program consists of 30 hours of courses in common with the Masters in Counseling program, an additional 6 hours of specialized study in human services administration and programming, and 3 hours of field experience. At present, the Master of Arts in Human Service degree is offered only in an online delivery system. The MAHS degree takes seven semesters to complete. Applications are accepted for entry in the online programs for the fall, spring and summer semesters.

Residency Requirements

Two Thursday night through Sunday at noon residency experiences are required for online classroom students. These face-to-face sessions will allow faculty to engage in competency and readiness evaluations as well as to plan and evaluate practicum and internship arrangements. Students will also complete the experiential group requirements at this time. Dates will be announced six months in advance.

Courses of Instruction (All courses listed are open to counseling students only unless otherwise noted.)

721. Research Analysis in Counseling. (3) Qualitative and quantitative research methods. Analysis and evidence-based evaluation of research-based literature in the counseling field. Grant writing. Program evaluation. Descriptive, inferential, parametric and non-parametric statistical procedures involved in research.

723. Statistical Analysis for the Helping Professions. (3) Descriptive, inferential, and non-parametric statistical procedures involved in research. Computer methods for statistical analysis.

736. Appraisal Procedures for Counselors. (3) Appraisal, assessment, and diagnosis of personality, emotional, intellectual, and learning characteristics and disorders of clients in schools, colleges, and community human service agencies. Use of tests in counseling as an adjunct to clinical impressions.

737. Basic Counseling Skills and Techniques. (3) Basic communication skills, helping relationships, and strategies for personal change. Issues and ethics in counseling.

738. Counseling Practicum. (3) Supervised experience for the development of individual and group counseling skills under individual and group supervision in a school or community agency. Involvement in direct service work and activities similar to those of regularly employed professional staff. Individual and group supervision of practicum experiences. *P—EDU737*

- a. School
- b. Clinical mental health

739. Advanced Counseling Skills and Crisis Management. (3) Topics covered will be advanced and specialized counseling interventions including crisis intervention, suicide prevention, and emergency management models. Students will be required to demonstrate appropriate skill level. *P—CNS 737*

740. Professional Orientation to Counseling. (3) Covers the history, roles, organizational structures, ethics, standards, specializations, and credentialing in the profession of counseling. Public policy processes and contemporary issues are also considered.

741. Theories and Models of Counseling. (3) Study of theories and approaches to professional counseling: psychoanalytic (Freud, Adler, Jung), person-centered (Rogers), existential (May, Frankl), behavioral (Skinner, Glasser), cognitive/rational (Ellis), holistic/systemic, eclectic. Professional orientation, issues, ethics, cultural pluralism, and trends in counseling.

742. Group Procedures in Counseling. (3) An experiential and conceptual exploration of the psychological dynamics and interpersonal communication of small groups, including group structure, leadership models, group process and practice, stages of group development, group techniques, and ethical principles.

743. Career Development and Counseling. (3) Vocational development throughout life; psychological aspects of work; occupational structure and the classifications of occupational literature; theories of vocational choice and their implications for career counseling.

744. Counseling Internship I. (2-3) Supervised counseling experience in a school, college, or clinical mental health agency under a regularly employed staff member professionally trained in

counseling and in supervision. Active participation in direct service work to clients. Monitoring of audio or videotaped interviews. Case review. *P—CNS 738*

- a. School
- b. Clinical mental health

745. Counseling Internship II. (2-3) Supervised counseling experience in a school, college, or clinical mental health agency under a regularly employed staff member professionally trained in counseling and in supervision. Active participation in direct service work to clients. Monitoring of audio or videotaped interviews. Case review. *P—CNS 744*

- a. School
- b. Clinical mental health

746. Counseling Children. (3) Theory and practice of counseling with children in schools and community agencies. Elementary school counseling; models, methods, and materials. Counseling children with special emotional, learning, psychological, or behavioral concerns.

747. Cultures and Counseling. (3) The influence of culture in human development and in counseling relationships. A study of personal and ethnic diversity and commonality.

748. Life Span Development: Implications for Counseling. (3) Examination of major theories and principles of human development across the life span, including physical, psychological, intellectual, social, and moral perspectives.

749. School Guidance and Counseling. (3) The organization and management of comprehensive school guidance and counseling programs. Individual and group counseling, consultation, coordination, and collaboration in student services in schools. Program development in elementary, middle, and secondary schools.

750. The Vienna Theorists—Freud, Adler, Moreno and Frankl. (3) Examination of the original writings of four of the leading theorists of modern counseling, which is enhanced by a visit to the city in which they initially formulated their clinical ideas. Students read and discuss several original writings of each practitioner—Freud, Adler, Moreno, and Frankl—prior to and during a two-week stay in the Wake Forest University Flow House in Vienna during which they visit relevant historical sites and institutes.

752. Human Services Administration (3) This course will focus on the knowledge, theory, and skills used in the administrative aspects of the human services delivery systems including organizational management, supervision, strategic planning, budgeting, grant and contract negotiation, and legal/regulatory issues. The course also covers managing the professional development of staff, recruiting and managing volunteers, and advocacy techniques. *P—CNS 737, 741, 742*

753. Human Services Program Planning and Evaluation (3) This course will focus on the range and characteristics of human services delivery systems and major conceptual models used to integrate prevention, maintenance, intervention, and rehabilitation and healthy functioning. The course includes the history of human services as well as the systematic analysis of service needs. The course also covers the selection of strategies, services or interventions and the evaluation of outcomes. *P—CNS 737, 741, 742.*

754. Human Services Fieldwork (3) Field experience is a learning experience in a human services delivery organization in which the student will complete 350 hours of on-site volunteer work with an agency. Students, university supervisors, and on-site partners will determine the student's role, activities, outcomes, and instructional needs based on placement site possibilities. *P—CNS 752, 753.*

755. Counseling Internship III. (2) Supervised counseling experience in a school, college, or clinical mental health agency under a regularly employed staff member professionally trained in counseling and in supervision. Active participation in direct service work to clients. Monitoring of

audio or videotaped interviews. Case review. *P—CNS 745*

- a. School
- b. Clinical mental health

758. Studies in Educational Leadership. (3) This course includes examination of contemporary leadership theory and its various applications in education. It includes field work and reflections (Service Learning). *P—EDU 664L*

760. Issues in School Counseling. (3) Designed to allow students to investigate current issues related to the practice of school counseling. Emphasis is on identifying appropriate prevention responses to these issues.

762. Issues in Clinical Mental Health Counseling. (3) Examines specific issues related to clinical mental health counseling including, but not limited to, reimbursement, outcome evaluation, advocacy strategies, clinical mental health counselor roles and functions.

763. Specialized Study in Counseling. (1-3) Exploration of special topics or areas of practice in the field of counseling.

- a. School Guidance and Counseling
- b. College Student Development Services Counseling
- c. Mental Health Counseling
- d. Marriage and Family Counseling
- e. Business/Industry Counseling
- f. Correctional Counseling
- g. Career Counseling
- h. Rehabilitation
- i. Adult Development/Aging
- j. Religious Counseling
- k. Health Counseling
- l. Multicultural Counseling
- m. Holistic Counseling
- n. Tests, Measurements and Interpretation

764. Creative Arts in Counseling. (1-3) Examines history, theories, processes, and techniques of using the creative arts in counseling with clients throughout the life span. Particular attention is given to the visual and verbal arts, such as drawing, imagery, photography, cartooning, cinema, movement, dance, literature, drama, and music.

765. Addiction Counseling. (3) Introduces the concepts of chemical dependency, counseling procedures and techniques, and treatment considerations. The student has opportunities to apply models of chemical dependency counseling to hypothetical situations at various stages of substance use.

770. Classification of Mental and Emotional Disorders. (3) Analyzes healthy and unhealthy personality, as well as developmental and situational problems in adjustment. Studies the classification of mental disorders, as defined by the American Psychiatric Association in the most recent edition of the Diagnostic and Statistical Manual of Mental Disorders. Examines appropriate ways in which diagnosis can be utilized by counselors to explore personality and systemic interventions for career, educational, and relationship concerns.

771. Clinical Mental Health Counseling. (3) History, philosophy, organization, management, and delivery of counseling services in various clinical mental health settings. Preventative, developmental, and remedial strategies for use with various populations.

772. Marriage and Family Systems. (3) Study of the institutions of marriage and the family from a general systems perspective. Exploration of how changes in developmental and situational aspects of the family life cycle influence individuals within the systems of marriage and the family. Both horizontal and vertical dimensions of change are focused on through the use of genograms. Different forms of family lifestyles, such as dual career, single parent, and blended are covered.

773. Family Counseling. (3) Examination of the philosophy and goals of seven major theories of family counseling (Bowenian, Adlerian, psychodynamic, experiential/humanistic, behavioral, structural, strategic) as well as the development of the profession of family counseling from an historical

and current trends perspective. Differences between family counseling and individual/group counseling are highlighted and ethical/legal considerations for working with family units are stressed. Techniques associated with theories are demonstrated through video and play simulations. Research methods for gathering data on families are highlighted.

774. Marriage Counseling. (3) Study of the philosophy and goals of six main theories of marriage counseling (psychoanalytic, social learning, Bowenian, structural-strategic, experiential/humanistic, and rational-emotive) and the techniques associated with each. Historical and current trends associated with the field of marriage counseling are explored, along with related issues such as premarital counseling, family-of-origin influences within marriage, and widowhood. Appropriate marriage assessment instruments, research methods, and ethical/legal questions involved in marriage counseling are addressed.

775. Marital and Family Health and Dysfunctionality. (3) Examines system and individual dynamics associated with marital and family health and dysfunctionality. Longitudinal research on factors connected with healthy, long-term marriages and functional family life are explored. Interactive patterns that lead to such marital and family dysfunctionality as spouse and child abuse, anorexia nervosa, addictive disorders, and dependency are examined.

780. Professional, Ethical and Legal Issues in Counseling. (2) Provides an overview of the critical professional issues in counseling with emphasis on current ethical, legal, and values-related questions and the relationship of these issues to the counselor's role in training, supervision, consultation, appraisal, and research. *P—Advanced graduate standing or POI*

782. Developmental Counseling Psychology. (3) Theoretical, research, and methodological aspects of a developmental/holistic/systems framework for counseling. Integration and application of major theories and approaches to counseling.

786. Consultation and Program Development in Counseling. (2) Consultation theory and process. Consultation with families, schools, colleges, and community agencies. Models for facilitating change in human systems.

790. Professional Identity Capstone Course. (2) Review and application of counseling skills, settings, practice parameters and other current issues necessary to integrate students into the profession of counseling. *P—CNS 744*

Documentary Film Program (DOC)

Reynolda Campus

Program Director
Professor
Professor of Practice

Cynthia Hill and Cara Pilson
Sandra Dickson
Peter Gilbert

Overview

The Documentary Film Program offers an MFA degree through a three-year course of study. The program admits students on a full-time basis only.

The comprehensive lock-step curriculum is designed not only to equip students with the skill set needed to produce professional quality films, but also to develop a respect for the traditions of the craft, an understanding of the economic aspects of the industry, and the intellectual discipline required to translate a creative vision into film. While this is a skills intensive curriculum, it is also a plan of study that emphasizes the social awareness elements that lie at the heart of the documentary

tradition. The faculty believes it is imperative to impart to students the power and responsibility documentary filmmakers have in a world increasingly dependent on the moving image as a way to educate, inform, and affect change.

Requirements

The MFA requires 57 hours: The first two years of the program are dedicated to documentary core courses such as research, theory, writing, direction, and production and the development of the thesis film. The third year builds on the foundation of the first two years of study with courses in entrepreneurship and pedagogy, an option to take a teaching practicum, and the opportunity to produce an individual creative project. Students may also take elective courses in an area of special interest.

Courses of Instruction

701. Internship I. (1.5) Internships may be taken for 1.5 credits on a pass/fail basis when approved by faculty members. These internships provide students the opportunity for experiential learning at production houses, television networks, public television stations, and at other facilities deemed useful as well as with independent producers. *Pass/Fall*

702. Internship II. (1.5) Internships may be taken for 1.5 credits on a pass/fail basis when approved by faculty members. These internships provide students the opportunity for experiential learning at production houses, television networks, public television stations, and at other facilities deemed useful as well as with independent producers. *Pass/Fall*

713. Writing for Documentary. (3) The course provides an introduction to the fundamental theory and craft of non-fiction visual storytelling and familiarizes students with concepts such as drama structure, story development and visual style..

715. Cinematography and Sound. (3) Through a combination of lectures, film screenings, hands-on demonstrations, and field exercises, this course familiarizes students with the basics of documentary shooting, lighting, and sound gathering.

717. Fundamentals of Documentary Editing. (3) Through a combination of lectures, film screenings, hands-on demonstrations, and assignments, this course familiarizes students with the basics of documentary editing.

722. Documentary Storytelling II. (3) This course teaches students how to research, conceptualize and develop a non-fiction story idea. Students receive instruction on effective research strategies, idea development, production planning, and proposal writing and pitching. *P—DOC713, DOC715, DOC 717,*

724. Advanced Documentary Production. (3) Designed to teach theoretical, aesthetic, and technical principles of non-linear editing for documentary. Principally, students are taught how to: digitize and organize source material, create basic effects and titles, develop sequences, and organize and edit raw materials into a polished final product. *P—DOC 717*

728. Documentary History. (3) Acquaints students with the historical development of documentary film from its roots in 19th-century art forms to the present. Examines various styles and techniques of documentary and analyzes the contribution of the documentary as a persuasive means of communication to achieve social and political goals. Open to all Wake Forest University graduate students with POI.

735. Documentary Law and Ethics. (3) Provides students with the opportunity to explore the ethical issues that can arise in documentary filmmaking. The discussion points will evolve from the

in-depth examination of a select group of films and directors.

737. Documentary Storytelling III. (3) The class focuses on advanced principles of writing, producing, directing and editing documentary. Theoretical, aesthetic, technical and ethical aspects of the creative non-fiction storytelling process will be the focus. The class format will be a combination of theory and practice as it relates to the dramaturgical process of filmmaking. *P—DOC 713, DOC 715, DOC 717, DOC 728, DOC 722, DOC 724, DOC 750*

746. Documentary Storytelling IV. (3) The course combines lectures, screenings, and exercises to build a technical and aesthetic foundation in digital post-production. Special emphasis will be placed on advanced visual storytelling techniques—including continuity, pacing, character development and dramatic structure. Students will also explore various distribution strategies and transmedia applications *P—DOC 713, DOC 715, DOC 717, DOC 728, DOC 722, DOC 724, DOC 750, DOC 735, DOC 737, DOC 748.*

748. Creative Thesis Project. (9) Students work under faculty supervision on a creative thesis project.

750. The Imagination Project (3) Students will produce short films, digital study guides or E-books and/or other types of multimedia materials on important social, political, cultural and economic issues. The course, structured around digital media projects, provides opportunities for students to immerse themselves in a single topic and interact with scholars from various disciplines. The topics will vary each year. Students take this course in their first year and in their third year for a total of 6 credits. *P—1st year students: DOC 713, DOC 715, DOC 717, DOC 728; 3rd year students: DOC 713, DOC 715, DOC 717, DOC 728, DOC 722, DOC 724, DOC 750 (1st year course), DOC 735, DOC 737, DOC 748, DOC 746, DOC 751, DOC 755.*

751. Pedagogy and Curriculum. (3) Provides an understanding of pedagogical practices and major theories of curriculum and provide a foundation for students interested in pursuing careers in academe.

753. Individual Study. (1-3) For students who wish to perform independent study in a cognate area with a professor from the Documentary Film Program or another program. May be repeated for credit for a maximum of 9 hours.

755. Entrepreneurship Education in Non-fiction Filmmaking. (3) This course will provide students with the knowledge and skills to help them create their own creative arts venture and help them design and teach a course in entrepreneurship in the creative arts, particularly digital media and non-fiction filmmaking.

764. Individual Study. (1-3) For students who wish to perform independent study in a cognate area with a professor from the Documentary Film Program or another program. May be repeated for credit for a maximum of 9 hours.

766. Teaching Practicum. (3) Students work closely with Documentary Film Program faculty during the teaching of an undergraduate course. Students participate in the design and development of course material and observe classroom and organizational aspects of teaching in an apprenticeship role. *Satisfactory/Unsatisfactory*

780. Special Topics. (3) Intensive study of selected topics in documentary film. Topics may be drawn from any content area of documentary studies and production. May be repeated for credit for a maximum of 6 hours.

Education (EDU)

Reynolda Campus

Program Director

Chair

Professors

Associate Professors

Assistant Professor

Leah McCoy

Adam Friedman

Leah P. McCoy, Linda N. Nielsen, Mary Lynn Redmond

Ann Cunningham, Adam Friedman

M. Alan Brown

Overview

The Department of Education offers professional graduate programs in teacher education. The goals and requirements for these programs are available in the Licensure Office of the department.

Master Teacher Fellows Program. This program is designed for a select group of students who have earned a baccalaureate degree with a major in biology, chemistry, English, French, history, mathematics, physics, social science, or Spanish. Students enter the program in the first week of June and in thirteen months earn the Master of Arts in Education and the teaching license.

Teaching and Learning: Theory into Practice Program. This program is for candidates who have earned the initial teaching license, have a record of strong teaching, and seek to pursue advanced study in teaching and learning. Students in this program earn the Master of Arts in Education.

Requirements

Graduate work in the Department of Education is offered leading to the master of arts in education degree. In addition to qualifying for admission to the Graduate School, candidates for the master of arts in education degree seeking a North Carolina Class M Teacher's License must possess a North Carolina Class A Teacher's License or its equivalent. Master Teacher Fellows are not expected to hold a teacher's license when they enter the program.

Residence Requirement. Full-time teacher education students complete the program in one academic year. Students enrolled on a part-time basis may require three years or longer to complete the degree. The master of arts in education degree is awarded to candidates who successfully complete the following requirements within six calendar years of the date of initial enrollment in the Graduate School.

Course Requirements. The Master Teacher Fellows program requires 44 semester hours for English, math, science and social studies areas and 49 semester-hours for French and Spanish. The Teaching and Learning: Theory into Practice program requires 33 semester-hours. Field-based courses, including 654L, 664L, and 665, are offered only as pass/fail. All remaining coursework must be taken for a grade.

All courses must be approved, and an overall grade-point-average of B must be maintained. The course requirements must be completed in courses numbered 600 or above, with at least half of the total number of required hours in courses numbered 700 or above.

Research Competence in Teacher Education. Research competence in Teacher Education includes a set of three courses that include both research studies and personal reflection. Credit may be allowed for as many as six hours of graduate work transferred from another institution at the discretion of the program director and dean of the Graduate School, but the minimum residence requirement is not thereby reduced.

Admission to Degree Candidacy. A student is admitted to degree candidacy by the dean of the

Graduate School after recommendation by the education department. The student must expect to complete the master's degree requirements with one additional semester's work.

Licensure Only Coursework. Students who wish to enroll in graduate courses to obtain or renew a license may seek admission through the Licensure Officer of the Department of Education. The GRE is not required.

A copy of the Title II Federal Report Card may be obtained in the Licensure Office of the department.

Courses of Instruction

601. Microcomputer and Audiovisual Literacy. (3) Introduction to microcomputers for educators and other users, emphasizing familiarity with computers, use and evaluation of software, and elementary programming skills. Experience with audiovisual materials and techniques is included.

602. Production of Instructional Materials. (3) Methods of producing instructional materials and other technological techniques. *P—EDU 601 and senior or graduate standing.*

603. History of Western Education. (3) Educational theory and practice from ancient times through the modern period, including American education.

604. Social Justice Issues in Education. (3) This course facilitates exploration of issues of social justice and schooling from both theoretical and practical perspectives. It includes a focus on multicultural education, global awareness, issues of equity in school funding, urban and rural education, poverty, and marginalized populations.

605. The Sociology of Education. (3) Study of contemporary educational institutions. Examines such issues as school desegregation, schooling and social mobility, gender equity, and multiculturalism.

606. Studies in the History and Philosophy of Education. (3) Study of selected historical eras, influential thinkers, or crucial problems in education. Topics announced annually.

612. Teaching Children with Special Needs. (3) Survey of the various types of learning problems commonly found in elementary children. Students observe exemplary programs, tutor children with special needs, and attend seminars on effective instructional techniques.

613. Human Growth and Development. (3) Theories of childhood and adolescent development, their relation to empirical research, and their educational implications. Consideration of the relation to learning of physical, intellectual, emotional, social, and moral development in childhood and adolescence.

637. TESOL Linguistics. (3) Introduction to the theoretical and practical linguistics resources and skills for teaching English to speakers of other languages (TESOL) within the U.S. or abroad. *P—LIN/ANT 150, or ENG 304*

651. Adolescent Psychology. (4) Introduction to theories of adolescent psychology as related to teaching and counseling in various settings. Readings emphasize researchers' suggestions for parenting, teaching, and counseling adolescents between the ages of 13 and 19.

654. Content Pedagogy. (3) Methods, materials, and techniques used in teaching particular secondary subjects (English, mathematics, science, second languages, social studies).

654L. Content Pedagogy Rounds. (2) Practical experiences in classrooms with focus on pedagogy and content. Weekly public school experience and seminar. *Pass/Fail*

661. Foundations of Education. (3) Philosophical, historical, and sociological foundations of

education, including analysis of contemporary issues and problems.

664L. Student Teaching Internship. (9) Supervised teaching experience in grades 9-12 (K-12 for foreign language). Full-time, 15-week field experience. Includes a weekly on-campus seminar. *Pass/Fail*

665. Professional Development Seminars. (3) Analysis and discussion of problems and issues in secondary school teaching. Examination of research and practice-based strategies. *Pass/Fail*

674. Student Teaching Seminar. (1.5) Analysis and discussion of practical problems and issues in the teaching of particular secondary subjects (English, mathematics, science, second languages, social studies). Emphasis is on the application of contemporary instructional methods and materials. Includes prior (intercession) 20 hours field experience requirement.

677. Literacy in the 21st Century. (3) This course examines the impact of emerging literacy trends on 21st century students in a digital, global world. There is specific focus on engaging reluctant and struggling readers.

681. Special Needs Seminar. (1) Analysis and discussion of practical problems and issues in the teaching of special needs students in the secondary classroom. Topics include classroom management, reading and writing in the content area, inclusion, and evaluation. *Pass/Fail*

682. Reading and Writing in the Content Areas. (2) Survey of methods for teaching reading and writing to help students learn in the various content areas, and of techniques for adapting instruction to the literacy levels of students.

683. Classroom Management Seminar. (1) Examination of research and practice-based strategies for secondary school classroom management and discipline *Pass/Fail*

684. Creative Research Methodologies. (2) Investigation of source materials, printed and manuscript, and research methods which are applied to creative classroom experiences and the preparation of research papers in literature and social studies.

685. Diversity Seminar. (1) Exploration of multi-cultural issues and relevant Spanish language and cultural teaching practices essential for classroom communication. *Pass/Fail*

687. Tutoring Basic Writing. (2) Review of recent writing theory applicable to teaching basic writers (including the learning disabled and non-native speakers). Special attention to invention strategies and heuristic techniques. Includes experience with tutoring in the Writing Center. (Credit not allowed for both EDU 387 and ENG 387.)

688. Writing Pedagogy. (3) This course blends theory and practice, providing students from all content areas with a foundational understanding of writing pedagogy methods and approaches. Topics of study will include writing across the curriculum, writing research and writing assessment.

690. Methods and Materials for Teaching Foreign Language (K-6). (3) Survey of the basic materials, methods, and techniques of teaching foreign languages in the elementary and middle grades. Emphasis is on issues and problems involved in planning and implementing effective second language programs in grades K-6. Spring only.

693. Individual Study. (3) A project in an area of study not otherwise available in the department; permitted upon departmental approval of petition presented by a qualified student. May be repeated for credit.

695. Teaching Diverse Learners. (3) This course addresses diversity in the classroom, particularly the needs of English Language Learners (ELL) and Exceptional Children (EC). It examines differentiated instruction with appropriate instructional and behavioral strategies to meet the needs of all

students.

698. Seminar in Secondary Education. (1) Investigation of the issues that form the context for teaching in secondary schools.

705. Sociology of Education. (3) Study of contemporary society and education, including goals and values, institutional culture, and the teaching/learning process.

707. Educational Policy and Practice. (3) Examination of the impact of race, ethnicity, and social class on educational achievement and attainment, including consideration of philosophical, historical, and sociological issues.

708. School and Society. (3) Study of continuity and change in educational institutions, including analysis of teachers, students, curriculum, assessment and evaluation, and contemporary problems and reform movements.

711. Reading Theory and Practice. (3) Study of current reading theory and consideration of its application in the teaching of reading, grades K-12.

712. Learning and Cognitive Science. (3) Examination of patterns of human development, and theories and principles of cognition applied to teaching and learning.

713. Classroom Climate: Classroom Management and Conflict Resolution. (3) This course focuses on the development and maintenance of a safe, orderly, and respectful classroom environment in conjunction with advanced pedagogical strategies. Students learn classroom management and conflict resolution techniques while considering their own teaching practices.

714. Advanced Content Pedagogy. (3) This course assists students in developing skills for content-specific teaching of critical thinking and problem solving while building upon existing pedagogical content knowledge through collaboration that is rooted in current practice, and addressing state and national standards.

715. Action Research I. (3) Individual planning for action research study on a specific pedagogical topic in a school setting. Includes definition of research problem, literature review, and proposal for collection of field data and reporting of results.

716. Professional Growth Seminar. (3) Students will provide reflections on their teaching experiences, report the results of their action research, and define their professional goals.

717. Instructional Design, Assessment and Technology. (3) Introduction to contemporary technologies and their applications for supporting instruction, assessment, professional practice, and school leadership.

718. Advanced Multimedia Technology in Education. (3) This course develops advanced technology skills and knowledge of how to incorporate technology tools into pedagogical practice through a variety of assignments including an implementation project.

721. Educational Research. (3) Theory, construction, and procedures of empirical research on teaching and learning. Analysis and evaluation of published research studies.

723. Educational Statistics. (3) Descriptive, inferential, and nonparametric statistical procedures involved in educational research. Computer methods for statistical analysis.

725. Action Research II. (1) Reporting of results of action research study on pedagogical topic. Includes oral and written presentations.

730L. Service Learning: Tutoring. (1) Practical experiences in classrooms with focus on tutoring and assisting with preparation for standardized testing. Includes field work and reflection. *Pass/Fall*

731. Foundations of Curriculum Development. (3) Philosophical, psychological, and social influences on the school curriculum. Examination of both theoretical and practical curriculum patterns for the modern school. Processes of curriculum development, including the leadership function of administration and research.

733. Supervision of Instruction. (3) Analysis of various techniques of supervision: orientation of teachers, in-service education, classroom observation, individual follow-up conferences, ways to evaluate instruction, and methods for initiating changes.

735. Assessment of Teaching and Learning. (3) This course focuses on the assessment of learning from a theoretical and practical perspective. It includes an understanding of formative and summative assessments, traditional and non-traditional assessments, standardized testing, and the interpretation and application of test data.

747. Research and Trends in the Teaching of Foreign Languages. (3) Study of current trends and issues in foreign language education. Research topics include language and linguistics, culture, and technology.

751. Adolescent Psychology. (3) Introduction to theories of adolescent psychology as related to teaching and counseling in various settings. Readings emphasize researchers' suggestions for parenting, teaching, and counseling adolescents between the ages of 13 and 19.

758. Studies in Educational Leadership. (3) Examination of contemporary leadership theory and its various applications in education.

764. Seminar in Curriculum and Instruction. (3) Exploration of special topics in the field of curriculum and instruction.

781. Methodology and Research. (3) Advanced study of the methods and materials of a specific discipline (English, French, Spanish, social studies, mathematics, science) in the curriculum with special attention directed to the basic research in the discipline. Includes 20 hours field experience/project.

783. Readings and Research in Education. (1-3) Independent study and research on topics relevant to the student's field of concentration which may include a special reading program in an area not covered by other courses or a special research project. Supervision by faculty members. Hours of credit to be determined prior to registration. May be repeated for credit.

784. Research in Writing. (3) Investigation of selected topics related to the writing process.

785. The Teaching of Writing. (3) Examination of the theories and methods of instruction of writing.

787. Teaching Advanced Placement. (2 or 3) Investigation of the content of and the pedagogy appropriate to advanced placement courses in the various disciplines. A. English Literature and Composition; B. Calculus; C. English Language and Composition; J. Chemistry; L. U.S. Government and Politics; M. Psychology; I. U.S. History. Offered in summer only.

788. Teaching Foreign Languages in the Elementary Grades. (2) Intensive period of observation and instruction in an elementary school setting with a foreign language specialist. Methods for development of listening, speaking, reading, writing, and cultural awareness using content-based instruction and thematic units.

English (ENG)

Reynolda Campus

Program Director

Chair

Associate Chair

Reynolds Professor of English

Charles E. Taylor Professor of English

Thomas H. Pritchard Professor of English

Professors

Anne Boyle, Dean Franco, Jefferson M. Holdridge, Claudia Thomas Kairoff,

Scott W. Klein, Philip F. Kuberski, Barry G. Maine, William M. Moss,

Gillian R. Overing, Gale Sigal

Associate Professors

Omaar Hena, Melissa S. Jenkins, Judith Madera,

Jessica A. Richard, Erica Still, Olga Valbuena-Hanson

Assistant Professors

Laura Aull, Amy Catanzano, Susan Harlan, Sarah Hogan,

Zak Lancaster, Joanne Ruocco

Overview

The courses for which credit may be earned toward the fulfillment of requirements for the MA degree offer opportunities for study and research in most of the major areas of both British and American literature and in the English language. The courses for graduates only (numbered above 700) stress independent study and research out of which theses may develop. With approval by the departmental graduate committee, students may take one or two related courses in other departments.

Applicants for graduate work in the department are expected to hold an undergraduate degree in English from an accredited institution. This major should consist of a well-rounded selection of courses demonstrating significant exposure to the range of literatures written in English and to ideas of literary history and interpretation. Candidates for degrees are required to have a reading knowledge of a modern foreign or classical language. While no individual language course taken as an undergraduate may be used to fulfill the language requirement, evidence of 18 hours (six semesters) of undergraduate work in a single language will be accepted as fulfilling the requirement. The student can also meet this requirement by making a satisfactory grade in an advanced reading course in a foreign language taken in residence at the University or by satisfactorily passing a translation examination administered by the English department.

Degree and Grade Requirements:

8 Courses (24 credit hours) with an average grade of B or above: at least 5 courses at the 700-level, with three additional courses at the 600-level, or 6 courses at the 700-level and 2 courses at 600-level. A number of credit hours are allotted for doing thesis research; these courses receive a grade of satisfactory or unsatisfactory only.

Courses of Instruction

601. Individual Authors. (3) Study of selected works from an important American or British author.

602. Ideas in Literature. (3) Study of a significant literary theme in selected works.

604. History of the English Language. (3) Survey of the development of English syntax, morphology, and phonology from Old English to the present, with attention to vocabulary growth.

605. Old English Language and Literature. (3) Introduction to the Old English language and a study of the historical and cultural background of Old English literature, including Anglo-Saxon and Viking art, runes, and Scandinavian mythology. Readings from *Beowulf* and selected poems and prose.

606. Special Topics in Rhetoric and Writing. (1.5, 3) Study of significant rhetorical or writing theories and practices focused on one area of study.

608. Beowulf. (3) This course offers an intensive study of the poem, with emphasis on language, translation skills and critical contexts.

609. Modern English Grammar. (3) A linguistics approach to grammar study. Includes a critical exploration of issues such as grammatical change and variation, the origins and effects of grammar prescriptions/proscriptions, the place of grammar instruction in education, and the politics of language authority.

610. The Medieval World. (3) Examines theological, philosophical and cultural assumptions of the Middle Ages through the reading of primary texts. Topics include Christian providential history, drama, devotional literature, the Franciscan controversy, domestic life and Arthurian romance.

611. The Legend of Arthur. (3) The origin and development of the Arthurian legend in France and England with emphasis on the works of Chretien de Troyes and Sir Thomas Malory.

612. Medieval Poetry. (3) The origin and development of poetic genres and lyric forms of medieval vernacular poetry.

613. The Roots of Song. (3) Interdisciplinary investigation of poetry and song in the Middle Ages and early Renaissance. Study of the evolution of poetic and musical genres and styles, both sacred and secular. Students must complete a project or projects on the technical or theoretical aspects of early song.

615. Chaucer. (3) Emphasis on *The Canterbury Tales* and *Troilus and Criseyde*, with some attention to minor poems. Consideration of literary, social, religious, and philosophical background.

619. Virgil and His English Legacy. Study of Virgil's *Eclogues*, *Georgics*, and selected passages of the *Aeneid*, and their influence on English literature, using translations and original works by writers of the 16th through the 18th centuries, including Spenser, Marlowe, Milton, Dryden, and Pope. Knowledge of Latin not required.

620. British Drama to 1642. (3) British drama from its beginnings to 1642, exclusive of Shakespeare. Representative cycle plays, moralities, Elizabethan and Jacobean tragedies, comedies, and tragicomedies.

623. Shakespeare. (3) Thirteen representative plays illustrating Shakespeare's development as a poet and dramatist.

625. 16th-Century British Literature. (3) Concentration on the poetry of Spenser, Sidney, Shakespeare, Wyatt, and Drayton, with particular attention to sonnets and *The Faerie Queene*.

626. Studies in English Renaissance Literature. (3) Selected topics in Renaissance literature. Consideration of texts and their cultural background.

627. Milton. (3) The poetry and selected prose of John Milton with emphasis on *Paradise Lost*.

628. 17th-Century British Literature. (3) Poetry of Donne, Herbert, Vaughan, Marvel, Crashaw, prose of Bacon, Burton, Browne, Walton. Consideration of religious, political, and scientific backgrounds.

630. Restoration and 18th Century British Literature. (3) Representative poetry and prose, exclusive of the novel, drawn from Addison, Steele, Defoe, Swift, Pope, Johnson, and Boswell. Consideration of cultural backgrounds and significant literary trends.

635. 18th-Century British Fiction. (3) Primarily the fiction of Defoe, Richardson, Fielding, Smollett, Sterne, and Austen.

636. Restoration and 18th-Century British Drama. (3) British drama from 1660 to 1780, including representative plays by Dryden, Etherege, Wycherley, Congreve, Goldsmith, and Sheridan.

637. Studies in 18th-Century British Literature. (3) Selected topics in 18th-century literature. Consideration of texts and their cultural background.

640. Studies in Women and Literature. (3) Women writers in society.

641. Literature and the Environment. (3) This course studies the relationship between environmental experience and literary representation.

644. Studies in Poetry. (3) Selected topics in poetry.

645. Studies in Fiction. (3) Selected topics in fiction.

646. Studies in Theatre. (3) Selected topics in theatre.

650. British Romantic Poets. (3) A review of the beginnings of Romanticism in British literature, followed by study of Wordsworth, Coleridge, Byron, Keats, and Shelley; collateral reading in the prose of the period.

651. Studies in Romanticism. (3) Selected topics in European and/or American Romanticism with a focus on comparative, interdisciplinary, and theoretical approaches to literature.

653. 19th-Century British Fiction. (3) Representative major works by Dickens, Eliot, Thackeray, Hardy, the Brontës, and others.

654. Victorian Poetry. (3) A study of the Brownings, Tennyson, Hopkins, and Arnold or another Victorian poet.

656. Literature of the Caribbean. (3) Readings include significant works by authors from the Caribbean and authors writing about the Caribbean. Critical, historical, and cultural approaches are emphasized. All texts are in English..

657. Studies in Chicano/a Literature. (3) Writings by Americans of Mexican descent in relation to politics and history. Readings in literature, literary criticism, and sociocultural analysis.

658. Postcolonial Literature. (3) Survey of representative examples of postcolonial literature from geographically diverse writers, emphasizing issues of politics, nationalism, gender, and class.

659. Studies in Postcolonial Literature. (3) Examination of themes and issues in postcolonial literature, such as: globalization, postcolonialism and hybridity, feminism, nationalism, ethnic and religious conflict, the impact of the Cold War, and race and class.

660. Studies in Victorian Literature. (3) Selected topics such as development of genres, major authors and texts, cultural influences. Reading in poetry, fiction, autobiography, and other prose.

661. Literature and Science. (3) Literature of and about science. Topics vary and may include literature and medicine, the two-culture debate, poetry and science, nature in literature, the body in literature.

662. Irish Literature in the 20th Century. (3) Study of modern Irish literature from the writers of the Irish Literary Renaissance to contemporary writers. Course consists of overviews of the period

as well as specific considerations of genre and of individual writers.

663. Studies in Modernism. Selected issues in Modernism. Interdisciplinary, comparative, and theoretical approaches to works and authors.

664. Studies in Literary Criticism. (3) Consideration of certain figures and schools of thought significant in the history of literary criticism.

665. 20th-Century British Fiction. (3) A study of Conrad, Ford, Forster, Joyce, Lawrence, Woolf and later British writers, with attention to their social and intellectual backgrounds.

666. James Joyce. (3) The major works by Joyce, with an emphasis on *Ulysses*.

667. 20th-Century English Poetry. (3) A study of 20th-century poets of the English language, exclusive of the U.S. Poets will be read in relation to the literary and social history of the period.

668. Studies in Irish Literature. (3) The development of Irish literature from the 18th century through the early 20th century in historical perspective, with attention to issues of linguistic and national identity.

669. Modern Drama. (3) Main currents in modern drama from 19th-century realism and naturalism through symbolism and expressionism. After an introduction to European precursors, the course focuses on representative plays by Wilde, Shaw, Synge, Yeats, O'Neill, Eliot, Hellman, Wilder, Williams, Hansberry, and Miller.

670. American Literature to 1820. (3) Origins and development of American literature and thought in representative writings of the Colonial, Revolutionary, and Federal periods.

671. American Ethnic Literature. (3) Introduction to the field of American Ethnic literature, with special emphasis on post World War II formations of ethnic culture: Asian American, Native American, African American, Latino, and Jewish American. The course highlights issues, themes, and stylistic innovations particular to each ethnic group and examines currents in the still developing American culture.

672. American Romanticism. (3) Studies of Romanticism in American literature. Focus varies by topic and genre, to include such writers as Emerson, Thoreau, Hawthorne, Melville, Whitman, and Dickinson.

673. Literature and Film. (3) Selected topics in the relationship between literature and film, such as adaptations of literary works, the study of narrative, and the development of literary and cinematic genres.

674. American Fiction before 1865. (3) Novels and short fiction by such writers as Brockden, Cooper, Irving, Poe, Hawthorne, Melville, Stowe, and Davis.

675. American Drama. (3) An historical overview of drama in America, covering such playwrights as Boucicault, O'Neill, Hellman, Wilder, Williams, Inge, Miller, Hansberry, Albee, Shepard, Norman, Mamet, and Wilson.

676. American Poetry before 1900. (3) Readings and critical analysis of American poetry from its beginnings, including Bradstreet, Emerson, Longfellow, Melville, and Poe, with particular emphasis on Whitman and Dickinson.

677. American Jewish Literature. (3) Survey of writings on Jewish topics or experiences by American Jewish writers. Explores cultural and generational conflicts, responses to social change, the impact of the Shoah (Holocaust) on American Jews, and the challenges of language and form posed by Jewish and non-Jewish artistic traditions.

678. Literature of the American South. (3) Study of Southern literature from its beginnings to the present, with emphasis upon such major writers as Tate, Warren, Faulkner, O'Connor, Welty, and Styron.

679. Literary Forms of the American Personal Narrative. (3) Reading and critical analysis of autobiographical texts in which the ideas, style, and point of view of the writer are examined to demonstrate how these works contribute to an understanding of pluralism in American culture. Representative authors include Douglass, Brent, Hurston, Wright, Kingston, Angelou, Wideman, Sarton, Hellman, and Dillard.

680. American Fiction from 1865 to 1915. (3) Study of such writers as Twain, James, Howells, Crane, Dreiser, Wharton and Cather.

681. Studies in African-American Literature. (3) Reading and critical analysis of selected fiction, poetry, drama, and other writings by American authors of African descent.

682. Modern American Fiction, 1915 to 1965. (3) Includes such writers as Cather, Lewis, Hemingway, Fitzgerald, Faulkner, Dos Passos, Wolfe, Baldwin, Ellison, Agee, O'Connor, Styron, Percy, and Pynchon.

683. Theory and Practice of Poetry Writing. (3) Emphasis on reading and discussing student poems in terms of craftsmanship and general principles.

684. Playwriting. (3) Examines the elements of dramatic structure and their representations in a variety of dramatic writings. Explores the fundamentals of play writing through a series of writing exercises.

685. 20th-Century American Poetry. (3) Readings of modern American poetry in relation to the literary and social history of the period.

686. Directed Reading. (1-3) A tutorial in an area of study not otherwise provided by the department; granted upon departmental approval of petition presented by a qualified student. May be repeated for credit if topic varies.

687. African-American Fiction. (3) Selected topics in the development of fiction by American writers of African descent.

689. African-American Poetry. (3) Readings of works by American poets of African descent in theoretical, critical, and historical contexts.

690. The Structure of English. (3) Introduction to the principles and techniques of modern linguistics applied to contemporary American English.

691. Studies in Postmodernism. (3) Interdisciplinary, comparative, and theoretical approaches to works and authors.

692. Magazine Writing. (3) Analysis of magazines and their audiences through tone, design, and content. Practice story pitches and writing articles of various lengths aimed at a stated magazine which students research and select. Digital skills practiced; class magazine produced.

693. Multicultural American Drama. (3) Examines the dramatic works of playwrights from various racial and ethnic communities such as Asian American, Native American, and Latino. Includes consideration of issues, themes, style, and form.

694. Contemporary Drama. (3) Considers experiments in form and substance in plays from Godot to the present. Readings cover such playwrights as Beckett, Osborne, Pinter, Stoppard, Churchill, Wertebaker, Albee, Shepard, Mamet, Wilson, Soyinka, and Fugard.

695. Contemporary American Literature. (3) Study of post-World War II American poetry and fiction by such writers as Bellow, Gass, Barth, Pynchon, Morrison, Ashbery, Ammons, Bishop, and Rich.

696. Contemporary British Fiction. (3) Study of the British novel and short story, with particular focus on the multicultural aspects of British life, including work by Rushdie, Amis, Winterson, and Ishiguro.

697. Creative Nonfiction. (3) A writing intensive course exploring the practice and theory of non-fiction, a genre that encompasses memoir, the personal essay, travel writing, and science writing.

698. Advanced Fiction Writing. (3) Primarily a short story workshop with class discussion on issues of craft, revision, and selected published stories.

699. Practice in Rhetoric and Writing. (3) Training and practice in the reading and writing of expository prose. Students study the uses of rhetoric to frame arguments and marshal evidence, then learn to practice these skills in their own writing of expository prose.

700. Teaching Internship. (1.5) An internship for the observation and practice of undergraduate pedagogy, placing an MA student into a core literature course taught by a tenured or tenure-track professor, typically in the first semester of the student's second year. Arranged by permission or invitation of the supervising faculty member. Must be taken as an overload in addition to the course-work for the degree. May be repeated for credit for a maximum of 3 hours.

701. Individual Authors. (3) Study of selected works from an important American, English, or Global Anglophone author.

702. Ideas in Literature. (3) Study of a significant literary theme in selected works.

710. Early Medieval Narrative. (3) A variety of forms of early medieval narrative (history, saga, chronicle, poetry, hagiography), with a focus on issues of genre and narrative form, connections between story and history, and the text's relation to the culture that produced it. Emphasis is on interdisciplinary viewpoints (artistic, archaeological, geographic), and on contemporary narrative theory.

711. Studies in the Arthurian Legend. (3) Emphasis is on the origin and developments of the Arthurian legend in England and France, with primary focus on Malory's *Le Morte d'Arthur*. Attention to social and intellectual backgrounds.

712. Studies in Medieval Literature: Romance and Identity. (3) A diverse corpus of medieval poetry, both lyric and narrative, is explored in an effort to trace the origin and evolution of the idea and meaning of "romance," a term signifying, for the medieval audience, narrative poetry in the vernacular, and, for our purposes, that uniquely new concept of ennobling love that emerged in the 12th century.

715. Studies in Chaucer. (3) Emphasis on selected *Canterbury Tales*, *Troilus and Criseyde*, and the longer minor works, with attention to social, critical, and intellectual background. Lectures, reports, discussions, and a critical paper.

720. Renaissance Drama. (3) Using an historical approach, this seminar examines the relationship between the theater as an institution and centers of authority during the Tudor and Stuart periods. The plays—tragedies, comedies, tragicomedies—are approached as the products of a dynamic exchange between individual authors and the larger political and social concerns of the period.

721. Studies in Spenser. (3) Emphasis on *The Faerie Queene*; attention to the minor works; intellectual and critical background. Lectures, discussions, and class papers.

722. Studies in 16th-Century British Literature. (3) Introduction to critical and scholarly methodology for the study of the literature; particular emphasis on Spenser's *Faerie Queene* and Sidney's *Arcadia*.

723. Studies in Shakespeare. (3) Representative text from all genres, examined in light of critical methodologies in the field of Shakespeare studies. Emphasis is on reading primary sources as well as on discussion of the impact that historical, cultural, and religious developments had on Shakespeare, the theater, and the thematics of his plays.

725. Studies in 17th-Century British Literature. (3) Non-dramatic literature of the 17th century, exclusive of Milton. Emphasis on selected major writers. Lectures, discussions, and presentation of studies by members of the class.

727. Studies in 17th-Century British Literature: Primarily Milton. (3) The work of John Milton, primarily *Paradise Lost*, within its cultural environment. Some attention to connections between Milton's writings and that of his contemporaries.

733. 18th-Century British Fiction. (3) A study of two major British novelists of the 18th century. Lectures, reports, critical papers. Authors for study chosen from the following: Defoe, Richardson, Fielding, Smollet, and Austen.

737. Studies in Restoration and 18th-Century British Literature. (3) Selected topics in Restoration and 18th-century literature. Consideration of texts and their cultural background.

740. Studies in Gender and Literature. (3) An examination of selected writers and/or theoretical questions focusing on issues of gender.

743. 19th-Century British Fiction. (3) Study of one or more major British novelists of the 19th century. Lectures, reports, discussions, and a critical paper. Authors for study chosen from the following: Austen, Dickens, Thackeray, Eliot, and Hardy.

745. British Poetry of the 19th and 20th Centuries. (3) Study of several British poets chosen from the major Romantics, Tennyson, Browning, Hardy, and Yeats.

746. Studies in British Romanticism. (3) Examination of major writers, topics, and/or theoretical issues from the late 18th and early 19th centuries.

757. American Poetry. (3) Studies of the poetry and poetic theory of three major American writers in the 19th and 20th centuries. Writers chosen from the following: Whitman, Dickinson, Frost, Eliot, Stevens, or Williams. Discussions, reports, and a critical paper.

758. Studies in Modern Poetry. (3) Theoretical issues and themes in 20th-century poetry.

759. Studies in Postcolonial Literature. (3) Examination of themes and issues in postcolonial literature and/or theory such as globalization, identity and hybridity, feminism, nationalism, ethnic and religious conflict, the impact of neo-imperialism and economic policy, and race and class.

760. Studies in Victorian Literature. (3) Selected topics such as development of genres, major authors and texts and cultural influences of Victorian Literature. Readings in poetry, fiction and autobiography, and other prose.

763. Studies in Modernism. (3) This course will examine elected issues in Modernism, from interdisciplinary, comparative, and theoretical approaches.

765. Literary Criticism. (3) Review of historically significant problems in literary criticism, followed by study of the principal schools of 20th-century critical thought. Lectures, reports, discussions, and a paper of criticism.

766. Studies in 20th-Century British Literature. (3) Examination of major writers, topics and/or theoretical issues in 20th-century British literature. In addition to fiction, the course focuses on drama, theory, prose readings, and poetry.

767. 20th-Century British Fiction. (3) Study of one or more of the major British novelists of the 20th century. Authors chosen from among the following: Conrad, Ford, Forster, Joyce, Lawrence, or Woolf.

768. Irish Literature. (3) Study of major themes, theories, individual authors, or periods, which might include discussions of mythology, folklore, landscape, poetics, narrative strategies, gender, and politics.

771. American Ethnic Literature. (3) Examination of how ethnic writers narrate cultural histories and respond to and represent the ambiguity of cultural location. Literary topics include slavery, exile, the Holocaust, immigration, assimilation, and versions of the American Dream.

772. Studies in American Romanticism. (3) Writers of the mid-19th century, including Emerson, Thoreau, Hawthorne, and Melville.

774. American Fiction Before 1865. (3) Study of novels and short fiction by such writers as Brown, Cooper, Irving, Poe, Hawthorne, Melville, Stowe, and Davis.

776. American Poetry Before 1900. (3) Close reading and critical analysis of selected American poets, such as Bryant, Longfellow, Poe, Emerson, Whitman, and Dickinson.

779. Autobiographical Voices: Race, Gender, Self-Portraiture. (3) Using an historical and critical approach, this seminar examines autobiography as an activity which combines history, literary art, and self-revelation. Lectures, reports, discussions, a critical journal, a personal narrative, and a critical paper. Authors for study chosen from the following: Douglass, Brent, Hurston, Wright, Angelou, Crews, Dillard, Moody, Malcolm X, Kingston, Wideman, or Sarton.

780. Studies in American Fiction from 1865 to 1915. (3) Study of the principal fiction of one or more major American writers of the late 19th and early 20th centuries. Lectures, seminar reports, and a research paper. Authors for study chosen from the following: Twain, James, Howells, Adams, Crane, Dreiser, Wharton, or Cather.

781. African-American Literature and the American Tradition. (3) Critical readings of selected works of major American writers of African descent within the contexts of the African-American and American literary and social traditions. Covers such genres as autobiography, fiction, drama, and poetry. Lectures, reports, discussions, and a critical paper.

782. Studies in American Fiction from 1915 to 1965. (3) Study of the principal fiction of one or more major American writers of the 20th century. Writers are chosen from the following: Cather, Lewis, Hemingway, Fitzgerald, Faulkner, Dos Passos, Wolfe, Baldwin, Ellison, Agee, O'Connor, Percy, or Pynchon.

783. Contemporary American Fiction. (3) Seminar devoted to the close study of some of the most important novels produced in the United States since World War II.

784. Contemporary American Poetry. (3) Seminar devoted to the close study of some of the most important poems written in America since World War II.

786. Directed Reading. (1-3) A tutorial in an area of study not otherwise provided by the department; granted upon departmental approval of petition presented by a qualified student. May be repeated for credit if topic varies.

789. Linguistics in Literature. (3) Examination of theories of grammar and attitudes toward the

English language reflected in the literature of selected periods.

791, 792. Thesis Research. (1-9). May be repeated for credit. *Satisfactory/Unsatisfactory*

Health and Exercise Science (HES)

Reynolda Campus

Program Director

Chair

Thurman D. Kitchin Professor of Health and Exercise Science

Professors

Associate Professors

Assistant Professor

Peter H. Brubaker

Michael J. Berry

W. Jack Rejeski

Michael J. Berry, Peter H. Brubaker, Anthony P. Marsh,

Stephen P. Messier, Patricia A. Nixon

Jeffrey A. Katula, Shannon L. Mihalko, Gary D. Miller

Kristen M. Beavers

Overview

The Department of Health and Exercise Science offers a graduate program leading to the master of science degree. This program offers specialization in the area of health and exercise science and is designed for those who are interested in careers in research, preventive, and rehabilitative programs, and/or further graduate study.

Candidates for the health and exercise science program are not required to have a specific undergraduate major or minor. However, an undergraduate concentration in the sciences is preferred. Candidates for the program generally pursue research careers in exercise science (exercise physiology, biomechanics, or rehabilitation), and/or direct programs of exercise training or rehabilitation (YMCA's, corporate fitness programs, and cardiac rehabilitation). The prerequisites for this program include course work in human anatomy, human physiology, physiology of exercise, and biomechanics. These courses should be completed before admission to the program. None of the prerequisites may apply toward the graduate degree. All students in the program are required to take the following courses: 660, 675, 715, 721, 733, 761, 763, 765, 783-784 and 791-792. Students can normally expect to spend two years in this program. The first year is devoted to required coursework and the identification of a thesis topic. The research and data collection for the thesis are usually completed in the second year. The second year also allows an opportunity for elective coursework outside the department.

The Department of Health and Exercise Science supports the Healthy Exercise and Lifestyle Programs (HELPS), a chronic disease prevention program for the local community. As part of the coursework in HES 761 and 765, graduate students serve an internship in HELPS to gain practical experience as clinical exercise specialists. After serving an internship with HELPS during the first academic year, each student will have the opportunity to be certified as an American College of Sports Medicine (ACSM) exercise specialist.

The Department of Health and Exercise Science began offering graduate study in 1967. Departmental graduate committee: Brubaker (chair), Beavers, Berry, Katula, Marsh, Messier, Mihalko, Miller, Nixon, Rejeski.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Courses of Instruction

650. Human Physiology. (3) A lecture course that presents the basic principles and concepts of the function of selected systems of the human body, with emphasis on the muscular, cardiovascular,

pulmonary, and nervous systems.

651. Nutrition in Health and Disease. (3) A lecture/lab course that presents the principles of proper nutrition including an understanding of the basic foodstuffs and nutrients as well as the influence of genetics, eating behavior, and activity patterns on performance, energy balance, and weight control. Labs focus on intervention in obesity and coronary heart disease through diet analysis, methods of diet prescription, and behavior modification.

652. Human Gross Anatomy. (4) A lecture/lab course on the structure and function of the human body. Labs are devoted to the dissection and study of the human musculoskeletal, neuromuscular, and vascular systems.

653. Physiology of Exercise. (3) Lecture course that presents the concepts and applications of the physiological response of the human body to physical activity. The acute and chronic responses of the muscular and cardiorespiratory systems to exercise are examined. Other topics include exercise and coronary disease, strength and endurance training, somatotype and body composition, gender-related differences, and environmental influences. *P—HES 650 or POI*

660. Epidemiology. (3) Introduction to basic determinants of the incidence of chronic disease in the population, and development of an understanding of individual, community, and environmental approaches to promoting healthful lifestyles in youth, adults, and elderly populations. Issues are analyzed by formal statistical modeling.

670. Biomechanics of Human Movement. (3) Study of the mechanical principles which influence human movement, sport technique, and equipment design.

675. Advanced Exercise Physiology. (3) Lecture course which provides an in-depth examination of the physiological mechanisms responsible for both the acute and chronic changes which occur with exercise. Included are cellular changes in response to exercise, the ventilatory response to exercise and metabolic consequences of exercise.

682. Independent Study. (1-3) Literature reviews and/or laboratory research performed on an individual basis under the supervision of a faculty member.

715. Experimental Design. (3) Study of the various types of research relevant to health and exercise science. While attention is given to topics such as statistical treatment of data, the primary emphasis involves discussion concerning threats to internal and external validity for experimental and quasi-experimental designs. In conjunction with a sound methodological approach, practical experiences are provided in the preparation and presentation of thesis proposals.

721. Data Analysis and Interpretation. (3) The application of basic statistical techniques in the analysis and interpretation of data in scientific research. Topics include descriptive statistics, simple linear and multiple correlation/regression analysis, t-tests, analysis of variance and covariance, and non-parametric statistics.

733. Health Psychology. (3) Seminar on current topics in health psychology with a focus on wellness programs and rehabilitative medicine.

761. Cardiopulmonary Disease Management. (3) A lecture/lab class that examines the physiologic, pathologic, and pharmacologic considerations of managing patients with cardiovascular and pulmonary disease. Special emphasis on learning diagnostic procedures, interventions, and therapies, particularly models for cardiac and pulmonary rehabilitation.

763. Advanced Biomechanics. (3) An in-depth study of the mechanical principles that influence human movement. Topics include the study of kinetics, kinematics, cinematography, sport shoe

design, and skeletal biomechanics. *P—Anatomy, kinesiology, physics, or POI*

765. Graded Exercise Testing and Exercise Prescription. (3) The study of the rationale for the use of graded exercise testing in the evaluation of functional work capacity and prescription of exercise. Lectures include the analysis of different modes of evaluation: treadmill, bicycle ergometer, arm ergometer, and field testing, with the application of the results in the evaluation of normal and cardiac patients and prescription of exercise for special populations. Lab experiences include the use of electrocardiographs, ergometers, and metabolic analyzers in the assessment of functional capacity.

780. Advanced Topics in Exercise and Sport Science. (3) This course is divided into two or more content areas to allow an in-depth treatment of selected topics that are not a regular part of required coursework. Topics are chosen from the following areas: anatomy, biomechanics, computer analysis, multivariate statistics, and physiology of exercise. Seminar and/or lab approach.

782. Independent Study in Health and Exercise Science. (1-3) Literature and/or laboratory research performed on an individual basis under the supervision of a faculty member. May be repeated for credit.

783, 784. Seminar in Health and Exercise Science. (1, 1) Seminar class designed to bring graduate students and faculty together on a regular basis to discuss research proposals, research design and studies, results of research, and current topics in health and exercise science. Talks by invited or visiting speakers are included as seminar sessions. Graduate students receive reading and work assignments related to the material presented in the seminar. May be repeated for credit.

791, 792. Thesis Research. (1-9). May be repeated for credit. *Satisfactory/Unsatisfactory*

Health Disparities in Neuroscience Related Disorders (HDND)

Bowman Gray Campus

Program Directors

Carol Milligan and Ronny Bell

Overview

Disparities in presentation, care, severity, and disability for neurological disorders such as stroke, Alzheimer's disease, epilepsy and Parkinson's have been identified in U.S. minority populations. Addressing health disparities becomes critical when considering the cost and burden on society of unequal care and treatment of what will be more than 50% of our society by 2060. The goal of the Health Disparities in Neuroscience-related Disorders master's program is to recruit students from diverse backgrounds into Health Disparities research program. The program builds on unique resources at Wake Forest University that make it an ideal institution for students to succeed.

The program will include coursework, a thesis research project, mentoring, and career development. The product of this program will be a solid foundation in Neuroscience, Epidemiology and Biostatistics training and hands-on, practical research projects. Another goal is to interest students in a career choice in health disparity and to develop a love of neuroscience and understanding neurological disorders to motivate students to consider moving onto PhD and MD programs and careers addressing these important issues.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Integrative Physiology and Pharmacology (IPP) Track 5

Bowman Gray Campus

Track Director

Allyn Howlett

Professors

Graca Almeida-Porada, Karl-Erik Andersson, Anthony Atala, Michael Berry, Khalil Bitar, Donald Bowden, Bridget Brosnihan, Pete Brubaker, David Carroll, Mark Chappell, Martin Childers (Adjunct), Steven R. Childers, Floyd H. Chilton, George Christ (Adjunct), J. Mark Cline, Suzanne Craft, Samuel A. Deadwyler, Osvaldo Delbono, Debra Diz, James Eisenach, J. Charles Eldridge, Carlos Ferrario, Jorge Figueroa, David P. Friedman, Patricia Gallagher, Randolph Geary, William Gmeiner, Dwayne Godwin, Leanne Groban, Robert Hampson, David Herrington, Allyn Howlett, Sara Jones, Jay Kaplan, Mei-Chuan (Holden) Ko, Nancy Kock, Greg Kucera, Frank Marini, Brian McCool, Stephen Messier, Michael A. Nader, Barbara Nicklas, John S. Parks, Linda Porrino, Jim Rose, Jack Rejeski, Carol Shively, Thomas Smith, Shay Soker, Ann Tallant, Richard Weinberg, Jeffrey L. Weiner, Koudy Williams, James Yoo, Xiaobo Zhou

Associate Professors

Paul Czoty, Matthew Edwards, Gary M. Hellmann (Adjunct), Timothy Howard, Anthony P. Marsh, Thomas Martin, Shannon Mihalko, Gary Miller, Nilamadhab Mishra, Christopher Porada, Wayne Pratt, Pat Nixon, Tom Register, Jasmina Varagic, Lisa Washburn

Assistant Professors

Susan E. Appt, Evgeny Budygin, David Caudell, Rong Chen, Tracy Criswell, James Daunais, TanYa Gwathmey-Williams, Matthew Jorgenson, Jeff Katula, Kylie Kavanaugh, Cynthia Lee, David Lyons, Tao Ma, Anthony Molina, Maggie Ng, Snezana Petrovic, Victor Pulgar, Hossam Shaltout, Allen Tsang, Liliya Yamaleyeva

Overview

Integrative Physiology and Pharmacology at Wake Forest University offers a PhD program designed to train students for a research career in the physiological and pharmacological sciences. The IPP program has excelled in obtaining federal and foundational funding for many years, with dozens of highly-funded investigators working in a highly collaborative research environment. Research interests of the IPP program include a strong emphasis on drug and alcohol abuse, life-span physiology, cardiovascular disease, cancer, the endocrine system, central pain modulation, neuropsychiatric disorders, and regenerative medicine. There are currently 21 PhD students and 3 masters students in various stages of training, and there are 75 full-time primary and adjunct faculty members.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Courses of Instruction

701. Principles of Pharmacology. (1-3) The first required course for physiology and pharmacology students introduces students to basic principles of physiology and pharmacology and the cellular, ADME principles (administration, distribution, metabolism, elimination), pharmacokinetics, and pharmacodynamics (receptors and signal transduction).

702. Systems Physiology and Pharmacology. (1, 4, 6) The second required course for physiology and pharmacology students is composed of five blocks including blocks on neuroscience (Blk 1), endocrine (Blk 2), renal/gastrointestinal (Blk 3), cardiovascular/pulmonary (Blk 4) and regenerative

physiology (Blk 5).

703, 704. Student Seminar. (1) Students present seminars as well as attend seminars by other IPP students and post-doctoral researchers. Students alternatively present a seminar or provide a written critique of a journal article. Course may be repeated.

705, 706. Student Journal Club. (1) Students participate in a journal club as well as attend a required number of seminars by faculty/outside speakers. Course may be repeated.

711, 712. Advanced Topics. (1-6) An advanced lecture and conference course that considers various topics of current research interest and concepts under rapid development. Areas of interest within the department are covered on a rotating basis. Additional topics can be offered by announcement.

713, 714. Advanced Readings. (1-4). Individualized instruction involving detailed review of literature pertaining to a specific area of interest in physiology or pharmacology.

715. Physiological Techniques. (1-2) Provides students with an introduction to the techniques used to assess physiological parameters by a combination of lectures and demonstrations.

717. Current Topics in Drug Abuse. (2-3) Provides students with perspective in the problem of drug abuse. Defines the basic issues central to the field of drug abuse, including concepts of tolerance, physical dependence and reinforcement mechanisms, and relate these issues to the current problems of drug abuse in society. Describes how current research in drug abuse contributes to the design of rational treatment and prevention programs. Also listed as NEUR 717.

722. Behavioral Pharmacology. (3) Focuses on behavioral factors that influence the effects of drugs. Material presented provides a detailed review of the rate-dependent, reinforcing, and stimulus effects of drugs. Additional topics include behavioral factors related to tolerance and sensitization and a review of animal models of drug action. Also listed as NEUR 722.

724. Biology of Alcohol Abuse—Alcoholism. (3) Designed to instruct graduate and postdoctoral students on the pharmacological, physiological, and behavioral effects of alcohol. Lectures cover topics ranging from the epidemiology and etiology of alcohol abuse and alcoholism to the basic biochemistry, metabolism, and pharmacokinetics of alcohol in the mammalian system. Lectures focusing on the effects of alcohol on the nervous system include neuroreceptor interactions, ethanol's effects on intracellular signaling processes, neuroanatomical substrates for the actions of alcohol, systems electrophysiology, and mechanism of the behavioral effects of alcohol such as the reinforcing effects, anxiolytic effects, amnesic effects, and motor impairing effects. These lectures provide the basis for an exploration of the conditions leading to tolerance and dependence, and how the brain adapts to prolonged exposure to alcohol. Also listed as NEUR 724.

726. Toxicology. (2) Lecture course designed to provide the student with the basic concepts and mechanisms underlying toxic responses to xenobiotics. Emphasis is on the toxicology relevant to the diagnosis and prevention of poisoning in humans from occupational, environmental, or iatrogenic origin. Broad area studies are general principles of toxicology, common toxic agents, and target organs. Experimental models and methodologies of risk assessment are explored.

730. Lifespan Physiology and Pharmacology. (1-2) Lectures on the physiology of development and aging and the study of drugs during development and aging. Presentations address current topics relevant to age-dependent changes in various organ systems and theories of aging. The topics of age-related alterations in drug absorption, kinetics, and metabolism are also examined.

731. Perinatal Physiology I. (2) Discussion of literature in physiology and pharmacology concerning developmental aspects of mammalian organ systems. Emphasis is on the cardiovascular, endocrine and renal systems with considerations of the consequences of fetal programming of these

systems.

732. Perinatal Physiology II. (2). Discussion of literature in physiology and pharmacology concerning developmental aspects of mammalian organ systems. Emphasis is on developmental pharmacology and the ability of drugs to program development.

736. Endocrinology. (2) Recent advances in endocrinology, with emphasis on receptor-linked functions, hormonally-active drugs, and influences of pharmacologic agents on endocrine function. In a tutorial setting, students study principles of structure and function, examine current technology and published literature, and design and critique experimental approaches.

738. Cardiovascular Physiology and Pharmacology. (2) Lectures, readings and discussions center on normal and abnormal cardiovascular physiology and recent developments in drugs affecting the heart and circulation.

740. Neuropharmacology. (2-3) General survey of neuropharmacology, emphasizing neurotransmitters, receptors and their interactions. Discussion of published literature with some lectures. Discusses general principles of drug action, including receptor binding, second messengers, and neurotransmitter metabolism. Surveys neurotransmitter function, including acetylcholine, biogenic amines, excitatory and other amino acids, and neuropeptides. Also covers techniques used to measure receptor function. Also listed as NEUR 740.

741. Quantitative Methods in Bioscience. (3). An introduction to essential concepts and methods for the quantitative analysis of biological data, with a focus on descriptive and inferential statistics. General topics include basic concepts in statistics such as probability theory and chance models, samples and populations, analyses of the relationships between variables, analysis of normal data, analysis of non-normal data and non-parametric analyses, an introduction to Bayesian frameworks, clustering analysis, and multivariate analyses. Didactic lectures cover core frameworks, analytic approach, and the mechanics and intuitive logic behind the methods. laboratory sessions provide experience using a software platform (R) for data analysis and visualization using practical problems. Also listed as NEUR 741.

797, 798. Research. Mentored research on physiological or pharmacological problems in preparation for the thesis. Course may be repeated. *Satisfactory/Unsatisfactory*

Interpreting and Translation Studies (ITS)

Reynolda Campus

Program Directors

Charles E. Taylor Professor of Romance Languages

Professors

Associate Professors

Assistant Professors

Overview

This program prepares professionals for working in the growing language industry as it relates to a variety of fields—foreign affairs, media, business, law, and especially healthcare delivery. The current lack of interpreters and translators has led the U.S. Department of Labor to project a 46 percent increase in employment over the next decade. The program in interpreting and translation studies will not only help meet this demand, but also responds to Wake Forest's "Pro Humanitate"

motto, as its graduates will serve underprivileged communities while at the same time contributing to the quality of mainstream healthcare delivery and demonstrating the strong connections between liberal arts education and public service. The program offers four MA tracks: Intercultural Services in Healthcare; Teaching of Interpreting; Interpreting and Translation Studies, Spanish-English and Chinese-English. For students who are not able or ready to commit to earning an MA degree, but who would like to focus on an area of interest, the program also offers four Graduate Certificates and one postgraduate Certificate in specialized areas.

Requirements

The ITS program offers graduate study leading to a professional MA degree in Interpreting and Translation Studies through an intense two-semester course of study or an extended two year program for the Chinese-English Track. The program admits students on a full-time basis only.

Interpreting and Translation Studies: Spanish-English, Intercultural Services in Healthcare and Teaching of Interpreting are intense two-semester programs, where students in each track are required to complete 30 credit hours of course instruction, 1 credit hour of internship, and a 4 credit hour applied research project. None of the 30 credit hours of course instruction may be taken Pass/Fail.

The Interpreting and Translation Studies: Chinese-English track is a two year program of study where students are required to complete a minimum of 36 credit hours including 1 credit hour of internship and a 4 credit hour applied research project during the last 2 semesters of the program.

At the end of each student's program of study, the applied research project will be presented to the ITS graduate committee. The primary members of the applied research project committee are the ITS program faculty, but a student may include an approved committee member from outside of the program.

MASTER OF ARTS TRACKS.

The *Interpreting and Translation Track* is a language-specific, professionally oriented and research-based program that prepares interpreters and language specialists for working in the language. Graduates of this program will have a solid foundation in applied interpreting and translation studies, analysis of contextual meaning and extra-linguistic aspects of communication, cross-cultural awareness, sociolinguistics and dialectology, localization and terminology management, and advanced technologies for linguistic services. This program is especially appropriate for those who intend to pursue a doctorate in this field.

The *Teaching of Interpreting Studies Track* is a non-language-specific program that prepares graduates to be instructors in community or college-level interpreter training programs. It is the only program in the Northern hemisphere to focus on methodology of teaching interpreting in the medical context. Graduates of the program will not only provide their students with a set of techniques on how to interpret, but they will also teach, mentor, and raise awareness about the interpreting practice. The curriculum lays the foundation for understanding the interpreting encounter, the co-conversational process and sociocultural determinations. It also includes a broad interdisciplinary research component, which is absent from the training seminars/workshops of other, non-academic programs.

The *Intercultural Services in Healthcare Track* is a non-language-specific program and is the first such specialization in the U.S. It prepares graduates to enter managerial positions in culture-sensitive healthcare delivery areas such as bilingual employment, patient relations, translation and interpreting services, health discourse and health messages. The curriculum provides a solid foundation in cross-cultural health communication, sociolinguistics, applied interpreting and translation

studies, written and oral discourse analysis, medical translation, advanced technologies for linguistic services, localization and terminology management, organizational behavior, and health promotion as related to ethnicity.

Foreign Language or Special Skills Requirements

The Interpreting and Translation Track: Spanish-English. Applicants who do not have a college or high school degree from a Spanish speaking country are required to take an online Spanish proficiency exam.

The Interpreting and Translation Track: Chinese-English. Applicants who do not have a college or high school degree in Chinese (Mandarin) may be subject to a written exam and/or oral interview.

The Teaching of Interpreting Studies Track. Proven interpreting experience is required for this program.

The Intercultural Services in Healthcare Track. Foreign language competency is desirable, but not required for this program

Courses of Instruction

SPA 671. Contrastive Spanish/English Grammar and Stylistics. (3) Advanced study of structures and vocabulary, with an emphasis on common transfer mismatches in healthcare settings. Exploration of general principles behind 'atom-like' rules and the main lexical dichotomies, and how implications for meaning help in choosing the best option. Discussion of structures that are usually taught as idiomatic but are more compositional than previously thought: satellite-frame vs. verb frame constructions, datives, verb+particle, reflexive constructions, etc.

SPA 681. Spanish Translation. (3) Spanish 681 develops advanced translating skills through practice with a strong emphasis in Spanish into English translating, primarily having in mind English speakers as a target public. Some back translation exercises will be offered.

SPA 682. Spanish English Interpreting. (3) Spanish/English Interpreting an introductory course to the art of oral translation. It develops basic strategies useful in community, conference, court, escort and other types of interpreting. Current employment opportunities in the field of interpreting will be also briefly presented. In class work will focus on learning and practicing interpreting techniques. Individual, at home, preparation- besides the assigned readings and interpreting exercises- will also include a strong terminology enhancement.

SPA 683. Medical-Scientific Translation. (3) In this elective course, students will develop and refine a practical translation skill set within the scientific and medical domains. In addition, students will gain familiarity with textual conventions that govern source and target texts within these domains and deepen their understanding of both Spanish and English as language for special purposes. Apart from translation proper, students will also be able to analyze texts for register, style, tone and content to determine the most appropriate process to achieve the highest quality translation. Finally, students' research skills will improve through the examination of available resources and the creation of domain-specific resources.

SPA 685. Spanish for Medical Professions. (3) Study of terminology and sociocultural issues relevant to interlinguistic medical communication. Oral and written practice in the medical context..

TIS 684. Internship (1) The internship requires 60 hours of interpreting, translation or observation work in a professional interpreting, translation, educational or healthcare setting, depending on the student's chosen track. May be repeated for credit for a maximum of 3 hours.

TIS 731. Applied Interpreting Studies. (3) Explores connections between research and practical issues in studies of interpreting (simultaneous, consecutive, bilateral and other modalities). Focuses on the interdisciplinary nature of the interpreting field and, based on case studies, examines the interface between interpreting as a profession, research in interpreting studies, and the teaching of interpreting. Students are required to complete a research project.

TIS 732. Methodology of Teaching Interpreting. (3) Addresses syllabus design and lesson planning for teachers of interpreting in a field-specific context. It focuses on the development of interpreting skills, including recent technological developments. It explores classroom management options and strategies for providing feedback to students and covers internship design methods, including an on-site observation of various interpreting settings. Overall program design and methodology for teaching other courses in the interpreting curriculum will be also discussed.

TIS 733. Applied Translation Studies. (3) Examines the theory and practice of translation from a variety of linguistic and cultural angles. Introduces key concepts such as relevance, equivalence, skopos, back-translation, and explores critical approaches depending on the translated text types.

TIS 734. U.S. Heritage Speakers and Bilingualism. (3) Provides a comprehensive introduction to the fields of heritage languages, bilingualism, and bilingual education from a cross-disciplinary perspective. Covers a wide variety of topics, including, among others, individual and societal conceptions of heritage and dominant languages, general bilingual educational issues, bilingualism and multilingualism as they relate to identity, political and ideological issues, Spanish in the U.S.

TIS 735. Discourse Organization and Interpreting. (3) Explores the links between social situations, interlocutors, and the functional aspects of communicative events. Focuses on several important methodological approaches that have been developed to do discourse analysis in as much as they highlight important features of translation and interpreting. Students will review the varied traditions around meaning-making, including sociolinguistics, conversation analysis, critical discourse analysis, and discursive psychology. Readings will tie in traditional topics in discourse analysis with specific issues in translation and interpreting. This course will link theory to practice. One session per week will be devoted to practical, hands-on activities using real world data in various formats: written transcripts, aural speeches, or videos.

TIS 736. Organizational Behavior and Interpreting. (3) This course is designed to apply organizational behavior theories into the interpreting field in order to bring about a better understanding of how individual interpreters or interpreter teams actually behave in the large-scale project/organizational settings. Particular emphases are placed on interpreter roles and on how to evaluate interpreter performance, motivate interpreters, and maintain a high level of interpreting services. This course prepares students to enter managerial positions in translation/interpreting companies or organizations.

TIS 750. Contrastive Chinese-English Grammar and Stylistics. (3) Advanced study of structures and vocabulary. Exploration of general principles behind 'atom-like' rules and the main lexical dichotomies, and how implications for meaning help in choosing the best option. Discussion of structures that are usually taught as idiomatic but are more compositional than previously thought: subject-predicate vs. topic-comment, verb-particle, verb-complement, serial verb construction, relative clause construction, reduplication, imperative, negation, adposition, etc.

TIS 751 Chinese-English Translation. (3) Development of advanced translating skills through the practice or bidirectional translation with a strong emphasis on Chinese into English translating. Some back translation exercises will be offered as part of this course.

TIS 755 Chinese-English Interpreting. (3) Chinese-English Interpreting develops strategies for

community, conference, escort and other types of interpreting. Current employment opportunities in the field of interpreting will be also briefly presented. In class work will focus on learning and practicing interpreting techniques. Individual, at home, preparation – besides the assigned readings and interpreting exercises– will also include a strong terminology enhancement.

TIS 760 U.S. Landscape: Systems, Culture and Norms. (3) This course is designed for international students to increase their knowledge of U.S. socio-political structures and Anglo-American cultural identity through the study of U.S. history, politics and popular traditions.

TIS 785. Applied Research Project. (2) The applied research project will establish a rigorous connection between the practical experience in the workplace and the more theoretical experience in research and in the classroom. The applied research project will be divided in two components: during the fall semester (2 credit hours) students will learn about general research methodology and receive individual guidance to choose between the research project options. During the spring semester (2 credit hours) students will complete the research project under supervision of a project director.

TIS 789. Independent Study. (1-3) Independent research project to meet the needs and interests of selected students to be carried out under the direction of a faculty member. Must be approved by program director. May be repeated for credit.

Liberal Studies (LBS)

Reynolda Campus

Program Director

Anthony Parent

Assistant Director

Wanda S. Duncan

Overview

The liberal studies program is devoted to the interdisciplinary examination of human ideas and values, challenging students to engage in nuanced contemplation of life's most complex problems, through the perspectives of diverse academic disciplines. Two degrees are offered: the MA in Liberal Studies and the MALS degree. In the MA degree, students choose either American Cultural Studies or Global Studies as the integrated theme. Students who choose the MA program are likely to be enrolled full-time, with aspirations for further study in an interdisciplinary doctoral program. The MALS degree is designed for the individual who is compelled by intellectual curiosity to pursue a broad, interdisciplinary course of studies on a part-time basis. Students in either program choose from courses designed specifically for the liberal studies program and courses available in the University curriculum. Students are encouraged to use this flexibility to tailor interdisciplinary programs to suit their particular needs and interests.

Applicants for the liberal studies program should have demonstrated an ability to succeed in a graduate-level humanities program. Ability to succeed is determined by either having obtained a B average in undergraduate work or at least two Bs in graduate level courses. Because of the nature of the program, no specific undergraduate major is required. However, the applicant should have taken courses in the humanities area as an undergraduate or graduate and should express appropriate interest in an interdisciplinary humanities degree program.

Requirements

Residence Requirement. There is no minimum residence requirement. Degree requirements must be met within six years.

Course Requirements

MA in Liberal Studies: The degree is awarded to candidates who complete 24 hours of faculty-approved coursework with an average grade of B or above on all courses attempted and an acceptable thesis/project for which six hours of credit toward the 30 required for graduation are awarded.

A minimum of 12 of the 24 hours of coursework must be chosen from the interdisciplinary courses particularly designed for the liberal studies program. A student may take all required courses from these specially designed offerings. The Directed Study Course (786) does not count toward the requirement of four liberal studies courses. A maximum of five courses may be chosen from 600- and 700-level departmental courses that carry three hours of graduate credit. No more than four 600-level courses may count toward the MA degree. A student may transfer a maximum of six semester-hours from another liberal studies program or from an appropriate graduate program at the discretion of the director and the dean of the Graduate School.

MALS: The degree is awarded to candidates who complete 33 hours of faculty-approved coursework with an average grade of B or above in all courses attempted and an acceptable final paper which synthesizes their experience in the program.

A minimum of 21 of the 33 hours of coursework must be chosen from the interdisciplinary courses particularly designed for the liberal studies program. A student may take all required courses from these specially designed offerings. The Directed Study Course (786) does not count toward the requirement of five liberal studies courses. A maximum of four courses may be chosen from 600- and 700-level departmental courses that carry three hours of graduate credit. No more than five 600-level courses may count toward the MALS degree. A student may transfer a maximum of six semester-hours from another liberal studies program or from an appropriate graduate program at the discretion of the director and the dean of the Graduate School.

Admission to Degree Candidacy. A student is admitted to degree candidacy by the dean of the Graduate School after recommendation by the liberal studies program. The student must expect to complete the master's degree requirements with one additional semester's work.

Thesis Requirement (MA degree only). Six of the 30 hours required for the MALS degree are allotted for the thesis. Thesis courses are graded S (Satisfactory) or U (Unsatisfactory). If a U is assigned, the course must be repeated and an S earned before the degree can be awarded.

Theses are written under the supervision of the student's advisory committee (an advisor, and two other readers). All members of the advisory committee should be members of the graduate faculty. The committee will be approved by the dean of the Graduate School. With the approval of his or her advisor, a student may recommend a person who is not on the graduate faculty to serve on the examining committee as a voting member; however, the committee must have a minimum of two members from the graduate faculty. The thesis advisor must justify the participation of this person on the basis of research, publications, and/or professional activities in a letter to the dean. The defense must take place by the deadline date listed on the academic calendar. The liberal studies thesis project may be a traditional research paper, a field research project, or a creative work.

Final Examination. Requirements for thesis submission and format are posted on the WFU Graduate School website. (<http://graduate.wfu.edu>) The examination covers the thesis and knowledge in related areas. The possible committee decisions are unconditional pass, pass upon rectifying deficiencies, and fail. If a student fails, he/she may be reexamined only once.

Pass. If all committee members agree that the student has passed unconditionally, there is consensus to pass the examination. The committee chair will sign the ballot, submit the ballot to the Graduate School, and the student shall be recommended for award of the degree.

Pass Upon Rectifying Minor Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student

and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the thesis is modified to meet the committee's reservations. When the thesis has been modified, the student passes the examination and the student will be recommended for award of the degree.

Pass Upon Rectifying Major Deficiencies. If reservations are expressed by committee members, the chair of the committee will ensure that the reservations are communicated to the student and the dean of the Graduate School by signing and submitting the ballot to the Graduate School. The student and the advisor are jointly responsible for ensuring that the thesis is modified to meet the committee's reservations. When the thesis has been modified, the student passes the examination and the student will be recommended for award of the degree.

Fail. If, in the opinion of more than one member of the thesis committee, the student has failed the examination, there is no consensus to pass. The chair of the committee will advise the student that the thesis fails to meet the requirements of the Graduate School. The chair will ensure that the student knows the reason(s) for failure and will submit the ballot to the Graduate School. If the modified or new thesis fails to meet the requirements of the Graduate School, the student shall be dismissed.

Courses of Instruction

700. Prophecy & Protest: The Prophetic Voice in American Public Discourse (3) This course addresses how prophecy is a communicative act, and how prophetic speech has influenced American public discourse. Prophetic speech forms from the Hebrew Bible, traced through to American prophetic traditions such as those of the Quakers, Puritans, & Native Americans, and the use of American dissent rhetoric will be discussed. Readings will include primary texts from the Bible and American public discourse as well as important critical discussions of prophetism as a social and rhetorical phenomenon.

704. Globalization in Contemporary World Literature (3) This course explores globalism in contemporary poetry, narrative fiction, and films from the Caribbean, South Asia, South Africa, and multi-ethnic Britain. Students will focus on how literature reflects social processes associated with globalization, become familiar with recent postcolonial literature in English, and be introduced to debates over globalization. Students will also acquire skills in literary interpretation.

706. Reading Illness Narratives: Clinical & Literary Perspectives (3) This Course will examine fiction, memoirs, poems, plays, films, medical journal articles, and feminist theory that represent the experience of living with (and sometimes dying of) a serious illness. From their perspectives as a psychosocial oncologist and a literary and gender studies scholar, the professors will seek to illuminate how contemporary writers depict life-threatening illness, what people living with chronic disease choose to document, and what literary and visual techniques they use. We will also consider what these artists teach others about living close to death and how gender affects the themes and strategies of illness narratives. Emphasis will be placed on how the quality and skill of empathy appears in assigned texts and how it impacts patients, caregivers, readers, and viewers.

707. Ideas and Practices in Contemporary Political Protests. (3) The notion that contemporary political protests lack coherent ideas and visions has become sufficiently commonplace as to warrant critical investigation. Focusing on several recent cases from both the national and international scene, our seminar will explore the following questions: What are intellectual origins of and political visions being articulated by those individuals and groups active in recent waves of protest activity? What old and new understandings of some of the central concepts of politics—such as identity, power, sovereignty, territory, government, the state, democracy, the public sphere, movement, protest, and representation—emerge from these actions and our analysis of them?

708. Bodies, Commodities, & Global Environments. (3) this course investigates human practices that bring health, commodities, and environments together on multiple spatial scales from the

personal to the global. By exploring both historical and contemporaneous case studies, students will analyze how people understand and engage the natural world through specific cultural practices. The course looks into both material connections between bodies, commodities, and environments, and conceptualizations of human relationships with non-human nature. It examines biology, capitalism, mass media, environmental knowledge, and changes to the physical world. Students will evaluate commonly deployed concepts, develop a new lexicon of spatial connections, and make meaningful comparisons between locales and cultures that span the globe.

709. Bollywood: Culture & Identity in Modern India. (3) Popular Hindi cinema - widely known as “Bollywood” and purportedly the largest and one of the most ubiquitous film industries in the world- is a great media to understand India and its people in both their local as well as global dimensions. This course seeks to understand various markers of identity in India by considering films as both sources and interpretations of history and culture. It recasts Indian society by counterpoising Bollywood films and other visual sources such as documentaries and Indian television series with textual primary sources, secondary readings, and works of fiction. Specific topics include Indian nationalisms, gender relations and sexuality, social stratification, modernity, and community-driven identities such as those pertaining rural-urban dichotomy, family, and religion.

710. Herman Melville & His World. (3) This course is an introduction to certain classics of world literature and to American culture in the nineteenth century. We will study the literary, biographical, historical, and societal contexts out of which Melville’s important works grew, including the texts that inspired “Moby Dick,” such as Homer’s *Odyssey*, selections from the Bible, Plato’s dialogues, Shakespeare, Coleridge’s *Rime of the Ancient Mariner*, and Emerson’s essays. We will also consider the major events in Melville’s life; nineteenth-century debates about American identity; and the features of the U.S. literary marketplace.

711. Social Medias you: The Benefits & Burdens. (3) The course will describe the development of Computer Mediated Communication from its early days, tracing the important points of inflexion, and then focus on the way in which the current systems and devices allows for interactions through digital media using narbs, pointing towards the Otetlcal underpinning of the idea of narbs and its applications.

712. Afghanistan, Pakistan, Iraq Wards and U.S. Foreign Policy. (3) This course broadly addresses the phenomena of U.S. involvement in two wars -the Afghan War (2001-) and the Iraq War (2003-2011), approaching this topic from a historical and policy perspective. Owing to the on-going nature of the conflicts readings and emphasis may change as the term progresses. Readings will be drawn from books, policy reports, government documents, and journalistic sources.

713. Race, Myth, and the American Imagination. (3) This course is an examination of race, myth, and the American imagination. Students will interrogate how race has functioned in mythical ways, across space and time, in American history. From the ante-bellum period to the present, biblical narratives, literary texts, popular entertainment, including, journalism, television, and cinema, have shaped racial thinking in the United States. Such thinking has been internal and external to the American experience. Students will attend to the local and global import of racialized mythology. Because racial mythology is gendered, specific attention will be given to racialized myths about African- American women and men. Such a focus illuminates how racial mythology has been applied to the moral character of African- American communities. At the end of this course, students will have a heightened appreciation for the study of myth and its relation to race and the American imagination.

715. Rumor and Urban Legend. (3) The purpose of this course is to allow students to explore and discuss academic literature on rumor, urban legends, gossip and myths. Our society prides itself

on its rationalist perspective, but the reality is that people find and construct knowledge in ways that are idiosyncratic, but personally logical. These four related communication phenomena may serve constructive social functions even if those are not immediately obvious. The power of rumor and urban legends to capture the human imagination and to influence the workings of society is profound and fascinating. The readings will draw on important studies in sociology, psychology, communication and folklore.

720-729. Special Topics. (3) Topics vary by semester.

786. Directed Study. (1-3) Working with a faculty advisor, the student completes a special reading project in an area not covered in regular courses or a special research project not related to the master’s thesis. A student who wishes to enroll must submit the Directed Study Form, signed by the advisor, to the program director. May be repeated for credit for a maximum of 6 hours if topic varies.

824. Commemoratives of the Middle Passage. (3) This course examines the historical memory of the slave trade which forcibly removed more than 10 million Africans from their homes. The Middle Passage has been memorialized in films, novels, poetry, the plastic arts, exhibits, and historical monuments, especially the slave castles along the West African coast. Major themes explored are the sensory and experiential expressions, cultural diversity, internal population dynamics, gendered relations of power, and sexual difference. The social reproduction of cultural mores with the removal of “saltwater” Africans to the Americas and the absorption of new sources of slaves in Africa will also be examined.

853. State, Economy and International Competitiveness. (3) The course explores a range of important case studies of national economic performance, including the strengths and weaknesses of leading examples of welfare capitalism, liberal capitalism, and capitalisms in which the state plays an active developmental role. We will examine the viability of welfare capitalism against the growing penchant for liberal capitalist solutions to contemporary problems of economic growth, international competitiveness and unemployment. We will also explore the impact of labor, capital, culture and the state, including an examination of the main theories of economic growth currently informing public policy, and the future of the American model of capitalism.

791. Thesis Research I. (3) Research directed toward fulfilling the thesis requirement. *Satisfactory/Unsatisfactory*

792. Thesis Research II. (3) Research directed toward fulfilling the thesis requirement. *Satisfactory/Unsatisfactory*

Mathematics and Statistics (MTH)

Reynolda Campus

Program Director

Chair

Associate Chair

Taylor Professor

Gail Family Faculty Fellow and Professor

Professors

Edward E. Allen, Kenneth S. Berenhaut, Richard D. Carmichael,

Mioahua Jiang, Ellen Kirkman, James L. Norris III

Associate Professors

Jennifer Erway, Jason Parsley, Sarah Raynor

Sterge Faculty Fellows and Assistant Professor
 Assistant Professors
 Teacher-Scholar Postdoctoral Fellows
 Research Professors

Sarah Mason, Jeremy Rouse
 Robert Erhardt, W. Frank Moore
 Jason Gaddis, M. Matthew Mastin, Mauricio Rivas
 John Baxley, Fredric T. Howard, James Kuzmanovich,
 Robert J. Plemmons

Overview

The department offers a program of study leading to the master of arts degree in mathematics. The program is designed to accommodate students seeking either a terminal master's degree or preparation for PhD work.

To obtain the MA in one year, a graduate student must present evidence of having completed the work required of an undergraduate who majors in mathematics in a fully accredited college or university. Such a major is understood to include at least 33 semester hours of mathematics, of which at least 18 require as prerequisite one year of calculus. Students who are admitted with less than the level of preparation specified should expect to take additional courses at the 600-level and remain in residence for more than one year.

The requirements for the MA degree may be met in either of two ways, depending upon whether or not a thesis is submitted. If a thesis is written, 30 semester hours of coursework, including MTH 791, 792, and at least four additional courses numbered above 700, are required for the MA degree. If a thesis is not written, 36 semester hours of coursework, including at least five courses numbered above 700, are required for the MA degree. Math 791 and 792 cannot be counted as part of this coursework. An advanced course is required in each of the areas of analysis, algebra, and topology; normally this requirement is met with the courses 711, 721, 731. With the approval of the Graduate Committee, graduate courses may be taken in related areas to fulfill requirements; however, no more than 6 such hours may count toward the requirements for either the thesis or non-thesis option.

Students desiring to use work taken in the department for graduate teacher certification should consult the Department of Education before applying for candidacy.

Computers are used in mathematics in conjunction with coursework and research. The department utilizes UNIX-based workstations and file servers along with microcomputers connected to local and wide-area networks. Access is available to the University's computing facilities, supercomputers at the North Carolina Supercomputing Center and other specialized computing equipment.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Courses of Instruction

605. Applied Multivariable Mathematics. (3) Introduction to several topics in applied mathematics including complex numbers, probability, matrix algebra, multivariable calculus, and ordinary differential equations. May not be used toward any graduate degree offered by the department.

606. Advanced Mathematics for the Physical Sciences. (3) Advanced topics in linear algebra, special functions, integral transforms, and partial differential equations. May not be used toward any graduate degree offered by the department. *P—MTH 605*

611, 612. Introductory Real Analysis I, II. (3, 3) Limits and continuity in metric spaces, sequences and series, differentiation and Riemann-Stieltjes integration, uniform convergence, power series and Fourier series, differentiation of vector functions, implicit and inverse function theorems.

617. Complex Analysis I. (3) Analytic functions Cauchy's theorem and its consequences, power series, and residue calculus.

622. Modern Algebra II. (3) A continuation of modern abstract algebra through the study of

additional properties of groups, rings, and fields.

624. Linear Algebra II. (3) A thorough treatment of vector spaces and linear transformations over an arbitrary field, canonical forms, inner product spaces, and linear groups.

626. Numerical Linear Algebra. (3) An introduction to numerical methods for solving matrix and related problems in science and engineering using a high-level matrix-oriented language such as MATLAB. Topics include systems of linear equations, least squares methods, and eigenvalue computations. Special emphasis is given to applications.

631. Geometry. (3) An introduction to axiomatic geometry including a comparison of Euclidean and non-Euclidean geometries.

634. Differential Geometry. (3) Introduction to the theory of curves and surfaces in two and three dimensional space including such topics as curvature, geodesics, and minimal surfaces.

645. Elementary Number Theory. (3) Course topics include properties of integers, congruences, and prime numbers, with additional topics chosen from arithmetic functions, primitive roots, quadratic residues, Pythagorean triples, and sums of squares.

646. Modern Number Theory (3) Course topics include a selection of number-theory topics of recent interest. Some examples include elliptic curves, partitions, modular forms, the Riemann zeta function, and algebraic number theory.

647. Graph Theory. (3) Paths, circuits, trees, planar graphs, spanning trees, graph coloring, perfect graphs, Ramsey theory, directed graphs, enumeration of graphs and graph theoretic algorithms.

648, 649. Combinatorial Analysis I, II. (3, 3) Enumeration techniques, generating functions, recurrence formulas, the principle of inclusion and exclusion, Polya theory, graph theory, combinatorial algorithms, partially ordered sets, designs, Ramsey theory, symmetric functions, and Schur functions.

652. Partial Differential Equations. (3) Detailed study of partial differential equations, including the heat, wave, and Laplace equations, using methods such as separation of variables, characteristics, Green's functions, and the maximum principle.

653. Probability Models. (3) Course topics include an introduction to probability models, Markov chains, Poisson process and Markov decision processes. Applications will emphasize problems in business and management science.

654. Discrete Dynamical Systems. (3) Introduction to the theory of discrete dynamical systems as applied to disciplines such as biology and economics. Includes methods for finding explicit solutions, equilibrium and stability analysis, phase plane analysis, analysis of Markov chains and bifurcation theory.

655. Introduction to Numerical Methods. (3) An introduction to numerical computations on modern computer architectures; floating point arithmetic and round-off error including programming in a scientific/engineering language such as MATLAB, or Fortran. Topics include algorithms and computer techniques for the solution of problems such as roots of functions, approximations, integration, systems of linear equations and least squares methods. Also listed as CSC 655.

656. Statistical Methods. (3) A project-orientated course emphasizing data analysis, with introductions to nonparametric methods, multiple and logistic regression, model selection, design, categorical data or Bayesian methods. May not be used toward any graduate degree offered by the department.

657. Probability. (3) Course topics include probability distributions, mathematical expectation, and

sampling distributions. MTH 657 covers much of the material on the syllabus for the first actuarial exam.

658. Mathematical Statistics. (3) This course will cover derivation of point estimators, hypothesis testing, and confidence intervals using both maximum likelihood and Bayesian approaches. *P—MTH 657 or POI*

662. Multivariate Statistics. (3) This course will concentrate on multivariate and generalized linear methods for classification, modeling, discrimination and analysis.

664. Computational and Nonparametric Statistics. (3) This course focuses on computationally intensive methods to fit statistical models to data. Topics include simulation, Monte Carlo integration and Markov Chain Monte Carlo, sub-sampling, and nonparametric estimation and regression. *P—657 or POI*

667. Linear Models. (3) This course focuses on theory of estimation and testing in linear models. Topics include least squares and the normal equations, the Gauss-Markov Theorem, testing general linear hypotheses, and generalized linear models. *P—657 or POI*

669. Advanced Topics in Statistics. (1, 2, or 3) Topics in statistics not considered in regular courses or which continue study begun in regular courses. Content varies.

681. Individual Study. (1 or 2) A course of independent study directed by a faculty adviser. By prearrangement. May be repeated for credit.

682. Reading in Mathematics. (1, 2, or 3) Reading in mathematical topics to provide a foundational basis for more advanced study in a particular mathematical area. Topics vary and may include material from algebra, analysis, combinatorics, computational or applied mathematics, number theory, topology, or statistics. May not be used to satisfy any requirement in the mathematics MA degree with thesis. No more than three hours may be applied to the requirements for the mathematics MA degree without thesis. May be repeated for credit for a total of 3 hours.

683. Advanced Topics in Mathematics. (1, 2 or 3) Topics in mathematics that are not considered in regular courses. Content varies.

669. Advanced Topics in Statistics. (1, 2 or 3) Topics in statistics not considered in regular courses or which continue study begun in regular courses. Content varies.

711, 712. Real Analysis. (3, 3) Measure and integration theory, elementary functional analysis, selected advanced topics in analysis.

715, 716. Seminar in Analysis. (1, 1)

717. Optimization in Banach Spaces. (3) Banach and Hilbert spaces, best approximations, linear operators and adjoints, Frechet derivatives and nonlinear optimization, fixed points and iterative methods. Applications to control theory, mathematical programming, and numerical analysis.

718. Topics in Analysis. (3) Selected topics from functional analysis or analytic function theory.

721, 722. Abstract Algebra. (3, 3) Groups, rings, fields, extensions, Euclidean domains, polynomials, vector spaces, Galois theory.

723, 724. Seminar on Theory of Matrices. (1, 1)

725, 726. Seminar in Algebra. (1, 1)

728. Topics in Algebra. (3) Topics vary and may include algebraic coding theory, algebraic number theory, matrix theory, representation theory, non-commutative ring theory.

731, 732. General Topology. (3, 3) An axiomatic development of topological spaces. Includes continuity, connectedness, compactness, separation axioms, metric spaces, convergence, embedding and metrication, function and quotient spaces, and complete metric spaces.

733. Topics in Topology and Geometry. (3) Topics vary and may include knot theory, non-Euclidean geometry, combinatorial topology, differential topology, minimal surfaces and algebraic topology.

735, 736. Seminar on Topology. (1, 1)

737, 738. Seminar on Geometry. (1, 1)

744. Topics in Number Theory. (3) Topics vary and are chosen from the areas of analytic, algebraic, and elementary number theory. Topics may include Farey fractions, the theory of partitions, Waring's problem, prime number theorem, and Dirichlet's problem.

745, 746. Seminar on Number Theory. (1, 1)

747. Topics in Discrete Mathematics. (3) Topics vary and may include enumerative combinatorics, graph theory, algebraic combinatorics, combinatorial optimization, coding theory, experimental designs, Ramsey theory, Polya theory, representation theory, set theory and mathematical logic.

748, 749. Seminar on Combinatorial Analysis. (1, 1)

750. Dynamical Systems. (3) Introduction to modern theory of dynamical systems. Linear and nonlinear autonomous differential equations, invariant sets, closed orbits, Poincare maps, structural stability, center manifolds, normal forms, local bifurcations of equilibria, linear and non-linear maps, hyperbolic sets, attractors, symbolic representation, fractal dimensions. *P—MTH 611*

752. Topics in Applied Mathematics. (3) Topics vary and may include computational methods in differential equations, optimization methods, approximation techniques, eigenvalue problems. May be repeated for credit.

753. Nonlinear Optimization. (3) The problem of finding global minimums of functions is addressed in the context of problems in which many local minima exist. Numerical techniques are emphasized, including gradient descent and quasi-Newton methods. Current literature is examined and a comparison made of various techniques for both unconstrained and constrained optimization problems. Credit not allowed for both MTH 753 and CSC 753. *P—MTH 655 or CSC 655.*

754. Numerical Methods for Partial Differential Equations. (3) Numerical techniques for solving partial differential equations (including elliptic, parabolic and hyperbolic) are studied along with applications to science and engineering. Theoretical foundations are described and emphasis is placed on algorithm design and implementation using either C, FORTRAN or MATLAB. Credit not allowed for both MTH 754 and CSC 754. *P—MTH 655 or CSC 655*

758. Topics in Statistics. (3) Topics vary and may include linear models, nonparametric statistics, stochastic processes. May be repeated for credit.

761. Stochastic Processes. (3) Discrete time and continuous time Markov chains, Poisson processes, general birth and death processes, renewal theory. Applications, including general queuing models.

791, 792. Thesis Research. (1-9). May be repeated for credit. *Satisfactory/Unsatisfactory*

Microbiology and Immunology (MICR)

Bowman Gray Campus

Program Director

Jason Grayson

Chair

Martha A. Alexander-Miller

Professors

Martha A. Alexander-Miller, Charles E. McCall, Steven B. Mizel,
W. Edward Swords

Associate Professors

Rajendar Deora, Jason M. Grayson, David Ornelles

Assistant Professors

Erik Barton, Karen M. Haas

Overview

The Department of Microbiology and Immunology offers a graduate program leading to the PhD degree. The program prepares students for careers in research and teaching in the fields of bacteriology, immunology, molecular biology, and virology.

In addition to completion of the core curriculum, program specific course requirements include Fundamentals of Bacteriology, Fundamentals of Immunology, and Fundamentals of Virology. In addition, in the second and third years, all students participate in the interdisciplinary, literature-based course Advanced Topics.

Students enter the program through the Molecular and Cellular Biosciences Track and participate in the MCB common curriculum in the first year. At the end of the first year, students select their research area and dissertation advisor. Students entering the program may choose to do their thesis work among the areas of bacterial and viral pathogenesis, cellular and molecular immunology, and the cell and molecular biology of the microbe-host interaction.

See the Department of Microbiology and Immunology homepage (www.wakehealth/microbio) for further information on the department and detailed descriptions of faculty research interests.

Degree Requirements: please see “Requirements for Degrees” beginning on page 25.

MCB Track Electives

MCB 731. Fundamentals of Virology. (2) Basic aspects of the structure, replication, and pathogenesis of animal viruses are taught through a mixture of lectures and discussions based on current literature. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas of virology.

MCB 732. Fundamentals of Bacteriology. (2) Basic aspects of bacterial structure, physiology, genetics, and pathogenesis are taught through a mixture of lectures and discussions based on the current literature. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas of bacteriology.

MCB 734. Fundamentals of Immunology. (2) This course focuses on the cellular, biochemical, and molecular aspects of innate, cellular and humoral immunity. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas of immunology.

MICR Advance Courses

704. Microbiology of Infectious Diseases. (3) An in-depth study of the role of microbial agents in host-parasite interactions. The course includes a survey of the basic properties of bacteria, viruses, fungi, and parasites. The pathways leading from exposure to successful infection to disease are examined. Specific examples of major pathogens and the diseases they cause are discussed in detail in the context of clinical situations employing the problem-based learning format. *P—POI*

707. Scientific Methodology. (1) Instruction in the scientific method as applied to basic research in bacteriology, virology, and immunology and microbial pathogenesis. Examples from the scientific literature are used to provide practical training in effective oral communication and expository scientific writing. *P—POI*

711. Tutorial in Medical Microbiology. (1-3) Guided reading and discussion of the pathogenesis of infectious diseases.

716. Practical Statistics in Microbiology and Immunology. (1) Provides a practical introduction to the application of statistical methods commonly required for studies in bacteriology, virology, and immunology. Consists of a mixture of lectures and in-class exercises based on problems drawn from current research in the department. Topics include sampling principles, descriptive statistics, parametric and non-parametric tests, one-way analysis of variance, contingency tables, linear regression, and power calculations. Emphasis is on recognizing and applying the appropriate methods. *P—POI*

719, 720. Research in Microbiology. (1-9). *Satisfactory/Unsatisfactory*

721, 722. Teacher Training. (0) Advanced graduate students give a lecture in their areas of specialization in one of the graduate courses offered by the department. *P—Advanced standing.*

749, 750. Advanced Topics in Microbiology and Immunology. (2) Seminar course dedicated to the analysis of current research literature on the fundamental biochemical and molecular processes involved in the growth, differentiation, and functions of bacteria, viruses, and eukaryotic cells. The course not only provides the student with experience in literature analysis, but also offers a broad exposure to timely and important themes and principles that link the disciplines of microbiology, virology, and immunology. *P—bacteriology, immunology, and virology.*

Molecular and Cellular Biosciences (MCB) Track 4

Bowman Gray Campus

Track Director

Fred Perrino

Overview

Molecular and Cellular Biosciences (MCB) is an interdisciplinary graduate track that provides students with opportunities to choose from among mentors whose research spans basic and translational fields of cutting-edge molecular and cellular biology. Graduate programs within the MCB track enable students to earn a Ph.D. in Biochemistry and Molecular Biology, Cancer Biology, Microbiology and Immunology, Molecular Genetics and Genomics, or Molecular Medicine and Translational Science, as well as a Certificate in Structural and Computational Biophysics. In their first year, MCB students will complete a short course in analytical skills followed by a year-long core course that first examines macromolecular structure, synthesis and function, as well as gene expression and genetics; the second semester focuses on cell structure, cell communication, organ systems integration and physiology and pathology. MCB students will also select three program-specific electives. They will explore a range of research opportunities by participating in three research rotations, each in a different MCB laboratory. These rotations introduce them to new techniques and guide their selection of a graduate program and dissertation research advisor; as 2nd year students they will complete program-specific requirements along their path toward a doctoral degree.

Degree Requirements: please see “Requirements for Degrees” beginning on page 25.

Courses of Instruction

700. Analytical Skills. (1) Molecular and Cellular Biosciences students will begin their graduate education with this 1-credit course focused on data acquisition and analysis methods. Balancing theory and practice, it will refresh their mathematical skills; describe techniques for isolating and characterizing cells and their macromolecular components; explore methods for manipulating genes and performing high-throughput assays; and introduce bioinformatics approaches. A series of take-home exercises reinforce problem-based learning. MCB 700 will be offered as 10 x 1.5 h. sessions in the two weeks preceding fall term.

701. Molecular and Cellular Biosciences. (1-6) Molecular and Cellular Biosciences students will take a two-semester core course that will cover fundamental principles of the discipline. The overall goal of the course is to develop the student's understanding of molecular and cellular biosciences in the context of biomedical research as it relates to human disease. In the first semester students will focus on the basic building blocks of the cell, their synthesis, cellular metabolism and intracellular transport. The semester is broken into five blocks or themes that in order roughly cover; 1) proteins and enzymes; 2) carbohydrates and lipids; 3) DNA and microbial genetics; 4), mammalian genetics and genomics; and 5) intracellular sorting, cytoskeleton, extracellular matrix. The course is in the format of didactic lectures and meets for 6 hrs per week (four 90 minute lectures/week). Students are evaluated on the performance of 5 written exams given at the end of each block. Other Tracks may elect to have students take one or more blocks as 1 credit courses.

702. Molecular and Cellular Biosciences. (1-6) In the second semester students will focus on additional cell biological topics followed by several units devoted to integrative physiology. The semester is broken into five blocks or themes that cover 1) cell signaling, cell-cell communication; 2) cell cycle, cell death, oncogenesis, developmental and stem cell biology; 3) endocrinology and metabolic control and integration; 4) renal, gastrointestinal, cardiovascular, and respiratory physiology; and 5) microbiology and innate and acquired immunity. The course is in the format of didactic lectures and meets for 6 hours per week (four 90 minute lectures/week). Students are evaluated on the performance of 5 written exams given at the end of each block. Other Tracks may elect to have students take one or more blocks as 1 credit courses. Although not required, it is expected that students are familiar with material covered in MCB 701.

703, 704, 705. Introduction to Molecular and Cellular Biosciences Research. (1-6) Molecular and Cellular Bioscience students will gain experience with the planning and execution of research, and the interpretation and presentation of experimental results. To put these principles into practice, they will carry out mentored research projects in the laboratories of three different Molecular and Cellular Biosciences faculty members with an optional fourth rotation during the summer term.
Satisfactory/Unsatisfactory

711. Biological Systems and Structures. (2) In depth study of macromolecular assembly and interactions, as well as the application of structural biology and proteomics technology. Contemporary concepts of the principles of protein and nucleic acid structure will be presented. Other topics include methods for structure determination such as X-ray diffraction, NMR spectrometry, and molecular modeling.

712. Biological Spectroscopy. (2) Principles and practicalities of the study of biomolecules using spectroscopic techniques such as absorbance, fluorescence and circular dichroism analyses will be covered. Other biophysical approaches such as mass spectrometry and sedimentation analysis will be included. Topics in the study of enzymes utilizing these techniques will be discussed.

713. Large Experimental Datasets and Analysis. (2) Conducted as a combination of lectures,

reading assignments, and student-led discussions. Lectures detail experimental methods that generate large-scale datasets. Topics will include genotyping, expression profiling, metabolomics, high-content cellular imaging techniques and practical examples of bioinformatic software and statistic analyses.

714. Experimental Approaches to Cell Biology and Disease. (2) Conducted as a combination of lectures, reading assignments, and student-led discussions. With an emphasis on cellular functions involved in disease, lectures detail common techniques used in cell biology experimentation. Practical examples and issues of functional genomic approaches are discussed, including design of appropriate cell biology models.

721. Carcinogenesis, DNA Damage and Repair. (2) This course will cover the identification and reaction mechanisms of environmental carcinogens, DNA damage and mutagenesis by endogenous and exogenous agents, and the mechanisms of DNA repair.

722. Molecular Pathogenesis of Cancer. (2) Fundamental molecular changes in cells and tissues that contribute to the malignant phenotype are discussed. Topics include alterations in genes and chromatin, signaling pathways, tumor cell metabolism, and the tumor microenvironment.

723. Topics in Cancer Biology. (2) Teaches students how to evaluate and communicate scientifically in the area of cell biology and cancer. Examples are taken from all areas of cancer in this advanced course. Uses current peer-reviewed journal articles to teach fundamental concepts and act as a medium for allowing the students to communicate ideas with an emphasis on presentation skills.

731. Fundamentals of Virology. (2) Basic aspects of the structure, replication, and pathogenesis of animal viruses are taught through a mixture of lectures and discussions based on current literature. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas of virology.

732. Fundamentals of Bacteriology. (2) Basic aspects of bacterial structure, physiology, genetics, and pathogenesis are taught through a mixture of lectures and discussions based on the current literature. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas of bacteriology.

734. Fundamentals of Immunology. (2) This course focuses on the cellular, biochemical, and molecular aspects of innate, cellular and humoral immunity. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas of immunology.

741. Computational Biology. (2) An introduction to the use of software and resources available for analysis of genes and proteins. Students will learn how to use practical tools to analyze protein and gene sequences through a combination of lectures and completion of hands-on problem sets.

742. Molecular Genetics and Genomics of Human Disease. (2) This course will introduce students to applications of molecular genetic and genomic methods for the identification and functional characterization of genes contributing to human disease. In addition, complementary lectures will address the application of cell and animal model systems and methods which provide functional insights into the mechanism of action of genes that contribute to disease.

752. Foundations of Translational Science. (2) Builds on the student's basic biochemistry and cell biology knowledge with an intensive examination of the molecular basis of human disease and its' treatment. The course mixes lectures with a case-based approach to take students through the diagnosis, physiology, pathophysiology, and the molecular mechanisms of several diseases. Learning issues are developed by the group, centered upon treatment options, their mechanisms of action, the appropriate design of clinical trials to test new therapies, and the research base for further advances

in prevention and treatment. MD and PhD facilitators assist with student-led discussions. Relevant, current literature is examined.

753. Advanced Topics in Regenerative Medicine. (3) The remarkable advances in biomaterials, stem cell biology, and genetic manipulation over the last several years have now made it possible to begin devising means of treating diseases that were previously incurable, and developing corrective therapies for crippling injuries. These advances have led to the emergence of the field of research/clinical investigation that is known as Regenerative Medicine, and this field promises to revolutionize the way we treat/manage both disease and injury. In this course, students will learn about the major organ/tissue systems of the body, the key enabling technologies that make regenerative medicine possible, and how these technologies can be applied to each organ/tissue to mediate regeneration/repair to treat disease/repair injury. Students will then embark on projects that will require them to apply the knowledge gained from the lectures to develop realistic and clinically translational solutions to generate specific organs for transplantation. Students will present their projects to the class at the end of the semester.

761. Pathobiology of Atherosclerosis and Cardiovascular Disease. (2) This lecture course explores the pathogenic mechanisms that underlie this most prevalent of human diseases. Provides an overview of the current concepts of the pathogenesis of atherosclerosis and its clinical sequelae, myocardial infarction, stroke, and peripheral vascular disease. Specific topics include the natural history of atherosclerosis, experimental approaches for the study of atherosclerosis and cardiovascular disease (cell and animal models, featuring genetically-modified mouse models), metabolic perturbations underlying disease initiation, progression, and regression, lipid metabolism and dyslipidemias, diabetes, diet and obesity, hypertension, behavioral factors, vascular wall biology (including new imaging techniques) and treatment of cardiovascular disease. A unique feature of the course is its integration of basic, clinical, and translational research. The focus on current research directions provides an excellent foundation for students interested in atherosclerosis, lipid metabolism, vascular biology, and cardiovascular disease as they plan their own research careers. It should also be of interest to students in other areas of translational medicine.

762. Lipid Metabolism and Chronic Human Disease. (2) This is an introductory course designed to cover basic concepts of lipid metabolism and its relationship to the development of chronic human diseases. The first half of the course will cover lipid structure and properties and lipid absorption, transport, synthesis, storage and mobilization from tissues, and degradation. The role of lipids in cell signaling and innate/acquired immunity will also be discussed. The second half of the course will explore the role of lipid metabolism in monogenetic disorders and in the pathogenesis of chronic human diseases, such as atherosclerosis, insulin resistance, obesity and metabolic syndrome. Current research in Lipid Sciences and Chronic diseases will also be covered.

763. Fundamentals of Pathology. (2) Introduction to the principles of disease with special emphasis on biochemical and cellular mechanisms of pathogenesis. The course is designed to provide pathological correlates including, genetic, metabolic, immune and infectious, for concepts covered in Molecular and Cellular Biosciences (MCB 701 and 702). Organized by organ systems, the course also provides exposure to human gross pathology.

Molecular Genetics and Genomics (MOGN)

Bowman Gray Campus

Program Director

Timothy Howard

Professors

Rebecca W. Alexander, Martha A. Alexander-Miller, Colin E. Bishop, Donald W. Bowden, Yong Q. Chen, Martin K. Childers (Adjunct), H. Alexander Claiborne, Waldemar Debinski, William H. Gmeiner, Daniel B. Kim-Shapiro, Douglas S. Lyles, Charles E. McCall, Deborah A. Meyers, Carol E. Milligan, Steven Mizel, Gloria K. Muday, Barbara J. Nicklas, John S. Parks, Fred W. Perrino, Mark J. Pettenati, Leslie B. Poole, Thomas C. Register, Peter B. Smith, Beverly M. Snively, Shay Soker, W. Edward Swords, Ann Tallant, Richard B. Weinberg

Associate Professors

Zheng Cui, Rajendar Deora, Gregory A. Hawkins, Thomas Hollis, Timothy D. Howard, Fang-Chi Hsu, Steven J. Kridel, Yongmei Liu, W. Todd Lowther, Lance D. Miller, Akiva Mintz, Nilamadhab Mishra, Chor Yin Ng, David A. Ornelles

Assistant Professors

Peter A. Antinozzi, Timothy S. Pardee, Derek Parsonage, Stephen J. Walker

Overview

The graduate training program in Molecular Genetics and Genomics is an interdisciplinary curriculum that leads to the Ph.D. degree in Molecular Genetics and Genomics. The major goal of the program is to train students for independent research and teaching in the fields of laboratory molecular and cellular biology or computational analysis in genetics and genomics. The program faculty has departmental affiliations in both basic science and clinical departments of the Medical School, and departments on the Reynolda Campus.

The Graduate Program in Molecular Genetics and Genomics provides specialized training in the field of Molecular Genetics and Genomics while integrating student training as much as possible with traditional departmental disciplines. Students may elect to pursue this program of study after successful completion of the first year common curriculum of the Molecular and Cellular Biosciences (MCB) Track.

The program accepts students with a variety of undergraduate degrees including majors in the biological sciences, chemistry, mathematics, computer science and statistics. Students with a laboratory focus have usually successfully completed courses in general biology, general chemistry, organic chemistry, physics, statistics, and mathematics through calculus. Students with analytical interests have successfully completed advanced courses in mathematics, statistics, and/or computer science.

During the second year, students begin research in their dissertation laboratory and take specialty courses relevant to the area of research conducted in that laboratory. Second-year courses include the advanced seminar-style courses, 741 and 742. Dissertation research is performed under the supervision of a program faculty member and is tailored to meet the interests and training objectives of the individual student.

Degree Requirements: please see "Requirements for Degrees" beginning on page 25.

MCB Track Electives

MCB 741. Computational Biology. (2) An introduction to the use of software and resources available for analysis of genes and proteins. Students will learn how to use practical tools to analyze

protein and gene sequences through a combination of lectures and completion of hands-on problem sets.

MCB 742. Molecular Genetics and Genomics of Human Disease. (2) Introduces students to applications of molecular genetic and genomic methods for the identification and functional characterization of genes contributing to human disease. In addition, complementary lectures address the application of cell and animal model systems and methods which provide functional insights into the mechanism of action of genes that contribute to disease.

MOGN Advanced Courses

701, 702. Research in Molecular Genetics. (1-9) Research investigations in molecular genetics are conducted in the laboratories of program members studying a wide range of disciplines. *Satisfactory/Unsatisfactory*

710. Scientific Writing. (1) Designed to provide training in the preparation of scientific papers for publication, preparation of research proposals, and discussions of ethical conduct of scientific research. *P—POI*

719, 720. Special Topics in Stem Cell Biology. (2) Utilizes directed readings and student presentations of primary literature to introduce students to the field of stem cell biology. Content focuses primarily on human stem cell properties, including pluripotency and its maintenance, the role of chromatin remodeling in fate determination and lineage restriction, self-renewal and differentiation, and the genetic conversion of somatic cells into pluripotent stem cells. The field is expanding rapidly and course content will be modified as needed to incorporate new findings and applications in stem cell biology and translational medicine. A background in the form of undergraduate or graduate courses in and/or developmental biology is strongly recommended. Also listed as MMTS 719, 720. *P—POI*

726. Genetic Epidemiology. (2) Presents fundamental concepts and methods in genetic epidemiology. Introduces various genetic epidemiology study designs in related and unrelated individuals and covers basic analysis, inferences, plus their strengths and limitations. Lecture and lab. *P—MCB 701, CPTS 720; CPTS 730, or POI*

734. Human Molecular Genetics. (2) A combined lecture/seminar course providing an overview of current theoretical and technical approaches for locating, identifying, and cloning human genes using molecular genetic methods. Emphasis is on the search for genes that contribute to simple single-gene disorders and common complex diseases. Topics include genetic mapping and association studies, chromosome structure at the molecular level, identification of coding sequences and disease susceptibility genes, and functional analysis of gene products. *P—MCB 701 or POI*

741, 742. Tutorials in Molecular Biology. (2, 2) Seminar course that focuses on new and important aspects of research in molecular and cellular biology with an emphasis on the current literature. Each semester the course explores specific themes chosen by a committee of faculty and students. Students select topics for presentation and lead discussions with faculty and graduate students.

751. Medical Genetics. (3) Introduction to the principles and clinical evaluation of human genetic diseases. Covers modes of inheritance, etiology, characteristics, epidemiology, pathogenesis and clinical features of a wide variety of medical genetic disorders. Procedures for diagnostic confirmation (cytogenetic, molecular, biochemical), considerations in management and aspects of genetic counseling is presented.

Molecular Medicine and Translational Science (MMTS)

Bowman Gray Campus

Co-Directors

John S. Parks and Robert N. Taylor

Professors

Martha Alexander-Miller, Graca Almeida-Porada, Anthony Atala, Colin Bishop, Khalil Bitar, Eugene Bleecker, Donald Bowden, K. Bridget Brosnihan, Mark Chappell, Che-ping Cheng, Ski Chilton, J. Mark Cline, Larry Daniel, Paul A. Dawson, Waldemar Debinski, Osvaldo Delbono, James Eisenach, Steven Feldman, Carlos Ferrario, Barry Freedman, Randolph Geary, William Gmeiner, Dwayne Godwin, Leanne Groban, David Herrington, Kevin High, Allyn Howlett, Gregory Hundley, Tamison Jewett, Jay Kaplan, Danny Kim-Shapiro, S. Bruce King, Nancy Kock, Greg Kucera, Richard Loeser, Charles E. McCall, Donald McClain, Deborah Meyers, Emmanuel C. Opara, John Parks, Boris Pasche, Mark Pettenati, Leslie Poole, Thomas Register, Lawrence Rudel, Carol A. Shively, Thomas L. Smith, Shay Soker, W. Edward Swords, E. Ann Tallant, Robert N. Taylor, Mary Lou Voytko, William Wagner, Richard B. Weinberg, J. Koudy Williams, Jianfeng Xu, James J. Yoo

Associate Professors

Susan Appt, Werner Bischoff, Zheng Cui, Rajendar Deora, Purnima Dubey, Cristin Ferguson, Cristina Furdui, Jason Grayson, Kristen Hairston, Greg Hawkins, J. Jason Hoth, Timothy D. Howard, George Kulik, Jed Macosko, Nilamadhab Mishra, Akiva Mintz, Christopher Porada, Vidula Vachharajani, Raghunatha Yammani

Assistant Professors

Peter Antinozzi, Mark Brown, David Caudell, Tracy Criswell, Daniel Clark Files, TanYa Gwathmey-Williams, Sang Jin Lee, Nicole Levi, Tiefu Liu, Baisong Lu, Anthony Molina, Snezana Petrovic, Mercedes Porosnicu, Michael Seeds, Thomas Shupe, Allen Tsang, Jeff Willey, Liliya Yamaleyeva, Barbara Yoza, Xuwei Zhu

Overview

The graduate program in Molecular Medicine and Translational Science, an interdisciplinary program offering the PhD and MS degrees, is specifically designed to meet the challenge of training basic scientists to function successfully in clinical environments. The last decade has brought about fundamental and radical advances in a number of disciplines including biochemistry, cellular and molecular biology, and immunology. These changes have led to unparalleled opportunities to advance medical research and patient care. Both basic and clinical scientists can now test novel and provocative hypotheses using tools such as recombinant DNA technologies, functional imaging techniques, mass spectrometry, and monoclonal antibody therapy and quickly acquire results that would have seemed fanciful science fiction only a few years ago. These new approaches have not only made it possible to understand cellular and molecular mechanisms of human disease, but they also offer the promise of new and revolutionary therapeutic options for clinicians.

Translating new advances in science to improved bedside care for patients requires erasing many of the historical divisions between basic and clinical scientists. For modern-day clinicians to understand and take advantage of new developments, a great deal of time must be spent at both the bedside and the bench. Conversely, the potential to understand mechanisms of illness and its treatment brings relevance and urgency to the work of basic scientists, moving them closer to their clinical colleagues. This movement into the clinical arena facilitates the challenge of viewing a complex clinical disorder through the eyes of the basic scientist. For these reasons, there has been a major emphasis by national, private, and industrial granting organizations to fund basic research that has

the potential to immediately impact human disease. This creates a unique niche for basic (PhD) scientists who are trained on the cutting edge of molecular advances to perform “translational” research in human biology and disease.

The molecular medicine and translational science program provides training in the use of cellular, molecular, and integrative approaches to investigate biologic events with an emphasis on human disease. The multidisciplinary faculty consists of scientists who have major ongoing human research programs. The program offers PhD students a comprehensive knowledge of human biology and disease that allows them to develop basic research programs with fundamental clinical implications. It is also designed to train biomedical researchers to fill an important niche in academia or industry.

For MD, DVM or DO-trained physician-scientists on faculty or in training at Wake Forest University Baptist Medical Center, a master's or PhD degree in MMTS is also available for qualified candidates. The overall objective of the MS/PhD program is to train individuals who already hold an MD degree in the cellular and molecular techniques needed to integrate basic science with clinical applications involving human disease. An additional benefit of the program is that it enhances interaction between MDs in clinical departments and PhDs who are engaged in fundamental bench research focused on human disease.

The MMTS program participates in the Molecular and Cellular Biosciences (MCB) PhD track. Prospective students interested in MMTS apply to the MCB track and can indicate their interest in the MMTS program on the application. Applicants to the MCB Program should have a solid background in biological and/or physical sciences, prior research experience and a passion for scientific inquiry. Students enter the program through the Molecular and Cellular Biosciences Track and participate in the MCB common curriculum in the first year. Curriculum in subsequent years includes participation in Translational Science Seminar Series, Clinical Experience, Foundations of Translational Science, Scientific Development and Business of Science course, and electives of the student's choice.

Prospective students are encouraged to contact individual faculty members whose research is of particular interest. For more information regarding the PhD or MS degree programs in molecular medicine and translational science visit our homepage, <http://www.wakehealth.edu/School/Molecular-Medicine-Graduate-Program/Molecular-Medicine-Graduate-Programs.htm>.

Degree Requirements: *please see “Requirements for Degrees” beginning on page 25.*

The following electives are offered through the MCB track:

MCB 752. Foundations of Translational Science. (2) Builds on the student's basic biochemistry and cell biology knowledge with an intensive examination of the molecular basis of human disease and treatment. The course mixes lectures with a case-based approach to take students through the diagnosis, physiology, pathophysiology, and the molecular mechanisms of several diseases. Learning issues are developed by the group, centered upon treatment options, their mechanisms of action, the appropriate design of clinical trials to test new therapies, and the research base for further advances in prevention and treatment. MD and PhD facilitators assist with student-led discussions. Relevant, current literature is examined.

MCB 753. Introduction to Regenerative Medicine. (2) The course will address fundamental principles and progress in regenerative medicine (RM) and tissue engineering (TE) research in recent years. RM integrates the fundamentals of cell and molecular biology, materials science, biomedical engineering, and clinical science. The goal of RM and TE is to develop materials and therapies to repair or replace cells, tissues, and organs damaged by disease, trauma, or congenital conditions. Successful clinical translation of TE/RM therapies requires the expertise of scientists,

engineers and clinicians. The main topics discussed during the course will include cell sources and biomaterials for RM and TE, cellular therapies, strategies for gene therapy and animal models, as well as ethical and regulatory issues. In addition the course will consider issues relevant to stem cell biology, biomaterial selection and evaluation of functional tissue formation and healing. Students will be required to present a research summary on a regenerative medicine and tissue engineering application.

The following advanced courses in MMTS are offered:

Students who enter the MMTS program are required to take the following set of courses: MCB 752, MMTS 711, 712, 715, 716, 717, 724, 791, 792, and a statistics course. Students who have an MD or are in the combined MD/PhD program are exempt from MCB 752 and MMTS 715/716.

711, 712. Translational Science Seminar Series. (1, 1) Faculty and students jointly describe their research in a human disease, first in clinical terms and then to follow the development of the understanding of that disease to the molecular level with an emphasis on translational applications. Presentations introduce students to potential preceptors and experimental strategies used to study human disease. Students present their own research to gain experience and professional skills for seminars and national meeting presentations.

713. Advanced Readings in MMTS. (1-2) This course allows individualized advisor-student discussion of literature pertaining to a specific area of interest in Molecular Medicine. *Satisfactory/Unsatisfactory*

715/716. Clinical Experience. (1) Students who choose to enter the MMTS program must take this course in the fall (MMTS 715) and spring (MMTS 716) term. Serves as an introduction to clinical medicine for the PhD students. Each student observes and participates in clinical activities with his/her clinical mentor. Experiences are custom-designed by the clinical mentor for each student. At the end of the semester, students enrolled in the course meet and each student presents a case study, based on his/her personal clinical experience.

Choice of one of the following Statistics Courses:

HES 721. Data Analysis and Interpretation. (3) See Health and Exercise Science.

CPTS 730. Introduction to Statistics. (4) See Clinical and Population Translational Sciences. *P—POI*
IPP/NEUR 741. Quantitative Methods in Bioscience. (3)

724. Scientific Development and the Business of Science. (1-3) This course reviews techniques for effective communication of scientific proposals and presentations, both oral and written. For oral presentations, emphasis is on content organization and connecting with the audience. Assignments include the presentation and critical discussion of student research. For written presentations, the emphasis is on grant proposal development, as well as familiarization with the peer-review process. The course consists of lectures on all aspects of grant development (including budgets and protocols and compliance regulations for human and animal research), and student preparation of a grant proposal. An oral exercise includes the discussion of an NIH RO1 proposal in a mock study section format. *Also listed as P—POI.*

791, 792. Research. (1-9) This course involves closely supervised research in various topics in molecular medicine, with a special emphasis on models of human disease, including research in preparation for the doctoral dissertation. *Satisfactory/Unsatisfactory*

Additional Courses:

In addition to the required courses, students in the PhD program may select, in consultation with

their advisor, one or more other graduate-level science courses. Students should complete these additional courses prior to the end of their third year.

The following Wake Forest University programs offer graduate-level courses that meet this requirement: biochemistry and molecular biology, biology, biomedical engineering, cancer biology, chemistry, comparative medicine, health and exercise science, mathematics, microbiology and immunology, neuroscience, physics, integrative physiology and pharmacology. Also, students can choose the following MMTS course as an elective, with permission of the instructor.

719, 720. Special Topics in Stem Cell Biology. (2) This course utilizes directed readings and student presentations of primary literature to introduce students to the field of stem cell biology. Content focuses primarily on human stem cell properties, including pluripotency and its maintenance, the role of chromatin remodeling in fate determination and lineage restriction, self-renewal and differentiation, and the genetic conversion of somatic cells into pluripotent stem cells. The field is expanding rapidly and course content will be modified as needed to incorporate new findings and applications in stem cell biology and translational medicine. A background in the form of undergraduate or graduate courses in developmental biology is strongly recommended. Also listed as MOGN 719, 720. *P—POI*

721. Regenerative Medicine Immersion - Fundamentals, Principles and Clinical Applications. (1-2) The course will provide a state-of-the-art review of various aspects of RM addressing the fundamental principles and progress in tissue engineering and regenerative medicine in recent years, including background material, key scientific components of RM, ethical, economic and other issues important to the field. RM has the potential to deliver cures to many diseases while also improving quality of life. RM integrates the principles of cell and molecular biology, materials science, biomedical engineering, and clinical science with the goal to develop materials and therapies to repair or replace cells, tissue, and organs damaged by disease, trauma, or congenital conditions. In recent years, approaches are being used routinely in daily clinical practice, with others in clinical studies, and multitudes in preclinical testing phase. The course addresses the interdisciplinary nature of RM, major components necessary to produce engineered tissues and organs, opportunities and today's most critical challenges. A series of eight topic areas features prominent faculty members of the Wake Forest Institute for Regenerative Medicine (WFIRM) along with distinguished invited experts in the field. The eight content areas are grouped thematically and address a breadth of topics spanning: stem cells, cell sources, biomaterials, cellular therapies, enabling technologies and animal models, as well as legal, commercial, regulatory and ethical issues. In addition to the formal presentations, students also have the opportunity to interact with speakers in smaller groups during lunch and other informal, social networking events and settings. *Satisfactory/Unsatisfactory*

Neuroscience (NEUR) Track 6

Bowman Gray and Reynolda Campuses

Track Director

Carol Milligan

Overview

The program is composed of over 60 research faculty and 30 clinical faculty representing fourteen basic science and clinical departments. The program offers a PhD degree in neuroscience to students interested in a research and teaching career in all areas of neurobiology. All students are required to take a core curriculum of neuroscience courses over the first three semesters as well as coursework in statistics and experimental design. During the first year of graduate study, students

obtain hands-on research experience by participating in laboratory rotations. Additional graduate coursework is tailored to meet the individual needs of each student. A major goal of the program is the development of neuroscientists with a broad background in cellular, molecular and systems neuroscience with specialized skills in a specific sub-area of neurobiology.

Areas of faculty research expertise include: cellular and molecular neurobiology; developmental neurobiology; epilepsy; learning and plasticity; nerve growth and regeneration; neural basis of memory; neurobiology of aging; neurobiology of drug abuse; and neurodegenerative diseases.

As a major center of neuroscience research, the University has modern research facilities that cover all areas of contemporary neurobiological investigation, from gene cloning, genomics, and molecular genetics to electrophysiology, cell biology, and behavioral analysis. The PhD program began in 1989 and has graduated 60 students. There are currently 35 students in the program. For more information, visit our homepage at www1.wfubmc.edu/neuroscience. Prospective students are encouraged to contact individual neuroscience faculty members.

Applicants to the neuroscience graduate program should have demonstrated proficiency in biology, chemistry, physics, and mathematics with emphasis on coursework in cell and molecular biology, organic and inorganic chemistry, biochemistry, and statistics. Research experience although not required, is highly desirable.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

First-year Courses

701. Introduction to Neuroscience I. (2-5) Neuroscience I is the first in a required two-course series for first-year neuroscience graduate students covering basic topics in the neurosciences. Neuroscience I is offered only in the fall semester and deals with neuroanatomy (6 weeks), cellular and molecular neuroscience (six weeks), and developmental neuroscience (3 weeks). Approximately one third of the course includes laboratory work in neuroanatomy. For non-Neuroscience students, the neuroanatomy block may be taken separately as a two-credit course, and the cellular and molecular neuroscience block may be taken separately as a two-credit course.

702. Introduction to Neuroscience II. (2-5) Neuroscience II is the second in the series of required courses for first-year neuroscience graduate students covering basic topics in the neurosciences. Topics covered include: developmental neuroscience (3 weeks), sensory (six weeks) and motor systems (6 weeks). Cognitive and computational neuroscience are also covered. For non-Neuroscience students, the sensory block may be taken separately as a two-credit course, and the motor systems block may be taken separately as a two-credit course. *P—NEUR 701*

703, 704. Seminars in Neuroscience. (1) This will be a weekly seminar given by students, postdocs, faculty and external speakers. It will run throughout the year and will be structured so that each student will present a research seminar in a given year. First year students will give a 30-minute seminar and senior students will give an hour seminar. First year students will be assigned seminar slots during the summer between first and second year. The remaining slots will be used by postdocs, faculty, and visiting speakers. Departments and the WNCsfN Chapter will take turns sponsoring the seminars by external speakers.

705, 706. Tutorial in Neuroscience. (0) The Tutorial in Neuroscience will run during the spring and fall semesters. The format is one in which a faculty member or postdoc presents his/her research and a student presents a paper on a topic related to that research. It will be a required course for first- and second-year students, but will be open to all students. Not for credit.

707, 708. Research. (1-9) Lab research in all areas of modern neurobiology, including studies

done as part of the first-year research rotations and the requirements for the doctoral dissertation. *Satisfactory/Unsatisfactory*

741. Quantitative Methods in Bioscience. (3) An introduction to essential concepts and methods for the quantitative analysis of biological data, with a focus on descriptive and inferential statistics. General topics include basic concepts in statistics such as probability theory and chance models, samples and populations, analyses of the relationships between variables, analysis of normal data, analysis of non-normal data and non-parametric analyses, an introduction to Bayesian frameworks, clustering analysis, and multivariate analyses. Didactic lectures cover core frameworks, analytic approach, and the mechanics and intuitive logic behind the methods. Laboratory sessions provide experience using a software platform (R) for data analysis and visualization using practical problems. Also listed as IPP 741.

Upper-level Courses

Behavioral Neuroscience

714. Behavioral Neuroscience. (3). Behavioral neuroscience is a relatively new and rapidly expanding discipline utilizing techniques of molecular biology, neurochemistry, neurophysiology, and psychology to investigate the neurobiological basis of behavior. A broad overview of the field and its relationship to these individual disciplines is presented. The course provides a survey of the field from the cellular level to the complexity of molar aspects of behavior including learning and memory. An introduction to lab models of human neurobiological disorders is included. *P—NEUR 701; NEUR702*

722. Behavioral Pharmacology. (3) Focuses on behavioral factors that influence the effects of drugs. Material presented provides a detailed review of the rate-dependent, reinforcing, and stimulating effects of drugs. Additional topics include behavioral factors related to tolerance and sensitization and a review of animal models of drug action. Also listed as IPP 722.

See also:

- PSY 623; BIO 623 Animal Behavior. (3);
- BIO 624. Hormones and Behavior. (3)
- BIO 625. Chronobiology. (3)

Cell and Molecular Neuroscience

721. Molecular Neuroscience. (3) Introduces graduate and advanced undergraduate students to the basic principles of neurobiology as studied by cell and molecular biologists. Lectures introduce invertebrate and vertebrate model neuronal systems and the cellular and molecular methods to study them. *P—NEUR 701; NEUR 702*

See also:

MMTS, MOGN 719. Special Topics in Stem Cell Biology. (3)

Cognitive Neuroscience:

See:

- PSY 629. Perception. (3)
- PSY 728. Human Cognition. (3)

Development and Aging of the Nervous System

742. Developmental Neurobiology I: Molecular Control of Neural Lineages and Differentiation. (3) Designed as an introduction to principles of early neural development. Topics include

both the genetic and epigenetic control of early developmental events, including the determination of neuronal and glial cell lineages, expression of homeotic genes and neural pattern formation, inductive signal events required for neuronal differentiation and migration in both the central and peripheral nervous system, and the role of the extracellular environment in axonal growth. Students examine both historical and current models of molecular mechanisms regulating neural development through prescribed readings, tutorials and interactive discussion sessions. A weekly hands-on tutorial introduces students to a variety of cellular and molecular methods including mRNA analysis (mRNA purification, electrophoresis and Northern blot analysis, Rnase protection assays, RT-PCR analysis, cryostat sectioning, in situ hybridization) and protein analysis (protein polyacrylamide gel electrophoresis—PAGE, Western blot analysis, Immunoassays and Immunocytochemistry). *P—NEUR 701; NEUR702*

743. Developmental Neurobiology II: Progressive and Regressive Events in Neural Development. (3) Emphasizes regressive and progressive events required for the maturation of neural systems. Topics include molecular mechanisms of regulating both normal and pathological cell death in neurons and glia, including extracellular signals, receptors and intracellular pathways promoting or preventing cell death. Also included are topics concerning the development, specificity and pruning of synaptic connections in neural networks, as well as the role of cell adhesion and extracellular matrix in the formation of neural networks. Students examine both historical and current molecular models of cell death, neurotrophism, neurotrophic factors and their receptors. A weekly hands-on tutorial introduces students to a variety of cellular and molecular methods including in vitro methods of analysis (explant and dissociated neuronal cell culture assays for studies of cell death and axonal growth) and in vitro methods (quantitative analysis of cell death including fluorescent, histological and TUNEL labeling of cell death, methods of axonal and dendritic labeling and EM ultrastructural analysis of synaptic changes). *P—NEUR 701; NEUR 702; NEUR 742*

744. Developmental Neurobiology III: Neural Plasticity and Regeneration. (3) Focuses on the capacity of neural networks to be modified by experience or to be reconstructed after injury. Examines molecular mechanisms proposed for activity-dependent competition in the initial construction of the nervous system, the plasticity of connections in models of activity-mediated sprouting, mechanisms proposed for neural plasticity in learning and memory, and a comparison of events required for neuronal repair and regeneration in the PNS and CNS. Current attempts to utilize neural transplantation to enhance the recovery of function in models of neurological diseases and trauma are also reviewed. Students examine both historical and current models of neural plasticity and regeneration through prescribed readings, tutorials and interactive discussion sessions. *P—NEUR 701; NEUR702; NEUR 742; NEUR 743*

See also:

BIO 652. Developmental Neuroscience. (4)

Sensory Neuroscience

753. Sensory Neuroscience I: Visual and Auditory Systems. (3) This course is designed to introduce students to sensory neurobiology of visual, auditory, olfactory and gustatory systems from the cellular to systems level. Under each sensory system, the topics cover the receptors in the sensory organs, signal transduction, subcortical and cortical areas and higher order processing. The course also includes topics relevant to sensory perception such as attention, working memory, decision making and plasticity. The course is structured to enable the students to learn how individual sensory systems function and to recognize the parallels between sensory systems. *P—NEUR 701; NEUR 702*

754. Sensory Neuroscience II: Somatosensation and Multi-sensory Integration. (3) This course

is the second in a series that focuses on mammalian sensory systems. The course is designed to introduce students to somatosensory, pain and multisensory processing from the molecular to the systems level. The aim is to introduce key concepts of global organization that transcend individual modalities. Cellular, molecular, behavioral and pharmacological approaches will be covered against the backdrop of relevant model sensory systems. *P—NEUR 701; NEUR 702; NEUR 753*

755. Research Design in Sensory and Systems Neurobiology (3). This course combines didactic material with hands-on approaches so that students learn to properly design experiments in neurobiology and are able to analyze quantitatively the resulting experimental data. The didactic component provides a brief survey of fundamental mathematical and statistical concepts (e.g., probability, Bayesian inference, curve fitting, hypothesis testing, nonparametric statistics), which serves as a foundation for more advanced techniques used to analyze neuronal data (e.g., signal detection theory, cross-correlograms, information theory). Through computer-lab sessions and homework assignments tailored to each topic, students translate the theoretical knowledge to practical application as they learn to use the Matlab programming environment. The specific quantitative methods covered, as well as the sample data used for the hands-on analysis assignments, are tailored according to the students' backgrounds, programming experience, and research interests.

See also:

BIO 664. Sensory Biology. (4)
BIO 736. Bioacoustics. (4).

Substance Abuse and Addiction

717. Current Topics in Drug Abuse. (2-3) Provides students with perspective in the problem of drug abuse. Defines the basic issues central to the field of drug abuse, including concepts of tolerance, physical dependence and reinforcement mechanisms, and relates these issues to the current problems of drug abuse in society. Describes how current research in drug abuse contributes to the design of rational treatment and prevention programs. Also listed as IPP 717.

724. Biology of Alcohol Abuse—Alcoholism. (3) Designed to instruct graduate and postdoctoral students on the pharmacological, physiological, and behavioral effects of alcohol. Lectures cover topics ranging from the epidemiology and etiology of alcohol abuse and alcoholism to the basic biochemistry, metabolism, and pharmacokinetics of alcohol in the mammalian system. Lectures concerning effects of alcohol on specific organ systems include the hepatic system, the endocrine system, reproductive systems, the cardiovascular system, the gastrointestinal system, and the renal and pancreatic systems. Lectures focusing on the effects of alcohol on the nervous system include neuroreceptor interactions, ethanol's effects on intracellular signaling processes, neuroanatomical substrates for the actions of alcohol, systems electrophysiology, and mechanism of the behavioral effects of alcohol such as the reinforcing effects, anxiolytic effects, amnesic effects, and motor impairing effects. The neuroscience lectures provide the basis for an exploration of the conditions leading to tolerance and dependence, and how the brain adapts to prolonged exposure to alcohol. Also listed as IPP 724

740. Neuroparmacology. (3) General survey of neuroparmacology, emphasizing neurotransmitters, receptors and their interactions. Discusses general principles of drug action, including receptor binding, second messengers, and neurotransmitter metabolism. Surveys neurotransmitter function, including acetylcholine, biogenic amines, excitatory and other amino acids, and neuropeptides. Also listed as IPP 740. *P—NEUR 701; NEUR 702*

Translational Neuroscience

771. Clinical Neuroscience (3). Lectures and class discussions dealing with topics in neurobiology,

pathophysiology, and treatment of patients with neurological and behavioral/psychiatric problems. Includes a brief introduction to major concepts of patient treatment and care with utilization of up-to-date methodology in clinical neuroscience. Students have the opportunity to observe and participate in patient evaluation and diagnostic testing in the clinical setting and to visit many of the neuroscience-related clinical research and treatment centers. Taught by both clinicians and basic science researchers. *P—NEUR 701; NEUR 702*

See also:

BMES 631. Introduction to Regenerative Medicine. (3)
BICM 740. Drug Discovery, Design and Development – Molecules to Medicine. (3)

Neurosciences Journal Clubs

777, 778. Directed Journal Club in Pain and Anesthesiology. (1) This journal club covers articles related to mechanisms of pain and somatosensory processing including cellular/molecular, pharmacological, behavioral, and anatomical studies of acute and chronic pain disorders. Students are encouraged to review current research findings from all aspects of pain research including basic science, translational and clinical studies. Each week a student presents an article providing a thorough review of relevant background information drawing upon seminal and related papers.

780, 781. Directed Journal Club in Sensory Neuroscience. (1) Correlates with the formal lecture courses in Sensory Neuroscience I-II. Students are required to read and critique papers chosen to complement the classroom lectures. Both seminal papers and current research are reviewed. The directed nature of the readings enhances the student's appreciation and understanding of the formal lectures. Students lead the presentation of the journal articles, thus providing opportunities for teaching in the area of sensory systems.

783, 784. Directed Journal Club in Developmental and Molecular Neurobiology. (1) Students are required to read and critique papers related to developmental, cell and molecular, or disease/pathological issues in the nervous system. Both seminal papers and current research are reviewed. The directed nature of the readings enhances the student's appreciation and understanding of the formal lectures. Students lead the presentation of the journal articles, thus providing opportunities for teaching in these areas.

785, 786. Directed Journal Club in Network Science in Neuroimaging. (1) This journal club covers articles related to network science and its application in biological systems, with a particular emphasis on the brain. Assigned reading will cover methodological foundation of network science, as well as the current literature on applications of network science in neuroimaging studies. Although the brain network will be of the main focus, readings may also include other types of networks such as biological, social and technological networks.

787, 788. Memory, Cognition and Aging Journal Club. (1) The topics in this journal club will cover all aspects of memory, cognition and cognitive aging from molecular and cellular/synaptic mechanisms to behavioral and imaging studies. Papers on basic research and translational science in any model system ranging from rodent, non-human primates to humans will be discussed. In the Journal Club course, each week a student will present a paper using a format indicated by the course director.

789, 790. Behavioral Pharmacology Journal Club. (1) In this course, students read and present journal articles of current or historical importance that involve drugs and have behavior as the primary dependent variable.

Neurosciences Special Topic Courses

690. Contemplative Science. (2) Contemplative Science integrates experiential learning and reflection about traditional contemplative practices from a variety of secular and spiritual traditions with emerging neuroscience. It offers participants an opportunity to develop skills that will deepen and expand their future professional activities.

710. Human Gross Anatomy. (4) A regional and systemic approach to the study of human gross anatomy, incorporating cross-sections, x-ray films, CT and MRI scans with clinical implications. Course fees may apply.

713, 714. Advanced Readings. (2) Individualized instruction involving detailed review of literature pertaining to a specific area of interest in physiology and pharmacology.

782. Readings and Research in Neuropsychology. (1-3) Allows the graduate student, working under the supervision of a faculty member, to pursue and receive credit for a special project in an area not covered by regular courses or a special research project not related to the master's thesis. Supervising faculty member and credit hours for the course are determined by graduate committee prior to registration. Also listed as PSY 782

791, 792. Readings and Directed Study in Neurobiology. (1-2) Designed to provide an opportunity for graduate students to learn specific topics in the field that may not be covered by regular courses. Materials from the primary literature are presented to other participants, including at least one faculty member. The format is intended to generate in-depth discussion in a setting where each student acts as the lecturer. The supervising faculty member and the student will determine together the schedule and credit hours (either 1 or 2) for the course.

793, 794. Special Topics in Developmental Neurobiology. (2) Designed to focus on a specific theme each semester, including such topics as cell death and regressive events, synaptogenesis, determination and differentiation, axonal guidance and pathway formation, neuroglia interactions, and neurotrophic agents.

795. The Development and Anatomy of Sensory Systems. (2) Designed as an introduction to the structure and ontogeny of the sensory pathways. Provides a foundation for the subsequent advanced coursework in sensory systems, which provides one of the most fertile experimental areas in developmental biology. Topics include basic genetic control of developmental processes; embryonic development of the sensory nervous system; development and organization of subcortical sensory pathways; development of sensory cortices; role of the environment in neural development; and the genetics of neuronal ontogeny.

796, 797. Special Topics in Sensory Neuroscience: Hearing and Multi-Sensory Integration. (2) Emphasizes current topics in neuroscience pertaining to sensory systems. Topics cover neurobiology of individual sensory systems such as visual, auditory, somatosensory, olfactory, and gustatory systems. The importance of multi-sensory integration, i.e. how different sensory systems function together to generate perception, is highlighted. Includes lectures, seminars, discussions, and reading assignments in the area of interest. *P—POI*

798. Manuscripts, Seminars, and Posters. (2) A highly interactive course with enrolled students receiving detailed feedback on all written assignments. Covers areas such as writing style, composing abstracts, constructing figures and legends, as well as simulating the e-submission process (text, figures, cover letter, etc.). In addition, previously published work is dissected for style, structure, and presentation. Didactic lectures cover a wide range of subjects, including but not limited to, EndNote (for Web); basics of Adobe Illustrator; authorship issues, and responses to reviewer's comments. Background in neuroscience not required. Open to graduate students from all programs.

Joint International Cognitive Neuroscience (ICN) PhD Program

UNIVERSITY OF BOLOGNA AND WAKE FOREST

This is an innovative PhD program that upon successful completion will result in a Ph.D. conferred jointly by the University of Bologna and Wake Forest University. The program has been crafted by the Department of Psychology of Bologna, which will also serve as the sponsoring establishment, but involves a number of prestigious foreign institutions: University College of London, UK, University of Bangor, Wales, UK, INSERM U534 Espace et Action, Bron, France and Wake Forest University.

The ICN program emphasizes the neural bases of cognitive disorders and the mechanisms of functional recovery. Cognitive neuroscience is concerned with how cognitive and emotional functions are implemented via the architecture of the human brain. A key factor in the development of this discipline has been the integration of several academic disciplines that have historically been quite separate. These include: cognitive psychology; neuropsychology; neuroimaging; neurophysiology and neuroanatomy. Technological advances in methods for non-invasive brain imaging/recording now allow scientists to study the relationship between brain activity and cognitive mechanisms in awake, behaving, human subjects.

The goal of the program is to expose students to the highest standards of research and critical thinking from leaders in the field regardless of their location. In this way students will not only develop a profound understanding of their chosen field, and a familiarity with the most advanced techniques that are currently in use in this field, but will also be given access to experts.

Structure of the ICN PhD Program

Graduate students training and research activity will take place both in Bologna and in one of the partner Institutions (i.e., WFU), which will be chosen according to the student interests, competences and research field of the thesis work. Students interested in ICN must apply through the University of Bologna. (<http://neuroscience.psice.unibo.it>) Students will discuss potential thesis projects and select an advisor and lab at the University of Bologna or partner institution upon entering the program. Students will begin their training at the University of Bologna by completing the required courses and passing the qualifying exam for admittance to candidacy for the Ph.D. After this, the student will then enter a selected laboratory at one of the participating Universities.

Required Courses

Research Methods in Cognitive Neuroscience. This course surveys major approaches and methods for cognitive brain research, both in normal individuals and in people afflicted by neurological or psychiatric disorders. Topics include functional neuroimaging (fMRI, PET), electrophysiological recordings (EEG, ERP), stimulation and inactivation methods (TMS), and also cognitive and behavioral approaches.*

Research Training for the Cognitive Neuroscience. Research training is the primary emphasis of the program. Training in research-related skills is acquired through interaction with the faculty and formal coursework, including project design, formulation of testable hypotheses, design of group and case studies in neuropsychology, statistical and data management techniques, and reporting of scientific findings.*

Neural Basis of Cognitive Processing. Course topics explore the relations between neural systems and cognition, emphasizing perception, attention, space representation, motor control and memory. Furthermore, the course surveys the phenomenon of plasticity and recovery of function following damage to the nervous system.*

Seminars on Social and Cognitive Neuroscience. This course surveys the neural basis of social behavior, drawing on both theoretical and empirical approaches. Topics include perception of social cues, motivation, emotion, imitation and empathy, and brain processes in economic decisions.*

Journal Club. A central didactic feature of the program is a weekly journal club for the trainees and faculty. This meeting gives trainees a forum for discussion, assistance and task-relevant learning. At the core of this seminar are regular presentations by the trainees as they develop their research ideas, formalize their research projects and progress with data collection.

Ethics Requirement. Students in the ICN will be required to complete the requirements in scientific ethics and professional development required of all graduate students at Wake Forest University.

**These courses are available only to students accepted into the ICN Program. These courses are taken at the University of Bologna upon matriculation into the program.*

Physics (PHY)

Reynolda Campus

Program Director	Martin Guthold
Chair	Keith Bonin
Reynolds Professors	Richard T. Williams
Harbert Family Distinguished Chair Professor	Daniel B. Kim-Shapiro
Professors	Paul R. Anderson, Keith D. Bonin, David Carroll, Martin Guthold, Natalie A. W. Holzwarth, George Eric Matthews
Professors Emeritus	Robert Brehme, George M. Holzwarth, William C. Kerr, Howard Shields, George P. Williams Jr.
Associate Professors	Eric D. Carlson, Gregory B. Cook, Onana Jurchescu, Jed Macosko, Fred Salisbury, Timo Thonhauser
Assistant Professors	Samuel Cho,
Research Professors	George M. Holzwarth (Professor), William C. Kerr (Professor), K. Burak Ucer (Associate Professor), Swati Basu (Professor)
Lecturer	Jack Dostal
Adjunct Professor	J. Daniel Bourland, Peter Santago
Adjunct Assistant Professors	Adam Hall, Timothy E. Miller

Overview

The Department of Physics offers programs of study leading to the MS and PhD degrees. Opportunities for study are those usually associated with large research universities, while the atmosphere of a small liberal arts university with an ideal faculty/student ratio is maintained.

For admission to graduate work, the entering student should have knowledge of senior level undergraduate mechanics, electricity and magnetism, thermodynamics, and quantum physics. The course of study for each student is planned in conference with the graduate adviser after an evaluation of academic background and experience. Deficiencies may be removed during the first year of study by taking remedial courses.

For the MS degree, the student's course of study must include PHY 711, 712, and 741, as well as participation in the departmental seminar series (PHY601) each semester. These weekly seminars, in fields of special interest, and usually feature outside speakers. A MS degree candidate must have at least 30 credit hours of graduate credit. This must include at least six credit hours in thesis

research and at least 24 credit hours in coursework. At least 12 of these 24 credit hours must be in courses numbered 700 or above. Credit may be allowed for as many as six hours of graduate work transferred from another institution at the discretion of the program director and the dean of the Graduate School. Thesis research courses are graded S (Satisfactory) or U (Unsatisfactory). If a U is assigned the course must be repeated and an S earned before the degree can be awarded. In addition to satisfying the residency and course requirements, the student must be admitted to candidacy, complete an acceptable thesis under faculty supervision, and pass an oral examination in its defense. The minimum grade point average (GPA) required for graduation is 3.0

For the PhD degree, the student's course of study must include PHY 711, 712, 741, 742, 770, unless satisfactorily completed elsewhere, as well as participation in the weekly departmental seminar series (PHY601) each semester. Students must also take three elective courses at the graduate level (600 or 700 level), at least one of which must be in physics. To graduate, students must achieve an overall GPA of 3.0 and a 3.0 GPA in graduate courses within the physics department. The University's preliminary examination requirement is satisfied by passing a written and an oral exam. The written preliminary examination is usually taken at the end of the first year of graduate study. The written examination may be retaken once, and must be passed before the third year of graduate study; extensions, for example for part-time students may be approved by the department. Students must have at least a 3.0 GPA to take the preliminary examination. A research advisory committee, appointed after completion of the written preliminary examination, determines the additional courses needed for the PhD, such as Advanced Quantum Mechanics, Biophysics, Solid State Physics, General Relativity, Nonlinear Optics, Math or Computer Science, Medical Physics, Biomedical Engineering, et. Within eighteen months of completing the preliminary written examination, the student submits to his or her individual advisory committee, and defends orally a dissertation research plan. This constitutes the oral part of the preliminary exam and upon passing it, the student can be advanced to candidacy. The research advisory committee meets annually with the student to ensure timely progress toward the degree. Upon completion of the research in the approved plan, the student writes his or her dissertation, presents it to the department, and defends it orally as prescribed by the Graduate School.

The successful completion of a program in scientific ethics is required prior to admission to degree candidacy. This requirement is fulfilled either by participating in the courses designated by the Graduate School or by satisfactory completion of approved departmental electives that incorporate extensive discussion of scientific ethics.

The research interests of the graduate faculty are in experimental and computational biophysics, nanotechnology, optics, experimental and theoretical solid state physics, particle physics, and relativity. All research laboratories are well-equipped with state-of-the-art instrumentation, such as subpicosecond pulsed lasers; EPR; time-resolved, UV-vis spectrophotometers; optical tweezers; atomic force microscopes; single molecule manipulators; high-sensitivity optical and confocal microscopes; numerous, standard biochemical research apparatuses; and others. The Center of Nanotechnology and Molecular Materials (www.wfu.edu/nanotech), which houses state-of-the-art electronmicroscopies, and sample analysis and preparation instruments and a clean room, is part of the physics department. Theoretical research is supported by the DEAC Linux Cluster with over 2,300 computational processing cores.

For more details on the PhD program, visit www.wfu.edu/physics or write to the chair of the graduate committee. Departmental graduate committee: Guthold (chair), Carroll, Cook, Holzwarth, Jurchescu, Salisbury.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Courses of Instruction

601, 602. Physics Seminar. (0.5, 0.5) Discussion of contemporary research, usually with visiting scientists. May be repeated for credit. *Satisfactory/Unsatisfactory*

607. Biophysics. (3) Introduction to the structure, dynamic behavior, and function of DNA and proteins, and a survey of membrane biophysics. The physical principles of several biophysical methods, such as X-ray diffraction, sedimentation, light scattering, light absorption, fluorescence and single molecule tools are studied. Designed to be accessible to students with biochemistry, chemistry, or physics backgrounds. *C—PHY 626*

610. Extragalactic Astronomy and Cosmology. (3) Topics covered include galactic structure, models for galaxies and galaxy formation, the large-scale structure of the universe, the Big Bang model of the universe, physical processes such as nucleosynthesis in the early universe, and observational cosmology.

620. Physics of Biological Macromolecules. (3) Physics of biologically important molecules, especially proteins and nucleic acids. Topics covered include the physical basis of biomolecular structure, the energetics and statistical mechanics of biomolecular dynamics, and the electrostatics and solvation of biomolecules. Course requirements may include a field trip to a relevant conference, such as the Carolina Biophysics Symposium, and a discussion section with an appropriate physics colloquium speaker. Designed to be accessible to students with biochemistry, chemistry, or physics backgrounds provided they have some exposure to thermodynamics and macromolecular structure. *C—PHY 623*

623. Computational Molecular Biophysics Laboratory. (1) Application of techniques in molecular modeling, including energy minimization, molecular dynamics simulation, and conformational analysis, to biological macromolecules. *P—PHY 630 or POI*

625. Biophysical Methods Laboratory. (1) Lab involves experiments using various biophysical techniques such as DNA and protein gel electrophoresis, protein crystallography and X-ray diffraction, electron paramagnetic resonance, atomic force microscopy, fluorescence microscopy, light scattering, stopped-flow absorption spectroscopy and ultracentrifugation. *C—PHY 607*

637. Analytical Mechanics. (1.5) The Lagrangian and Hamiltonian formulations of mechanics with applications. Taught in the first half of the fall semester.

639, 640. Electricity and Magnetism. (1.5, 3) Electrostatics, magnetostatics, dielectric and magnetic materials, Maxwell's equations and applications to radiation, relativistic formulation. The first half course is taught in the second half of the fall semester, following PHY 637. The other course is taught in the spring semester. These should be taken in sequence. *P—PHY 601*

641. Thermodynamics and Statistical Mechanics. (3) Introduction to classical and statistical thermodynamics and distribution functions.

643, 644. Quantum Physics. (3,3) Application of the elementary principles of quantum mechanics to atomic, molecular, solid state, and nuclear physics.

645. Advanced Physics Laboratory. (1) The lab associated with PHY 643, 644

652. Physical Optics and Optical Design. (4) Interaction of light with materials; diffraction and coherent optics; ray trace methods of optical design. Lab—three hours.

654. Introduction to Solid State Physics. (3) Survey of the structure, composition, physical properties, and technological applications of condensed matter. *P—PHY 643*

661. Biophysics Seminar. (1) Seminal and current publications in biophysics are studied. Each week

a member of the class makes an oral presentation on a chosen publication and leads the ensuing discussion. Students may also be required to make a second oral presentation relevant to their own research. Does not fulfill course requirements for Master's or PhD degrees. May be repeated for credit.

663. Condensed Matter Seminar. (1) Seminal and current publications in condensed matter physics are studied. Each week a member of the class makes an oral presentation on a chosen publication and leads the ensuing discussion. Does not fulfill course requirements for Master's or PhD degrees. May be repeated for credit.

681, 682. Research. (1-3, 1-3) Library, conference, and lab work performed on an individual basis. May be repeated for credit.

685. Bioinformatics. (3) Introduces bioinformatics and computing techniques essential to current biomedical research. Topics include genome and protein sequence and protein structure databases, algorithms for bioinformatics research, and computer architecture and environmental considerations. Also listed as CSC 685. *P—Introductory courses in biology, chemistry, and molecular biology or biochemistry or POI.*

691, 692. Special Topics in Physics. (1-4) Courses in selected topics in physics. May be repeated if content differs.

711. Classical Mechanics and Mathematical Methods. (3) A study of variational principles and Lagrange's equations, the rigid body equations of motion, the Hamilton equations of motion and canonical transformations, Hamilton-Jacobi theory, and applications to continuous systems and fields.

712. Electromagnetism. (3) A study of electric and magnetic fields in vacuum and within media and their sources. Analytical and numerical methods for solving Maxwell's equations are also an important part of the course.

715. Nonlinear Optics and Quantum Electronics. (4) Nonlinear phenomena in laser spectroscopy, the quantum nature of optical processes in matter, and topics in laser physics. Lab—3 hours.

731. Elementary Particle Physics. (3) Fundamentals of contemporary elementary particle physics.

741, 742. Quantum Mechanics. (3, 3) Study of the foundations of modern quantum theory, with an emphasis on the meaning of the wave equation, operators, eigen-functions, eigenvalues, commutators, matrix mechanics, spin, and scattering.

743. Advanced Quantum Mechanics. (3) Advanced topics in quantum mechanics, including an introduction to relativistic quantum theory, quantum electrodynamics, and many particle treatments.

744. Introduction to Quantum Field Theory. (3) Introduction to relativistic quantum field theory, including canonical quantization, path integral techniques, perturbation theory, and renormalization.

745. Group Theory. (3) Group theory and its applications to the quantum mechanics of atoms, molecules, and solids.

752. Solid State Physics. (3) Introductory course including the structure of perfect crystalline solids, their thermal electronic properties, the free electron and band theory of metals, imperfect crystals, transport properties, and semiconductors.

754. Surface Science. (3) Experimental and theoretical methods for the study of surfaces and interfaces. Lab—1.5 hours.

756. Seminar on Defects in the Solid State. (2) The generation and interactions of point and line

defects such as color centers, vacancies, and dislocations treated.

765. Gravitational and Particle Theory Seminar. (1) Topics in general relativity, particle physics, and astrophysics are studied. Each week a faculty member or member of the class makes an oral presentation on a chosen topic and leads the ensuing discussion. Does not fulfill course requirements for Master's or PhD degrees.

770. Statistical Mechanics. (3) Introduction to probability theory and to the physics of systems containing large numbers of particles from the classical as well as the quantum point of view.

771. Radiological Physics. (3) The nature and fundamental concepts of Ionizing radiation Including: Ionizing radiation, radiation quantities, attenuation and stopping power, charged particle and radiation equilibrium, radioactive decay, photon interactions, charged and uncharged particle interactions, x-ray production and quality, dosimetry concepts, Ionization cavity theory, and calibration of Ionizing radiation beams. *P—POI*

773. Radiation Therapy Physics. (3) The physics of radiation treatment Including: radiation producing equipment, character of photon and electron radiation beams, radiation dose functions, computerized radiation treatment planning, brachytherapy, special radiation treatment procedures, quality assurance, and radiation shielding for high energy facilities. *P—POI*

780. Theory of General Relativity. (3) Study of the covariant formulation of physical laws in mechanics and electromagnetism.

785. Topics in Theoretical Physics. (1-3) Selected topics of current interest in theoretical physics not included in other courses.

787. Advanced Topics in Physics. (1-3) Lectures on advanced topics in physics that depend on the subspecialty of the instructor. Topics range from medical physics to special topics in biophysics, condensed matter physics, or quantum optics. May be repeated for credit.

789. Survival Skills for Scientists. (1) Students will learn skills that are essential to a successful career in the sciences. The following topics will be covered: Mentoring; How to Read, Write, and Review a Research Paper; Grant & Fellowship Basics; Choosing a Career Path & Creating a Winning Job Application; and Networking & Giving Effective Talks.

791, 792. Thesis Research. (1-9) May be repeated for credit. *Satisfactory/Unsatisfactory*

795. Physics for Education Research. (3) Fulfills the requirement for a graduate course in physics for students in the Masters in Education program seeking certification to teach physics.

891, 892. Dissertation Research. (1-9) May be repeated for credit. *Satisfactory/Unsatisfactory*

Psychology (PSY)

Reynolda Campus

Program Director

Chair

William L. Poteat Professor of Psychology

Professors

Associate Professors

Eric Stone

Dale Dagenbach

Deborah L. Best

Terry D. Blumenthal, Christy M. Buchanan, Dale Dagenbach,

William W. Fleeson, R. Michael Furr, James A. Schirillo,

Catherine E. Seta, Carol A. Shively, Eric R. Stone

Janine M. Jennings, Lisa Kiang, John V. Petrocelli,

Wayne E. Pratt, Cecilia H. Solano

Eranda Jayawickreme, Lara Kammrath, E.J. Masicampo,

Christian E. Waugh

Jay R. Kaplan, W. Jack Rejeski Jr.

C. Drew Edwards

Assistant Professors

Adjunct Professors

Adjunct Associate Professor

Overview

The Department of Psychology offers graduate work leading to a research-oriented general master's degree. The general MA emphasizes the scientific, theoretical, and research bases common to all areas of psychology (e.g., social, cognition, personality, developmental, statistics).

The program is designed for capable students who expect to continue to the PhD degree but wish to begin graduate work in a department where they receive a high degree of individual attention from the faculty.

The applicant is expected to have an undergraduate major in psychology at an accredited institution, including a subset of basic foundational courses such as developmental, social, biopsychology, personality, cognition, learning, perception, etc., as well as statistics and/or research methods. The department does accept applications from students who were not psychology majors as undergraduates, but such applicants should have a background in coursework that prepares the student for graduate level work in psychology.

The department has unusually good research facilities. The areas in which research is currently being conducted include aging, cognitive processes, judgment and decision making, adolescent development, cultural identity, neuropsychology, perception, personality, physiology, and social psychology.

Most students take two academic years to complete the program. Students who hold assistantships are required to spend two years in residence. In addition to satisfying the University requirements for the degree, all graduate students must write a major research paper, and conduct and defend a thesis.

The MA degree has been offered since 1964. Departmental graduate committee: Stone (committee chair and program director), Furr, Jennings, Petrocelli, Seta, Dagenbach (ex officio).

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Courses of Instruction

613. History and Systems of Psychology. (3) The development of psychological thought and research from ancient Greece to present trends, with emphasis on intensive examination of original sources.

620. Physiological Psychology. (3) Neurophysiological and neuroanatomical explanations of behavior.

622. Psychopharmacology. (4) Survey of the influences of a wide range of psychoactive drugs, both legal and illegal, on human physiology, cognition, and behavior.

623. Animal Behavior. (3) Survey of lab and field research on animal behavior.

626. Learning Theory and Research. (3) Theory and current research in learning with emphasis on applications of learning principles for behavior modification and comparisons across species.

629. Perception. (3) Survey of theory and research findings on various sensory systems (vision, hearing, touch, taste).

631. Research in Cognitive Psychology. (3) In-depth examination of research in a selected area of cognitive psychology such as memory, attention, or executive function. Research projects required.

633. Motivation of Behavior. (3) Survey of basic motivational concepts and related evidence.

635. Fundamentals of Human Motivation. (3) Description and analysis of some fundamental motivational phenomena, with special reference to human problems; includes reward and punishment, conflict anxiety, affection, needs for achievement and power, aggression, creativity, and curiosity.

638. Emotion. (3) Survey of theory, methods, and research in the area of emotion. Developmental, cultural, social-psychological, physiological, personality, and clinical perspectives on emotions are given.

641. Research in Developmental Psychology. (3) Methodological issues and selected research in child development. Research projects required.

642. Current Issues in Developmental Psychology. (3) Intensive examination of selected theoretical or research issues in this area.

646. Stereotyping and Prejudice (3) Research and theory on social and cognitive processes that underlie prejudice and discrimination.

648. Clinical Neuropsychology. (3) Surveys connections between abnormal neurological processes and clinical abnormalities. This implies already having an understanding of normal brain function and anatomy.

651. Personality Research. (3) The application of a variety of research procedures to the study of human personality. Research projects required.

655. Research in Social Psychology. (3) Methodological issues and selected research in the study of the human as a social animal. Field research projects required.

657. Cross-Cultural Psychology. (3) Examination of differences in psychological processes (e.g., attitudes, perception, mental health, organizational behavior) associated with cultural variation.

659. Psychology of Gender. (3) Exploration of the psychological similarities and differences between human males and females, including consideration of social, cognitive, motivational, biological, and developmental determinants of behavior.

661. Operant Conditioning and Behavior Modification. (3) Principles, theory, and experimental research in operant learning, with applications to the modification of behavior in various populations and situations.

662. Psychological Testing. (3) Theory and application of psychological assessment procedures in the areas of intelligence, aptitude, vocational interest, and personality.

663. Survey of Clinical Psychology. (3) Overview of the field of clinical and other selected areas of applied psychology.

664. Stereotyping and Prejudice. (3) Theoretical and empirical examination of the processes underlying prejudice, discrimination, and racism.

667. Parent-Child Relationships. (3) Surveys characteristics of parent-child relationships and issues of parenting as related to a variety of factors, including developmental changes of parent and child, family structure, and sociocultural context.

669. Contemporary Applications of Psychology. (3) Supervised field experience in applied psychology.

674. Judgment and Decision Making. (3) Theoretical and empirical examination of how people make decisions and judgments about their lives and the world, and how these processes can be improved.

678. Instrumentation for Psychological Research. (1) Lecture/demonstration presentation of electrical and mechanical equipment, followed by practical application in small group project work. Assumes no prior knowledge of electricity or construction.

692. Contemporary Issues in Psychology. (3) Seminar treatment of current theory and research in specific areas within psychology. The course is one-half semester.

701, 702. Current Topics in Psychology. (1.5, 1.5) Seminar courses in selected topics in psychology. *P—POI*

715, 716. Research Design and Analysis in Psychology. (3, 3) Intensive study of the design of experiments and the analysis of research data in psychology. Covers conventional methods, including univariate and multivariate analysis of variance, multiple regression, and factor analysis. Requires previous or concurrent coursework in basic statistics. *Written POI required.*

720. Biological Psychology. (3) Study of the biological basis of behavior and mental processes, with emphasis on current developments in neuroscience, and human applications of this information. Laboratory work in neuroanatomy and psychophysiology.

728. Human Cognition. (3) Current theory and research on functional characteristics and neural correlates of cognitive processes in such areas as memory, attention, and language.

738. Learning and Motivation. (3) Basic learning principles and concepts and related motivational concepts.

742. Seminar in Developmental Psychology. (3) Critical examination of the major findings, principles, and theories of development, with attention to both human and lower-animal research.

752. Seminar in Social Psychology. (3) Content and methodology of social psychology examined through a critical and comparative analysis of contemporary theory and literature.

757. Seminar in Personality Psychology. (3) Evaluation of contemporary solutions to important problems in personality psychology, with special attention to historical context and anticipated future directions.

761. Theory and Practice of Psychological Testing. (3) In-depth study of intelligence and ability testing as carried out by psychologists. Comparative analysis and examination of standard tests in these areas, with special focus on techniques of administration and interpretation.

767. Neuropsychology and Learning Disabilities. (3) Language, perceptual/motor, memory, attentional, and emotional deficits arising from neurological factors are studied in the context of brain functioning and information processing and applied to learning disabilities in children, in both theoretical and practical terms. *P—POI. Summer only.*

770, 771, 772, 773. Psychology Practicum. (1-3) Work experience in an applied psychology setting (such as clinical or industrial) under a qualified supervisor.

782. Readings and Research in Psychology. (1, 2, or 3) This listing allows the graduate student, working under the supervision of a faculty member, to pursue and receive credit for 1) a special reading project in an area not covered by regular courses or 2) a special research project not related to the master's thesis. Supervising faculty member and hours credit for which enrolled determined by graduate committee prior to registration.

785, 786. Directed Thesis Research. (3, 3) First-year students undertake a substantial research project under the direction of their adviser.

791, 792. Thesis Research. (1-9, 1-9) May be repeated for credit. *Satisfactory/Unsatisfactory*

Religious Studies (REL)

Reynolda Campus

Program Director	Jarrold Whitaker
Chair	Jay Ford
Associate Chair	Lynn Neal
Professors	Stephen Boyd, Jay Ford, Mary Foskett, Kenneth Hoglund, Simeon Ilesanmi, Nelly van Doorn-Harder, Ulrike Wiethaus
Associate Professors	Lucas Johnston, Lynn Neal, Jarrod Whitaker
Associate Teaching Professor	Tanisha Ramachandran
Assistant Professors	Shawn Arthur, Annalise Glauz-Todrank, Ron Neal
Emeritus Professor	Fred Horton

Overview

Associated Faculty Michaelle Browsers (politics), Stewart Carter (music), Steve Folmar (anthropology), Robert Hellyer (history), Kevin Jung (School of Divinity), Christian Miller (philosophy), Patrick Toner (philosophy), Neal Walls (School of Divinity), David Yamane (sociology)

The Master of Arts in Religions Studies offered by Wake Forest University's Department for the Study of Religions provides students an opportunity to forge a unique, creative, and rigorous program of study. The degree can serve either as a terminal degree or as preparation for a doctoral program. It emphasizes the comparative and theoretical study of religion in its various traditions and forms. Reflecting the teaching and research interests of the current graduate faculty in the department, the program fosters interdisciplinary approaches, offering training in traditional and contemporary theories and methods in conjunction with substantive investigations of diverse religious traditions and topics. Students are encouraged to make imaginative use of all available resources in the creation of their own distinctive programs of study. Typically, this would involve 1) a focus on a particular religious culture/region or historical period, and 2) an approach or approaches to the study of the subject area.

The general MA in religion program began in 1967. Departmental graduate committee: Whitaker (chair), Hoglund, Ilesanmi, Ramachandran.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Program Structure

Students can graduate with an M.A. in Religious Studies via two options:

- Course Intensive Option
- Thesis Option

Course Intensive Option. The M.A. in Religious Studies "Course Intensive Option" is the default way in which students can graduate from the program. It requires a total of 36 hours of coursework. At least 12 of the 36 hours in coursework must be in courses numbered 700 or above, and one of these courses must be "REL 700: Theory and Method in the Study of Religion." The remaining 24 hours may be in courses at either the 600-level or 700-level. Students must also submit to a

committee of 1 professor of their choice and the graduate director a final portfolio no less than a month before the end of their final semester, comprising a resume, personal statement, a selection of 3 papers (at least 1 theoretical) from any graduate level courses they have taken during their M.A., and a 12-15 page reflection paper that discusses the trajectory, methods, and personal growth across the 3 papers and the way in which the student's views of "religion," broadly defined, have developed. In addition, students will present and discuss their portfolio with their committee in a meeting lasting no longer than one hour. The portfolio will be graded pass/fail (with an option to resubmit) and the committee will consider its overall presentation, clarity of expression and purpose, and attention will be given to the reflection paper and the student's ability to articulate its views during this oral examination.

Thesis Option. The Thesis Option is available for students who wish to undertake substantial independent research and who are already thinking and writing in a succinct, analytical, and sophisticated manner. In order to write a thesis, the student must have submitted a proposal and been approved by the graduate director and primary thesis adviser. The student must also form a committee of 3 faculty (2 must come from the Department for the Study of Religions). If no faculty member in the Department of the Study of Religions agrees to serve as Primary Adviser, then the student cannot finish the program via the Thesis Option. The M.A. in Religious Studies Thesis Option requires a total of 36 hours course work. At least 12 hours of coursework (not counting thesis research hours) must be in courses numbered 700 or above, and one of these courses must be "REL 700: Theory and Method in the Study of Religion." A further 18 hours may be in courses at either the 600-level or 700-level (not counting thesis research hours). The final 6 hours are to be taken as thesis research (REL 791 and 792), typically in the final semester of study.

Thesis Proposal. In order to write a thesis, the student must have a primary thesis adviser from the Department for the Study of Religions faculty, and a committee comprising two additional faculty in relevant areas of research (one of whom must also be a member of the Department for the Study of Religions). In addition, the student must submit a thesis proposal in her or his third semester of study (typically in the Fall, by October 15th) to the graduate program director and the primary thesis adviser. The proposal must be 6-10 pages, with a clear synopsis of the thesis argument, proposed chapters, a timeline for chapter submission, and an annotated bibliography. If the student cannot demonstrate her or his ability to pursue the thesis independently and in a sophisticated analytical manner, the advisory committee will recommend that the student continue with the Course Intensive Track to finish the program. This decision is made between the Graduate Program Director and the primary thesis adviser by November 1st.

Thesis Length and Quality. The length of the thesis is to be decided between the student and the primary faculty adviser, but the department recommends no more than 100 pages. At minimum, the department expects that the thesis should be a publishable, article-length paper (35-50 pages) accompanied by substantial sources. It should be original work and can be a heavy reworking of a previous term paper or other research effort. The thesis process culminates in an oral examination by a committee of at least three faculty members who must assess the thesis according to the normal guidelines (see Graduate Handbook).

Language Requirements

The Department of Religion requires proficiency in a foreign research language relating to the student's area of study, whether ancient or modern. Proficiency is normally a minimum of two years work in a specific language at the university level or equivalent and may include, but not limited to, the following: Hebrew, Greek, Sanskrit, Arabic, Spanish, French, German, Chinese, or Japanese. A second research language is not required, but may be advised depending on the student's area of

study and their plans after graduation (i.e., whether or not they plan on pursuing a Ph.D.). For example, students working on the Hebrew Bible, New Testament, or Sanskrit literature may be advised to learn German (the German Department offers a reading course for graduate students most summers: 001 German for Science and Humanities).

Courses of Instruction

In the list of courses offered with graduate credit, not every course is scheduled every year, but usually 1-2 courses at the 700-level are offered each year, including REL 700: Theory and Method in the Study of Religion. In addition, we encourage students to approach individual professors to teach 700-level directed reading courses on specific topics. Substantive efforts are made to offer courses that are needed by students in either graduate course of study, and student input is welcome in determining the course schedule from semester to semester.

600. Approaches to the Study of Religion. (3) A phenomenological study of different ways of defining religion, including views of representative philosophers, psychologists, sociologists, anthropologists, theologians, and historians of religion.

601. Visions of the End: Apocalypticism and Religion. (3) An exploration of Apocalyptic themes in religious traditionals. Emphasis may vary according to instructor

604. Myth, Ritual, and Symbolism. (3) Explores how people envision and manipulate the supernatural in cross-cultural perspective. Emphasizes functional aspects of religious beliefs and practices.

605. Ethnography of Religion. (3) Study of theory and method in ethnography of religion where students closely read ethnographies from a variety of cultures and discuss the practical, methodological, and ethical issues related to ethnography. Culminates with students researching and writing their own ethnographies.

606. Ritual Studies. (3) An introduction to the various methods and theories employed in the field of ritual studies, while examining comparative rituals and ritualized practices from around the world.

607. Magic, Science, and Religion. (3) Explores concepts of magic, science, and religion that emerged in Western thought and culture from late antiquity through the European Enlightenment and analyzes connections between religious traditions and Western, Modern Science.

608. Sacred Scripture in the Traditions of Abraham. Comparative study of sacred texts in Judaism, Christianity, and Islam with particular attention to the issues authority, function, and interpretation.

610. The Prophetic Literature. (3) Examination of the development and theological contents of the literary products of Israel's prophetic movement.

612. The Critical Study of the Pentateuch. (3) Study of the five traditional books of Moses (the Torah) and various lines of analysis that modern Biblical critics have used to interpret their composition and role in the development of Israelite theological thought.

613. Near Eastern Archeology. (3) Survey of 20th-century archeology in the Near East with attention to its importance for Biblical studies.

615, 616. Field Research in Biblical Archeology. (3, 3) Study of the religion and culture of the ancient Near East through the excavation and interpretation of an ancient site.

617. Wisdom Literature. (3) Examination of the development, literary characteristics, and theological contents of the works of ancient Israel's sages.

618. Feminist and Contemporary Interpretations of the Bible. (3) Study of feminist and

contemporary approaches to the Bible in light of the history of interpretation and a range of contemporary concerns and interpretive contexts.

620. The Search For Jesus. (3) Introduction to the issues, assumptions, evidence, and debate that shapes the continuing quest for the historical Jesus.

623. Jesus Traditions. (3) Examines ancient Christian and other religious representations of Jesus in historical, social, cultural and theological context.

624. Early Christian Literature. (3) Examination of various literature and perspectives of the first three centuries of the Christian movement.

628. Jewish-Christian Relations and the New Testament. (3) Study of Jewish-Christian relations and selected writings of the New Testament in the historical, social, religious and political contexts of ancient Judaism and emerging Christianity. Focus varies with instructor.

629. Chinese Medicine. (3) An interdisciplinary exploration and analysis of Chinese medicine, its fundamental theories, and its range of health-oriented and religious applications.

630. Pope, Jefferson & Imam: A Study in Comparative Ethics. (3) Comparative study of the moral values and socio-ethical positions in the major religious traditions of the world, with particular focus on their various methods of reasoning and sources of authority.

631. Religion and Law. (3) A study of religion and law as distinct yet interdependent spheres that influence cultural negotiations about authority, power, identity, and the regulation of society. Geographic and tradition-specific focus may vary with instructor.

632. Religion and Public Engagement. (3) This seminar introduces students to dynamics at work at the interface between religious communities and the public sphere. It will explore, through a wide range of readings, guest lectures, and films, the potential for social change-constructive and destructive-within and between communities in locally, regionally, nationally and globally.

635. Religious Ethics and the Problem of War. (3) Examination of the causes and characteristics of war, various Christian response to it, and approaches to peacemaking, with attention to selected contemporary issues.

636. Religious Traditions and Human Rights. (3) Study of the relationships and tensions between religious traditions and human rights, with illustrations from historical and contemporary issues and movements.

638. Religion, Ethics, and Politics. (3) Examination of ethical issues in religion and politics using materials from a variety of sources and historical periods.

639. Religion, Power and Society in Modern Africa. (3) Interdisciplinary study of the growth transformations of Africa's major religious traditions (Christianity, Islam, and the indigenous religions), and of their relations with secular social changes.

640. Men's Studies and Religion. (3) Examination of the ways in which masculine sex-role expectations and male experiences have both shaped religious ideas, symbols, rituals, institutions, and forms of spirituality and been shaped by them. Attention is given to the ways in which race, class, and sexual orientation affect those dynamics.

641. Religion and Ecology. (3) Cross-cultural examination of the relationships among human beings, their diverse cultures, habitats, and religions, including social and political understandings of the environment.

642. Religious Intolerance in the U.S. (3) Study of the various manifestations of religious

intolerance in the U.S. from the colonial period until the present.

643. Religion, Culture, and the Body. (3) A cross-cultural, multi-disciplinary exploration of the body as a malleable locus of contested ideals that informs personal, social, and religious identity formation.

645. The African-American Religious Experience. (3) Exploration of the religious dimensions of African-American life from its African antecedents to contemporary figures and movements.

648. Race, Memory and Identity. (3) Explores the collective memory and identity of American-Indian and African-American communities and their response to historical trauma in their cultural imagination, spirituality, and political and social activism.

649. Asian Meditation Practices. (3) Introduces and examines theoretical and practical aspects of various forms of Eastern meditation (concentration, mindfulness, Zen, visualization, and moving energy work) from both practitioner and modern scientific perspectives.

650. Psychology of Religion. (3) Examination of the psychological elements in the origin, development, and expression of religious experience.

651. Sociology of Religion. (3) Introduces the sociological analysis of religion, including religious beliefs and experiences, the cultural context of religion, varieties of religious organization, religious change and social change.

655. Jewish Identities: Religion, Race, and Rights. (3) Examines how evolving definitions of race, religion, and Jewishness have correlated and conflicted in varied and sometimes surprising ways and how these shifts have been tied to legal rights and social privileges.

656. Modern Jewish Movements. (3) Examines modern Jewish movements from Isaac Luria's system of Kabbalah in 16th century Palestine through Jewish Renewal in the Contemporary United States.

657. Jews in the United States. (3) Focusing on the 19th-21st centuries, this course examines Jewish American histories, experiences, and identities, as well as their impact on American society as a whole.

659. Hinduism in America. (3) Study of the meanings, values, and practices associated with the religions of Hinduism in dialogue with the dominant culture of America.

661. Topics in Buddhism. (3) Variable topics in Buddhist history, thought, and/or practice. May be repeated for credit if topic varies.

662. Topics in Islam. (3) Examination of the origins and development of Islam, the world's second largest religious tradition. Attention is given to the formation of Islamic faith and practice as well as contemporary manifestations of Islam in Asia, Africa, and North America. May be repeated for credit if topic varies.

663. The Religions of Japan. (3) Study of the central religious traditions of Japan from pre-history to the present, including Shinto, Buddhism, Zen Buddhism, Christianity, and Confucianism.

665. History of Religions in America. (3) Study of American religions from Colonial times until the present.

666. Gender and Religion. (3) Examination of the historical and contemporary interaction between religion and sex roles, sexism, and sexuality.

667. Contemplative Traditions in Christianity. (3) Interdisciplinary study of contemplative practices (meditation, spirit possession, visions, and dreams) of gaining spiritual insight understood to

lead to transformation of self and community.

668. Protestant and Catholic Reformations. (3) Study of the origin and development of Reformation theology and ecclesiology.

669. Radical Christian Movements. (3) Study of selected radical movements in the Christian tradition and their relation to contemporary issues.

672. History of Christian Thought. (3) Study of recurring patterns in Christian thought across time and cultures and some of the implications of those patterns in representative ancient and modern figures.

681. Zen Buddhism. (3) An examination of the origins and development of Zen Buddhism from China (Ch'an) to Japan and contemporary America. Particular attention is given to Zen doctrine and practice in the context of the broader Buddhist tradition.

682. Religion and Culture in China. (3) A thematic study of Chinese religious traditions and culture focusing on history, ritual, scripture, and popular practice. Topics include cosmology, ancestor veneration, shamanism, divination, and the role of women.

683. The Quran and the Prophet. (3) Examines the history, content, and main approaches to the sacred book of Islam. Explores the influence and interaction between the holy word and its transmitter the Prophet Muhammad.

684. Islam and Law: Varieties in Interpretation and Expression. (3) Explores main tenets of the Islamic law (Shari'ah) and how this law has been applied in past and present Islamic societies. Looks at legal issues through the lens of gender, ethics, non-Muslim minorities, rights, and duties.

685. Topics in South Asian Religions. (3) Variable topics in the religions of South Asia. May be repeated for credit if topic varies.

686. Indian Epics. (3) Examines one or both Indian epics, the Mahabharata and Ramayana, while paying attention to either epic's religious, social, and political contexts, performance, and development in Indian history.

687. Priests, Warriors, and Ascetics in Ancient India. (3) Introduces students to the history, culture and religious traditions of ancient India by examining the overlapping practices, beliefs, ideologies, and gender representations of priests, warriors, kings, and ascetics.

688. South Asian Women: Religion Culture & Politics. (3) This course examines the intersection of religion, race, and gender of South Asian women from a feminist and postcolonial perspective.

689. Islam in the West: Changes and Challenges. (3) Explores issues of identity, ethnicity and religion within various Muslim communities living in western countries. A central goal is to understand how these communities negotiate the new environment and the challenges they face.

690. Special Topics in Religion. (1.5-3) Religion topics of special interest. May be repeated for credit.

691. Topics in East Asian Religions. (3) Variable topics in the religions of China, Korea, and Japan. May be repeated for credit if topic varies.

692. Topics in First Peoples' Traditions. (3) Variable topics in the religions of American Indian and Canadian First Nations. May be repeated for credit if topic varies.

693. Topics in Religions of Africa. (3) Variable topics in the religions of Africa or African diaspora. May be repeated for credit.

696. Interreligious Encounters and Engagements. (3) Surveys the history of dialogue activities

among various religious communities and introduces the methods and theories of interreligious dialogues. Part of this class is interaction with local interfaith projects.

Seminars

700. Theory and Method in the Study of Religion. (3) Explores the history of and methodological resources for the study of religion. Focus may vary according to the instructor, but the emphasis is on the ways religion has been defined, studied, and interpreted over the last several centuries.

701, 702. Directed Reading. (1-3, 1-3) May be repeated for credit if topic varies.

703. Postmodern Perspectives on Power, Symbolism, and Performance. (3) A critical examination of postmodern theories on religion as a part of culture.

704. Conceptions of the Ultimate. (3) A comparative study of religious conceptions of the ultimate (divine, sacred) within Eastern and Western traditions through a range of methodological lenses including phenomenological, philosophical, theological, and sociological.

705. Research in Religion. (3) Tools and methodologies applicable to research in religion. Fulfills the three hours in research methods that the religion department requires of first-year MA students.

708. Religious Language and Symbol. (3) Examination of the distinct use of language in religious discourse, with attention to theoretical understandings of human language, the variety of philosophical efforts to define the validity of religious language, and the role of metaphor and analogy in religious communication.

709. Field Program in Religion and Public Engagement. (1-3) Integrated study of major themes in religion and public engagement carried out in partnership with one or more communities off campus. Focus varies with instructor. *On request.*

716. Old Testament Theology. (3) Major motifs of revelation in the Old Testament; analysis of recent attempts to write an Old Testament theology.

718, 719. Old Testament Exegesis. (3, 3) Detailed analysis and exegesis of selected portions of the Hebrew Bible. *P—Biblical Hebrew*

720. History of Biblical Interpretation. (3) Detailed study of the history of biblical interpretation and hermeneutics.

721. New Testament Theology. (3) Delineation of an approach to New Testament theology as a whole, a consideration of the hermeneutical problem, and an examination of two or three themes in New Testament theology.

723, 724. New Testament Exegesis. (3, 3) Examination of selected portions of the Greek New Testament, with attention to the tools necessary for exegesis. *P—Koine Greek*

726. Seminar in Early Christianity Studies. (3) An intensive study of selected topics and texts in early Christianity studies.

737. Figures and Traditions in Religious Ethics. (3) Seminar course that examines the basic ethical works and theories of central figures in Western and non-Western traditions. Students engage in close readings of important texts in religious thought and morality and produce essays reflecting on the themes addressed by the authors.

738. Seminar in Christian Social Ethics. (3) Critical study of classic texts and figures in the history of Christian ethics and social thought.

740. Seminar in the Sociology of Religion. (3) Examination of selected classical and contemporary

texts illustrative of the theories, methods, and purposes of the sociological study of religion.

751. Theory and Practice of Pastoral Counseling. (3) Study of counseling methodologies, psychotherapeutic techniques, personal development, and human behavior in terms of the implications for pastoral counseling.

755, 756. Clinical Pastoral Education. (3, 3) Clinical experience in pastoral care, including work in crisis situations, seminars, interdisciplinary clinical group sessions, formal pastoral counseling, urban ministry assignments, and participation in group therapy. (Both semesters must be completed.)

761. Seminar in Eastern Religion. (3) Directed study in selected areas of the religious traditions of the East.

762. The Literature of Ancient Judaism. (3) Examination of the rabbinic writings (Mishnah, Tosefta, Talmud, Midrashim, Targumim, and the Liturgy), the Dead Sea Scrolls, the Old Testament Apocrypha and Pseudepigrapha, and the literature of Hellenistic Judaism (e.g., Philo and Josephus).

763. Hellenistic Religions. (3) Consideration of available source materials, questions of method, and bibliography related to such Hellenistic religions as the Mysteries, Hellenistic Judaism, and Gnosticism.

766. Seminar in Christian History. (3) Directed study of selected areas in the history of Christianity, including Baptist history.

768. The Protestant and Catholic Reformations. (3) Study of the origin and development of Reformation theology and ecclesiology.

771. Religions in America. (3) A study of religious traditions, events, and individuals shaping religious life in America. Attention is given to native religious, colonization, denominations, awakenings, religious liberty, the western movement, and the rise of the “American Self.” The development of pluralism and the impact of immigration, civil rights, and “new religions” are also studied.

775. Seminar in the History of Christian Thought. (3) Intensive study of a selected period or movement in Christian theological history, with special reference to seminal persons and writings.

780. Seminar in Theology and Literature. (3) Intensive study of a single theologian in relation to a literary figure with a similar religious outlook, the aim being to investigate how literature and theology mutually invigorate and call each other into question. Representative pairings: Niebuhr/Auden, Barth/O'Connor, Tillich/Updike, Newman/Eliot, Kierkegaard/Percy. May be repeated for credit if the writers studied are different.

781. Special Topics in Religion. (3) An intensive, in-depth study of a selected issue in the study of religion. Focus varies with instructor. May be repeated if topic varies.

791, 792. Thesis Research. (1-9) May be repeated for credit. *Satisfactory/Unsatisfactory*

NEAR EASTERN LANGUAGES AND LITERATURE (NLL)

111, 112. Elementary Hebrew. (3, 3) A course for beginners in the classical Hebrew of the Bible, with emphasis on the basic principles of Hebrew grammar and the reading of Biblical texts. (Both semesters must be completed.)

113. Standard Literary Arabic. (3) Introduction to the principles of Arabic grammar and a reading of selections from the Quran.

153. Intermediate Hebrew. (3) Intensive work in Hebrew grammar and syntax based upon the reading of selected texts. Readings emphasize post-Biblical Hebrew. P—NLL 111, 112, or equivalent.

211, 212. Hebrew Literature. (3, 3) The reading and discussion of significant Biblical texts. P—NLL 153.

601. Introduction to Semitic Linguistics. (3) Study of the history and structure of four languages from the Hamito-Semitic family of languages.

602. Akkadian I. (3) Analysis of the phonology, morphology, and syntax of the East Semitic languages of the ancient Near East as they relate to the larger family of Semitic languages.

603. Akkadian II. (3) A continuation of NLL 602 with further emphasis on building expertise in vocabulary and syntax through the reading of texts from the Middle Babylonian period.

610. Readings from the Rabbis. (1) Analysis of selected classical Hebrew texts designed to expand the student's facility with Hebrew. May be repeated for credit. *POI on request.*

611. Aramaic. (3) The principles of Aramaic morphology, grammar and syntax based on readings from the Bible and other ancient Near Eastern texts. *P—NLL 112 or POI on request.*

614. Readings from the Rabbis. (3) Texts in Hebrew and Aramaic from the Talmud and Midrash. *P—NLL 611 or POI on request.*

615. Syriac. (3) A study of the grammar, syntax, and scripts of Syriac based on the reading of selected texts. *P—NLL 611 or POI on request.*

621, 622. Introduction to Middle Egyptian I & II. (3, 3) The phonology, morphology, and grammar of Middle Egyptian. *POI on request.*

625. Coptic. (3) The phonology, morphology, and grammar of Sahidic Coptic with special emphasis on the texts from Nag Hammadi. Some knowledge of Greek is helpful. *POI on request.*

Sustainability (SUS)

Reynolda Campus

Program Director
Reynolds Professor
Professors

Dan Fogel
Richard Williams
Miles Silman, Abdou Lachgar, Ananda Mitra, Keith Bonin,
Dilip Kondepudi, Alan Palmiter, Robert Whaples, Dick Schneider,
Sid Shapiro, John Knox

Associate Professors
Assistant Professors

David Phillips, Saylor Breckenridge
Ron Von Burg, Lucas Johnston, Judith Madera, Steven Folmer,
Michael Gross, Rob Erhardt

Research Professors
Associate Faculty

Bailey Green
Dedee DeLongpre Johnston, Amy Wallis, Vanessa Zboreak,
Mark Curtis

Overview

The Center for Energy, Environment and Sustainability (CEES) offer the Master of Arts in Sustainability, an innovative and distinctive one-year program that combines the social sciences, humanities, natural sciences, management and law. Courses taught will include guest lecturers and off-site facility visits. As a result, students will have unparalleled opportunities to engage with

professionals beyond the Wake Forest campus. In addition to completing the four core courses, students will engage with organizations outside of the classroom through the completion of a two-credit practicum in Applied Sustainability as well as through course electives. In the summer following the second semester, students will complete a research thesis or internship.

The MA in Sustainability mission is to educate the next generation of leaders in sustainability and place them where they can be most effective. We provide students with a high caliber education and prepare them to enter the workforce or create new ventures to address the social, economic and environmental demands in their respective fields. We educate students to be change agents and develop a vision for ways to invest in and contribute to creating a sustainable future. The program expands Wake Forest's commitment to sustainability and creates opportunities for faculty members to direct their teaching and scholarship toward sustainability-related topics. The multidisciplinary program strengthens collaboration among the different schools at Wake Forest University and the greater communities of business, government agencies, and non-government organizations.

Candidates for the MA in Sustainability do not share a typical background nor are they required to have completed specific prerequisites prior to matriculation. The profile of a candidate will typically take the form of an accomplished mid-career professional seeking to re-orient or supplement their career with deep expertise in the field of sustainability, or a recent undergraduate from a highly ranked institution of higher education from across the nation or from across the globe. The integrated curriculum of our programs prepare students to join the vanguard of the sustainability movement, which is generating extensive and diverse opportunities for graduates in private business, as well as in NGOs, and government bodies. Candidates of the MA in Sustainability will utilize our program as a mechanism for adding value to their professional endeavors while simultaneously satisfying the urgent societal need for highly knowledgeable leaders in the field of sustainability.

Degree Requirements: *please see "Requirements for Degrees" beginning on page 25.*

Courses of Instruction

600. Communications Workshop. (1) Designed to build skills in writing and presentations. At the end of this workshop students will have advanced skills in writing memos to various constituents, making presentations in front of varied groups, an ability to write white papers, and criteria for evaluating other communication. Students will design and deliver various communication products that will be critiqued by trained professionals.

601. Professional & Leadership Skills. (1) This workshop builds a student's personal brand by focusing on resume design, interviewing skills, and the ability to be job market ready. the course builds on labor market theory in new types of job markets, such as sustainability. Most of the workshop will focus on leadership skills to create meaningful, planned change in various organizational settings. Students will engage in mock interviews and gain feedback from working professionals. Also, participants will take and receive feedback on various established leadership assessments.

602. Analytics. (1) This workshop builds on basic skills in statistics and quantitative and qualitative research. The main learning outcome of this workshop is how to evaluate data to make decisions. This critical thinking includes modeling data and evaluating research documents on various sustainability topics from peer reviewed and popular press sources.

603. Natural Capital Valuation. (1) This workshop includes tools and concepts on how to value nature and take this valuation into account in various decisions. Students will apply the basic principles underlying ecosystem service analyses and valuation and be able to identify and select tools and data to complete an analysis. Much of this workshop is case based comparing and contrasting various ecosystem solutions.

604. Global Human Systems. (3) This course will draw on anthropology, sociology, and health sciences to focus on the global social outcomes of decision making and resource management, with an emphasis on sustainability in cultural contexts. Topics that will be covered include sustainable community development, agricultural policy, the effects of sustainability policy choices on public and community health, and public policy regulating the built environment. Students will look at these topics through the lens of environmental ethics and learn to think critically about the interdependence of economic and environmental policy and community well-being. After studying sustainability initiatives in developing nations, they should be able to realistically assess the feasibility of development strategies in various societies.

691. Special Topics. (1-3) Examination of topics not covered in the regular curriculum.

694. Internship. (1-4) Internships are available for a student who has completed one year of graduate study and desires experience working in the private sector or a nonprofit or government agency. Internships typically take place during the summer months and last for three months, although the timing and duration may be adjusted to satisfy each student's needs and the type of internship available. Credit hours are adjusted based on the length of the Internship. The student receives a written evaluation from the host organization mentor and is required to submit a written report of his/her work. May be repeated for up to 4 credits.

695. Individual Study. (1-3) Opportunity to pursue a topic covered in a regular course in greater depth or topics relevant to the student's field of concentration. Usually involves extensive reading and tutorial sessions with a faculty supervisor. Written papers may be required. May be repeated for up to 6 credits.

702. Sustainable Organizational Management. (3) Drawing on business management, finance, and accounting, this course will examine strategies for sustainability in corporations, governments, and NGOs. Topics covered will include corporate management and social responsibility, organizational change, systems thinking, organizational strategy, innovation, sustainable supply chains, and measurement and accounting methods. Students will also examine emerging trends in global industry standards, inclusion of environmental mandates in free trade agreements, and voluntary codes of conduct; they will be expected to critique the effectiveness of these methods in terms of environmental impact and stakeholder outcomes. They will also learn methods by which to value an ecosystem through social, economic, and environmental criteria. Students will develop leadership abilities to apply to their fields as they identify levers to encourage systemic change in various contexts.

703. Resource Management and Energy Science. (3) Drawing on chemistry, ecology, biology, geology, climatology, oceanography, and physics, this course will provide an overview of various energy technologies and their long-term environmental effects, as well as the most urgent issues of resource management. Students will be expected to compare the effectiveness and environmental impact of traditional energy development and emerging alternative energy sources, including geothermal, solar, water, and wind energy. They will use the basics of energy science to analyze public policy, assess the feasibility of implementing alternative energy technologies, and craft solutions to environmental challenges. They will examine how energy is produced and used domestically and abroad, and analyze the tradeoffs inherent in electing sources of energy in societies with varying resource availability. During this course, they will have the opportunity to visit alternative energy corporations and view these systems to gain a better understanding of technologies in practice. They will evaluate the biotic effects of climate change and pollution on communities and ecosystems. Students should develop sufficient scientific competency to critically read scientific studies, and to differentiate between scientific theory and political punditry.

704. Environmental Law and Public Policy. (3) Drawing on domestic and international law and

public policy, this course will focus on the legal and policy context of environmental stewardship. During this course, students will develop an understanding of how administrative and environmental law is developed and implemented, and receive an overview of the most pertinent domestic environmental laws and international treaties. Students will look at case studies of environmental litigation to better understand the legal process and the mechanisms for enforcing these laws. They will be asked to compare and contrast examples of United States laws and processes to case studies from other countries, and evaluate the differing public policy priorities behind various approaches. They will also examine how incentives are used in lieu of legal regulations and critique the effectiveness of environmental incentives. Students should be able to perform cost-benefit analyses of environmental laws and articulate the benefits and detriments of public policy choices addressing policy targets such as carbon emissions, ocean management, and bio-engineered food.

705. Applied Sustainability 1. (2) Contextualizing the material covered in the four classroom courses, this course will provide opportunities for students to experience sustainability in action. On a biweekly basis, students may travel off campus for mini-practicum opportunities that will include visits to a perma-culture farm, a scientific research site devoted to monitoring coal byproduct runoff, local small businesses assisting corporations as they develop sustainability strategies, a nonprofit dedicated to remedying food shortages in poor and minority communities, and a solar farm. A longer study tour mid semester will take students to see the effects of mountain top removal and fracking and meet with organizations and legislators lobbying for and against these methods of energy production. Weeks when students remain on campus, this course will bring outside speakers and presentations to address issues of global development, environmental riders to trade treaties, biofuel production, genetically modified foods, LEED certification and sustainable building design, sustainable urban planning and transportation, and sustainable strategies for public health.

706. Applied Sustainability 2. (2) Contextualizing the material covered in the four classroom courses, this course will provide opportunities for students to experience sustainability in action. On a biweekly basis, students may travel off campus for mini-practicum opportunities that will include visits to a perma-culture farm, a scientific research site devoted to monitoring coal byproduct runoff, local small businesses assisting corporations as they develop sustainability strategies, a nonprofit dedicated to remedying food shortages in poor and minority communities, and a solar farm. A longer study tour mid semester will take students to see the effects of mountain top removal and fracking and meet with organizations and legislators lobbying for and against these methods of energy production. Weeks when students remain on campus, this course will bring outside speakers and presentations to address issues of global development, environmental riders to trade treaties, biofuel production, genetically modified foods, LEED certification and sustainable building design, sustainable urban planning and transportation, and sustainable strategies for public health.

791. Thesis Research. (1-4) Research directed toward fulfilling the capstone requirement. May be repeated for up to a total of 4 credits.

Courses in General Studies

701. Seminars in Professional and Career Development. A monthly seminar course, primarily for first-year graduate students, in which invited speakers give presentations on the training and career development that led them to their current professions. Typically, there are four speakers per semester from a variety of organizations, such as undergraduate colleges, research institutions, biotechnology and pharmaceutical companies, law firms, and scientific journal editorial offices. In addition

to the formal presentations, students also have the opportunity to interact with speakers in smaller groups over lunch and in other informal settings. Each student is required to write a short paper at the end of the semester describing a career track, other than the one for which they are currently training, and their plan for becoming a competitive job applicant in that area.

702, 703. Internship. (1-9) Internships are available for a student who has completed one year of graduate study and desires experience working in the private sector or a nonprofit or government agency. Internships typically take place during the summer months and last for three months, although the timing and duration may be adjusted to satisfy each student's needs and the type of internship available. Credit hours are adjusted based on the length of the internship. The student receives a written evaluation from the host organization mentor and is required to submit a written report of his/her work. May be repeated. Maximum hours not to exceed 54. *Satisfactory/Unsatisfactory*

704. Principles of Intellectual Property Development. (2) Designed for late-stage graduate students to supplement their scientific background with a greater understanding of intellectual property protection, commercialization, and start-up company formation. Numerous aspects of our knowledge-based economy will be covered including an overview of the diverse types of intellectual property protection available to protect inventions (with a focus on patents), the technology transfer process in an academic setting, a primer of company formation and organization, and an analysis of the different agreements (including confidential disclosure agreements, , material transfer agreements, and license agreements) necessary to move a technology from the bench to the bedside. *P—Scientific graduate students only.*

705. Problem Based Learning (PBL). (1-3) Small group sessions with post-baccalaureate premedical program students to facilitate the development of clinical reasoning skills and basic and clinical science knowledge. Topics on ethics and professionalism and the doctor-patient relationship are discussed. A combination of case studies, reading assignments, course notes and group discussion will be used.

707. Professional Responsibilities and Conduct I. (1) Students learn to identify general and discipline-specific professional norms and obligations for the responsible practice of science. Emphasizes development of professional decision-making skills. This course or equivalent is required for Reynolda campus masters students who will be supported on federal grants. *Pass/Fail*

708. Professional Responsibilities and Conduct II. (2) Students learn to identify general and discipline-specific professional norms and obligations for the responsible practice of science. Emphasizes development of professional decision-making skills. Required of all Reynolda campus doctoral students. *Pass/Fail*

709, 710. Scientific Outreach. (1) This course provides hands-on engagement with teaching and educational opportunities directed at the lay public or other, non-university groups. Planning outreach events and communicating scientific concepts to the lay public are essential skills for any scientist-in-training, especially those who may be involved in academic lecturing or public policy. The scope of such activities will derive from the scientific disciplines of the students involved, but will include activities involving the informal teaching of basic and translational science concepts in the biomedical sciences and other STEM-related disciplines. Examples of such engagement include K-12 school visits, involvement in public symposia related to science for lay audiences, or any similar activity performed under faculty guidance. May be repeated for credit not to exceed 6 hours each. *Satisfactory/Unsatisfactory*

711. Introduction to College Teaching. (1) Prepares graduate teaching assistants for teaching

roles. Coursework includes a 1-2 day orientation introducing students to the role and responsibility of being a teaching assistant, departmental orientation to teaching in the discipline, a series of educational workshops conducted by the Teaching and Learning Center, and classroom observation. *Satisfactory/Unsatisfactory*

713, 714. Scientific Professionalism and Integrity. (1) The Problem-Based Learning Method (PBL) is used to teach students in small groups to identify discipline-specific and broad professional norms and obligations for the ethical practice of science. Content will include the norms and principles for the responsible conduct of scientific research such as data acquisition, management, sharing and ownership, publication practices, and responsible authorship. Emphasis will be placed on learning the tenets of responsible conduct of research, the current regulatory and legal climate, as well as the underlying norms and principles that shaped these concepts. Topics will include the student and advisor relationship, laboratory dynamics, collaborations in science, appropriate handling of data and appropriation of credit, plagiarism, conflicts of interest and financial responsibility. Students will acquire skills to recognize ethical issues in the practice of science, identify role obligations, and develop sound ethical reasoning to address these issues. The courses also include plenary session presentations by experts on topics of professional development, such as preparing manuscripts and grant applications and policies regarding conduct of animal and human subject research. *Satisfactory/Unsatisfactory*

720. Topics in College-Level Teaching. (1-3) Students participate in the preparation and delivery of one or more lectures, homework assignments, and examinations, and facilitate small group learning sessions. Students attend at least two professional development workshops on a variety of aspects of the educational process. *P—Successful completion of the first year of coursework in a biomedical graduate training program and POI. Satisfactory/Unsatisfactory*

722. Teaching Skills and Strategies Seminar. (2) Designed to provide students with formal training and development in teaching strategies and teaching scholarship. A variety of theories and pedagogies are reviewed and discussed. Students receive some practical experience in developing and delivering instructional materials and assessment tools. Meets weekly for two hours throughout the spring semester.

724. Biosafety in Research Laboratories. (3) This one-term course provides an overview of the types of biohazards that may be encountered while conducting scientific research, with emphasis on laboratories, and effective methods to minimize the risks associated with those hazards. *P—At least one microbiology course and laboratory experience.*

As a mechanism for enrichment of graduate studies at Wake Forest University, additional courses in liberal arts are offered for graduate credit. These courses are designed to provide special opportunities for students in the humanities and social sciences, but are open to students on either campus. The courses may be taken after consultation with the student's departmental advisory committee.

Anthropology

605. Museum Anthropology. (3) Examines, through hands-on use of the Museum's collections, the historical, social, and ideological forces shaping the development of museums, including the formation of anthropological collections and representation, and the intellectual and social challenges facing museums today.

607. Collections Management Practicum. (1.5) The principles of collections management including artifact registration, cataloging, storage, and handling; conservation issues and practices; disaster planning and preparedness; and ethical issues are covered through lectures, readings, workshops, and hands-on use of the Museum's collections.

613. Tradition, Continuity, and Struggle: Mexico and Central America. (3) Acquaints students with the lives and struggles of indigenous and non-indigenous people of Mexico and neighboring countries, with special focus on the Maya. Includes study of contemporary and prehispanic traditions, including Mayan cosmology, language, art and architecture, issues of contact during Spanish colonization, and current political, economic, health, and social issues affecting these areas today.

615. Artifact Analysis and Laboratory Methods in Archeology. (3) Introduction to methods for determining the composition, age, manufacture, and use of different prehistoric and historic artifact types. Techniques for reconstruction of past natural environments from geological or ecofact samples. Exploration of data display tools including computer-based illustration, GIS, and archeological photography.

630. Seeing World Cultures. (3) Focuses on selected cultures throughout the world to better understand these societies through the use of ethnographic literature and assesses the effectiveness of visual communication in conveying ideas about these cultures through the use of ethnographic videos and films.

632. Anthropology of Gender. (3) Focuses on the difference between sex, a biological category, and gender, its cultural counterpart. An anthropological perspective is used to understand both the human life cycle and the status of contemporary women and men worldwide. In section one, topics covered include evolution and biological development, sexuality and reproduction, parenting and life cycle changes. The second section takes students to diverse locations, including Africa, South Dakota, China, India, and the Amazon for a cross-cultural comparison examining roles, responsibilities and expectations, and how these interact with related issues of class and race.

634. Peoples and Cultures of South Asia. (3) Survey of the peoples and cultures of the Indian subcontinent in the countries of Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka. Reviews major topics of interest to anthropologists, including prehistory, history and politics, religion, social organization, caste, gender, development and population.

636. Myth, Ritual, and Symbolism. (3) Explores how people envision and manipulate the supernatural in cross-cultural perspective. Emphasizes functional aspects of religious beliefs and practices.

637. Economic Anthropology. (3) Examines the relationship between culture and the economy and its implications for applied anthropology. The variable nature and meaning of economic behavior will be examined in societies ranging from non-industrial to post-industrial. Discusses the impact of economic development programs, foreign aid and investment, technology transfer, and a variety of other economic aid programs.

639. Culture and Nature. (3) Exploration of humanity's "place" in the cosmos, focusing on different worldviews of nature and culture. Case studies from anthropology, archeology, and environmental science examine conceptions of technology, resources, environment, and ownership in the context of environmental change, "natural" disasters, and resource scarcity.

640. Anthropological Theory. (3) Study and evaluation of the major anthropological theories of humans and society. The relevance and significance of these theories to modern anthropology are discussed.

642. Development Wars: Applying Anthropology. (3) Explores the application of anthropological concepts and methods in the understanding of contemporary problems stemming from cultural diversity, including competing social and economic development models and ideologies of terror. Emphasizes conflict and change in developing areas but also considers the urban experience.

653, 654. Field Research. (3, 3) Issues-based field program providing students with a critical

understanding of the historical, social, political-economic and environmental conditions that have shaped the lives of the people of the Greater Southwest, with special attention to the Native American and Latino/a experience. The program moves from the Mexican border region through New Mexico and Arizona, focusing on border issues, archaeology and prehispanic history, and contemporary Native American culture. Students camp, hike, and learn to use digital technology in the field. Specific sites may vary from year to year.

655. Language and Culture. (3) Covers theoretical and methodological approaches to the study of language and culture, including: semiotics, structuralism, ethnoscience, the ethnography of communication, and sociolinguistics. Topics include: linguistic relativity; grammar and worldview; lexicon and thought; language use and social inequality; language and gender; and other areas.

658. Native Peoples of North America. (3) Ethnology and prehistory of the indigenous peoples and cultures of North America.

661. Evolution of Human Behavior. (3) The application of Darwinian principles to the study of human nature and culture. Considers the existence, origin, and manifestation of human behavioral universals and the theoretical and practical implications of individual variability.

662. Medical Anthropology. (3) The impact of Western medical practices and theory on Western and non-Western cultures and anthropological contributions to the solution of world health problems.

663. Primate Behavior and Biology. (3) Examines the evolution and adaptations of the order primates. Considers the different ways that ecology and evolution shape social behavior. A special emphasis on the lifeways of monkeys and apes.

664. Primate Evolutionary Biology. (3) Examines the anatomy, evolution, and paleobiology of members of the order Primates. Emphasis is on the fossil evidence for primate evolution. Topics covered include: primate origins, prosimian and anthropoid adaptations, patterns in primate evolution, and the place of humans within the order Primates.

665. Evolutionary Medicine. (3) Explicitly evolutionary approach to complex relationships between human evolutionary adaptations and health problems related to modern behavior and culture.

666. Human Evolution. (3) The paleontological evidence for early human evolution, with an emphasis on the first five million years of bio-cultural evolution.

668. Human Osteology. (3) Survey and analysis of human skeletal anatomy, emphasizing archeological, anthropological, and forensic applications and practice.

670. Old World Prehistory. (3) Survey of Old World prehistory, with particular attention to geological and climatological events affecting culture change.

674. Prehistory of North America. (3) The development of culture in North America as outlined by archeological research, with emphasis on paleoecology and sociocultural processes.

676. Archeology of the Southeastern United States. (1.5) Study of human adaptation in the Southeast from Pleistocene to the present, emphasizing the role of ecological factors in determining the formal aspects of culture.

677. Ancestors, Indians, Immigrants: A Southwest Cultural Tapestry. (3) Exploration of factors that shaped the lives of people in the Southwest, with attention to Native American and Hispanic experience. From kivas to casinos, coyotes to cartels, it links archeological and prehispanic history to contemporary lifeways in the canyons, deserts, and cities of the U.S./North Mexico.

678. Conservation Archeology. (1.5) Study of the laws, regulations, policies, programs, and

political processes used to conserve prehistoric and historic cultural resources.

680. Anthropological Statistics. (3) Basic statistics, emphasizing application in anthropological research.

681, 682. Archeological Research. (3, 3) Integrated training in archaeological field methods and analytical techniques for researching human prehistory. Students learn archeological survey, mapping, excavation, recording techniques and artifact and ecofact recovery and analysis.

683, 684. Field Research in Cultural Anthropology. (3, 3) Comparative study of culture and training in ethnographic and cultural analysis carried out in the field.

685, 686. Special Problems Seminar. (3, 3) Intensive investigation of current scientific research within the discipline, concentrating on problems of contemporary interest.

687. Ethnographic Research Methods. (3) Designed to familiarize students with ethnographic research methods and their application. Considers the epistemological, ethical, political, and psychological aspects of research. Field experience and data analysis.

698. Individual Study. (3) Reading or research course designed to meet the needs and interests of selected students, to be carried out under the supervision of a departmental faculty member. May be repeated for a maximum of 6 hours.

785. Directed Research and Reading. (3) Research and reading course, including field component, designed to meet the needs of individual students and resulting in a professional-quality paper and/or presentation. May be repeated for a maximum of 6 hours. *P—POI*

Art

614. Video Art: Site Specific (3) A historical, aesthetic, and technical exploration of contemporary video art production. Students will produce multi-channel video projects that interact with physical space. *P—Video Art/Film-making experience required.*

624. Video Art: Cyberspace. (3) A historical, aesthetic, and technical exploration of contemporary video art productions. Students will produce multi-channel video projects that interact with cyberspace. *P—Video Art/Film-making experience required.*

628. Video Art: Theatre Works. (3) A historical, aesthetic, and technical exploration of contemporary video art productions. Students will produce single-channel video projects for theatre viewing *P—Video Art/Film-making experience required.*

685. Global Contemporary Art. (3) A global perspective on contemporary artistic trends since 1980, including discussions about art criticism, exhibitions and the changing art world.

696. Art History Seminar. (3) Offered by members of the faculty or visiting faculty on topics of their choice.

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|---------------------|------------------------------|
| a. Ancient Art | h. Modern Architecture |
| b. Medieval Art | i. American Architecture |
| c. Renaissance Art | j. Art and Popular Culture |
| d. Baroque Art | k. Film |
| e. Modern Art | l. Architecture and Urbanism |
| f. Contemporary Art | m. Museums |
| g. American Art | n. Special Topics |

697. Advanced Topics in Studio Art. (3) Focus on selected studio projects, critical readings, and discussions on topics selected by members of department faculty. May be repeated for a maximum of 6 hours.

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|----------------|-------------------|
| a. Drawing | e. Photography |
| b. Painting | f. Digital Art |
| c. Printmaking | g. Special Topics |
| d. Sculpture | |

697 H. Video Art. (3) Continues the historical, aesthetic, and technical exploration of contemporary video art production.

Classical Languages

698, 699. The Teaching of Latin. (3, 3) A reading course and workshop in the problems of Latin pedagogy and the secondary Latin curriculum, designed to meet the needs and interest of selected students. *P—POI*

History

605. Medieval and Early Modern Iberia. (3) The cultures that flourished on the Iberian peninsula between 700 and 1700 were diverse and contradictory. This course examines the formation of religious, cultural and political identities and the economics of empire in the medieval and early modern period.

607. Italian Renaissance. (3) Examination of the economic, political, intellectual, artistic, and social developments in the Italian world from 1350-1550.

608. The World of Alexander the Great. (3) Examination of Alexander the Great's conquests and the fusion of Greek culture with those of the Near East, Central Asia, and India. Special emphasis on the creation of new political institutions and social customs, modes of addressing philosophical and religious issues, as well as the achievements and limitations of Hellenistic Civilization.

609. European International Relations Since World War I. (3) This course surveys European international relations in the 20th century beyond treaties and alliances to examine the economic, social, and demographic factors that shaped formal arrangements between states. Additionally, it will cover the impact on European diplomacy and international relations of new forms of international cooperation, pooled sovereignty, and nongovernmental organizations.

610. Twentieth Century Eastern Europe. (3) Examination of the history of twentieth century Eastern Europe, including the creation of nation-states, World War II, and the nature of Communist regimes established in the postwar period. The course concludes with a discussion of the collapse of the Eastern Bloc and the challenges of European integration.

612. Jews, Greeks, and Romans. (3) Largely from a Jewish context, the course explores the political, religious, social, and philosophical values shaped by the collision between Jews, Greeks, and Romans, from the Hellenistic Period to the Middle Ages.

613. The History of European Jewry from the Middle Ages to the Present. (3) Examines the Jewish historical experience in Europe from the medieval period to the Holocaust and its aftermath. Includes a consideration of social, cultural, economic and political history, and places the particular experience of Jews within the context of changes occurring in Europe from the medieval to the modern period.

614. European Economic and Social History, 1700-1990. (3) Changes in Europe's economic structures and how they affected Europeans' lives, emphasizing how economic forces interacted with social and institutional factors.

615. Greek History. (3) The development of ancient Greek civilization from the Bronze Age to the end of the Classical Period stressing social institutions, individual character, and freedom of social

choice within the framework of cultural, political, and intellectual history.

616. Rome: Republic and Empire. (3) Survey of Roman history and civilization from its beginning to about 500 C.E., with emphasis on the conquest of the Mediterranean world, the evolution of the Republican state, the growth of autocracy, the administration of the empire, and the interaction between Romans and non-Romans.

617. The French Revolution and Napoleonic Empire. (3) The revolution and wars that constitute one of the pivotal points in modern history.

618. Weimar Germany. (3) Art, literature, music, and film of Weimar Germany, 1919-1933, in historical context. German or history credit determined at registration.

619. Poland and the Baltic Region. (3) Introduction to the history of Poland and the eastern Baltic littoral since 1760, covering territory that later became Estonia, Latvia, Lithuania, and Poland; emergence of independence after World War I; the Soviet experience; and re-establishment of independence during the breakup of the Soviet Union.

628. History of the English Common Law. (3) Study of the origins and development of the English common law and its legacy to modern legal processes and principles.

629. British Empire. (3) A survey of Britain's global empire from the 17th century to its continuing influence on the Commonwealth, globalization, and violent conflict today.

630. Race, Religion, and Sex in Early Modern Europe. (3) Explores issues of race, ethnicity, and gender in Europe between 1400 and 1800. Topics include contact and conflict among Jews, Muslims, and Christians; marriage, the family, and sexuality; migration and immigration; and slavery and conquest in early European colonies and empires.

633. European Diplomacy, 1848-1914. (3) The diplomacy of the great powers, with some attention given to the role of publicity in international affairs. Topics include the unification of Italy and of Germany, the Bismarckian system, and the coming of World War I.

634. Mystics, Monarchs, and Masses in South Asian Islam. (3) An introduction to Islam through South Asian social, political, cultural, and intellectual history.

635. Hindus and Muslims in India, Pakistan, and Beyond. (3) Examining the shared yet different, intertwined yet separate histories of the Hindus and Muslims of modern India, Pakistan, Bangladesh, and Sri Lanka primarily over the last two centuries. This course explores the checkered existence of the two communities in order to understand diversity and questions of coexistence and conflict.

636. Gender in African History. (3) Examines the centrality of gender to the African past. Major topics include definitions of gender in African settings; the operation of gender in precolonial African societies; gender and slavery; gendered transformations during colonial rule; gender, nationalism and independence; and the evolution of relationships between men and men, men and women, and women and women in various regions of the continent.

637. Gender in Early America. (3) The history of gender roles from the colonial period to the mid-19th century. Examines the social constructions of femininity and masculinity and their political and cultural significance.

638. Gender, Race and Class since 1800. (3) Analyzes how American political, economic, and cultural changes impact the definitions of femininity and masculinity, the changing notions of sexuality, and the continuity and diversity of gender roles, with special attention to race, class, and ethnicity.

639. Sickness and Health in American Society. (3) Analysis of major trends in health, sickness, and disease within the broad context of social, political, and economic developments. Examines indigenous healing; colonial medicine; emergence of hospitals and asylums; public health; race, class and gender issues; and natural versus high-tech approaches to health care in the 20th century.

640. Africa's Cities and Urban History. (3) Examines African cities in a historical perspective. Major topics include the structure of urban settlements in precolonial Africa, colonial and government efforts to regulate and reshape Africa's urban landscapes, cities as arenas of economic struggle, cultural transformations and political debates, urban gendered relations, and the contemporary conditions and challenges of African urban areas.

641. Africans in the Atlantic World, 1750-1815. (3) Explores Africans' experience in the Atlantic world (Africa, Europe, and the Americas) during the era of slave trade by examining their encounters with Indians and Europeans and their adjustment to slave traders in West Africa.

646. Japan before 1800. (3) A survey of Japan from the earliest times to the coming of Western imperialism with emphasis on regional ecologies, economic institutions, cultural practice, military organization, political ideology, and foreign relations.

647. Japan since World War II. (3) Survey of Japanese history since the outbreak of the Pacific War, with emphasis on social and cultural developments. Topics may include occupation and recovery of independence, the "1955 System," high-growth economics, and the problems of prosperity in recent years.

648. Samurai and Geisha: Fact, Film, and Fiction (3) Focuses on two well-known groups in Japanese history, the samurai (warriors) and geisha (entertainers). By analyzing historical studies and primary sources, as well as works of fiction and films about samurai and geisha, the course considers how Japanese and Western historians, novelists, and filmmakers have portrayed the two groups and by implication Japan and its history in the modern period.

650. World Economic History: Globalization, Wealth, and Poverty, 1500-Present. (3) Explores the growth of globalization and its role in the creation of wealth and poverty in both developed and underdeveloped nations. Focuses on trade, industrialization, and agriculture and technological advances in global contexts.

651. Global Environmental History. (3) Analysis of environmental aspects of world history from the beginning of agriculture to the present. Focus on how humans have used the environment to different ends. Topics include forests, agriculture, water, urbanism, science, warfare, conservation, energy, and perceptions of nature.

652. Ten Years of Madness: The Chinese Cultural Revolution, 1966 to 1976. (3) A history of the Chinese Cultural Revolution from 1966 to 1976. Examines the origins, consequences, and collective memories of the catastrophic political events and the social and cultural transformations that took place in China during the last decade of Mao's leadership.

653. War and Society in Early America. (3) Examines the evolution of warfare among the indigenous and colonial societies of North America between 1500 and 1800 and considers the roles of economics, class, gender, race, religion, and ideology in cultures of violence.

654. The Early American Republic. (3) A history of the formative generation of the United States. Considers the dramatic transformations of the constitutional, economic, and racial orders, as well as new performances in politics, national identity, gender and culture.

655. History of Nature Conservation in Latin America. (3) Explores the human dimensions of nature conservation in Latin America in a global perspective. Topics include the methods used by

different cultures and societies to conserve natural resources (including forests, fields, waterways, and wildlife), the social consequences of environmental protection, and how conservation changed over time. Taught only in Latin America.

656. Jacksonian America, 1815-1850. (3) The U.S. in the age of Jackson, Clay, Calhoun, and Webster.

657. The Civil War and Reconstruction. (3) The political and military events of the war and the economic, social, and political readjustments which followed.

658. Race and the Courts. (3) Examines the impact of state and federal court cases upon the evolution of race relations in the U.S. Beginning with Dred Scott, the historical context of each case is placed in juxtaposition to the social and political realities for the given time periods. Case law, scholarly articles, as well as the Supreme Court Digest provide a foundation for analyzing government intervention, inaction, and creative interpretation.

659. Bitter Contests: Industrialization, Urbanization, and Conflict, 1877-1933. (3) This course will examine the post-reconstructed nation with special attention to the politics of equilibrium; the economic impact of industrialization and agricultural revolutions; the positive and negative aspects of rapid urbanization; immigration and the class, ethnic, and religious clashes that ensued; Jim Crow and civil rights; the growth of Big Business and labor's response; Populism; the acquisition of an empire; Progressive reforms at city, state and federal levels; World War I at home and abroad; and the changing notions of femininity and masculinity. The course will end with the onset of the Depression and Hoover's response to it.

660. U.S. Since the New Deal. (3) This course will examine the institution of the New Deal as FDR's response to the depression; wars at home and abroad, including World War II, the Cold War, Korea, Vietnam, and Iraq I & II; the rise and fall of unionism; various movements from civil rights, women's rights, welfare rights, Native American rights, to student rights; countercultures from the 1950s through the 1980s; government regulation of the environment; mainstream and new religions; science and technology; the growth of the Imperial Presidency; Watergate and beyond; and liberalism and conservatism.

Political, social, and economic history of the U.S. since 1933 with emphasis on the Depression, wars at home and abroad, unionism, civil rights movements, countercultures, environmentalism, religion, the Imperial Presidency, and liberalism and conservatism.

661. Economic History of the U.S. (3) The economic development of the U.S. from colonial beginnings to the present.

662. American Constitutional History. (3) Origins of the Constitution, the controversies involving the nature of the Union, and constitutional readjustments to meet the new American industrialism.

663. American South and Reconstruction. (3) Examination of the origins of southern distinctiveness, from the first interactions of Europeans, Native Americans, and Africans to the Civil War and Emancipation.

664. The American South since the Civil War. (3) Examination of sharecropping, segregation, political reform, the Sunbelt phenomenon, the Civil Rights Movement, and southern religion, music, and literature. Includes a service learning component.

665. Modern Native American History. (3) Considers broad historical issues and debates about Native American identity, experiences with and memories of colonialism, cultural preservation and dynamism, and political sovereignty from 1830 to the present. Focuses on individual accounts, tribal case studies, and popular representations of Native people.

666. Historic Preservation. (3) Examines the history, legal frameworks, agencies, practices and emerging challenges of historic preservation in the United States and other nations.

667. Issues in Public History. (3) Introduces students to the major issues involved in the practice, interpretation, and display of history for nonacademic audiences in public settings. Central themes include controversial historical interpretations, the role of history in popular culture, issues and aims in exhibiting history, and the politics of historical memory. Explores some of the many ways people create, convey, and contest history, major themes in community and local history, and the problems and possibilities of working as historians in public settings.

668. The Sectional Crisis 1820-1860. (3) Examines the deepening crisis that led to civil war in the U.S., with special attention to politics, culture, reform, economics, and questions of causation, responsibility, or inevitability.

669. Modern Military History. (3) Making war in the modern era, with special attention to the social context of military activity.

670. Topics in North Carolina History. (3) A general chronological survey of North Carolina with emphasis on selected topics. Lectures, readings, and class reports.

671. Winston-Salem/Forsyth County. (3) History of the Winston-Salem/Forsyth County area utilizing the techniques of local history, including local archives, museums, and oral history projects. Lectures, readings, and class projects.

674. Protest and Rebellion in Latin America. (3) Study of the history of protest movements and rebellions in Latin America from primitive and agrarian revolts to mass working class and socialist organizations.

675. Historical Black Biography (3) Explores both the lived experience and the historical reality of African Americans. Black lives are profoundly shaped by their group experience, influenced in no small part by the role of racism. The biographical approach individuates historical figures struggling to fashion identity. Topics include character development, intimacy, gender roles, public and private personas, self-deceptions or defenses, and personal perceptions and biases. The craft of writing biography is taught throughout the semester.

676. Civil Rights and Black Consciousness Movements. (3) A social and religious history of the African-American struggle for citizenship rights and freedom from World War II to the present.

677. American Diplomatic History. (3) Introduction to the history of American diplomacy since 1776, emphasizing the effects of public opinion on fundamental policies.

678. Reconciling Race. (3) Comparative history of 20th-century racial oppression, black rebellion, and religious reconciliation. Also listed as Religion 648.

680. America at Work. (3) Examines the people who built America from 1750 to 1945. Themes include free labor versus slave labor, the impact of industrialization, the racial and gendered realities of work, and the growth of organized labor and its political repercussions.

681. Religious Utopias and the American Experience. (3) Religious groups of many different origins have found in North America an open space for creating settlements that would embody their ideals. This course surveys a range of such 18th- and 19th-century communities, including Moravians, Rappites, Shakers, and the Oneida and Amana colonies.

683. Revolution and Culture in Latin America. (3) Explores the links between revolutionary movements and cultural expression in Latin America and the Caribbean. Includes a Language Across the Curriculum component that allows students to earn credits in Spanish by reading and

discussing at least half of the texts in Spanish.

684. Global Outlaws in History Since 1500. (3) This course examines the motivations, ideologies, goals, and behavior of those who have been deemed “outlaws” to international society since fifteen hundred, including pirates, terrorists, smugglers, war criminals, and violators of copyright. It also analyzes the role of power in creating the global regimes that define and target such activities.

685. History of Film: Bollywood and the Making of Modern India. (3) This course juxtaposes historical films made by the world’s largest film industry based out of Bombay/Mumbai with textual primary sources and secondary historical works and seeks to understand films as both interpretations and sources of history. It also explores specific themes such as nation, gender, caste, and community characteristics that are critical to understanding modern India.

687. Islamic Empires Compared: The Ottomans, Safavids, and Mughals. (3) Examines, in a comparative way, central themes in the history of the three great Islamic empires of the early modern period (1400-1800). Considers the problem of political legitimacy faced by Muslim rulers, transformations in Islamic religious practices, and the relationship between war and other aspects of Islamic society and culture.

688. Nation, Faith, and Gender in the Middle East. (3) Traces the development of nationalism and its interaction with religious, transnational, and gender identities in the Middle East in the 19th and 20th centuries. Topics include Zionism, Arabism, Turkish nationalism, and Islamic revivalism.

690. Research Seminar. (3) Offered by members of the faculty on topics of their choice. A paper is required.

691. Honors Seminar. (3) Seminar on problems of historical synthesis and interpretation. *P—POI*

692. Individual Research. (3) Writing of a major research paper. May be repeated for credit. *P—POI*

693. American Foundations I. (3) Interdisciplinary study of American art, history, literature, and music. Using its collection of American art as the basis for study, Reynolda House Museum of American Art, in cooperation with Wake Forest University, accepts a limited number of students to study with professors from various disciplines through lectures, discussions, and concerts. Includes a study tour to New York City. (Taught in summer; students enroll for both courses. Students may enroll in either 693 or 763)

697. Historical Writing Tutorial. (1.5) Individual supervision of historical writing to improve a project. *P—POI*

698. Individual Study. (3) A project in an area of study not otherwise available in the department; permitted upon departmental approval of petition presented by a qualified student. May be repeated for credit.

699. Directed Reading. (1-3) Concentrated reading in an area of study not otherwise available. May be repeated for credit if topic varies. *P—POI*

763. American Foundations I. (3) Interdisciplinary study of American art, history, literature, and music. Using its collection of American art as the basis for study, Reynolda House Museum of American Art, in cooperation with Wake Forest University, accepts a limited number of students to study with professors from various disciplines through lectures, discussions, and concerts. Includes a study tour to New York City. (Taught in summer; students enroll for both courses. Students may enroll in either 763 or 693).

765. Management of Cultural Organizations. (3) The structure and management of not-for-profit institutions, with emphasis on museums, historical societies and preservation organizations,

libraries, archives, and research institutions.

771. Internship. (1, 2, 3) A project involving supervised work in a historical organization or scholarly effort; permitted only upon approval by the graduate committee of a petition presented by a qualified student.

798. Individual Study. (3) A project in an area of study not otherwise available in the department; permitted upon approval by the graduate committee of a petition presented by a qualified student. May be repeated for credit.

Humanities

620. Perspectives on the Middle Ages. (3) A team-taught interdisciplinary course using a variety of literary, historical, and theoretical materials to examine one of the following: a) medieval women; b) medieval constructs of gender, race, and class; c) love and war in the middle ages; d) the medieval environment: landscape and culture. May be repeated for credit with different sub-topics.

653. African and Caribbean Women Writers. (3) Critical analysis of fiction by female authors whose works concern women in Africa and its Caribbean diaspora.

685. Legends of Troy. (3) Interdisciplinary investigation of translations and transformations of the Trojan Legend from the Greeks through the Middle Ages and the Renaissance to the present. Texts, studied in English translation, are by such authors as Homer, Virgil, Ovid, Chaucer, Racine, and Girandoux.

Linguistics

640. Special Topics. (3) Inter-cultural Communication. In-depth examination of the role of intercultural communication in the shaping of the world order today. Through a historical and theoretical survey, as well as self-awareness tools, students will acquire insights and experience in the analysis and design of intercultural communication strategies with a global mindset at personal, corporate, national and international mass-media levels.

680. Language Use and Technology. (3) Introduction to the fundamental concepts of creating and accessing large linguistic corpora (electronic collections of “real world” text) for linguistic inquiry. Course surveys a variety of cross-discipline efforts that employ corpus data for research and explores current applications.

683. Language Engineering: Localization and Terminology. (3) Introduction to the process of making a product linguistically and culturally appropriate to the target locale, and to computer-assisted terminology management. Surveys applications in translation technology. Taught in English. *P—POI*

Philosophy

631. Plato. (3) Analysis of selected dialogues, covering Plato’s most important contributions to moral and political philosophy, theory of knowledge, metaphysics, and theology. *P—POI*

632. Aristotle. (3) Study of the major texts, with emphasis on metaphysics, ethics, and theory of knowledge. *P—POI*

641. Kant. (3) Study of selected works covering Kant’s most important contributions to theory of knowledge, metaphysics, ethics, religion, and aesthetics. *P—POI*

642. Studies in Modern Philosophy. (3) Treatment of selected figures and/or themes in seventeenth and 18th century European philosophy. *P—POI*

652. Hegel, Kierkegaard, and Nietzsche. (3) Examination of selected sources embodying the basic concepts of Hegel, Kierkegaard, and Nietzsche, especially as they relate to each other in terms of influence, development, and opposition. *P—POI*

654. Wittgenstein. (3) The work of Ludwig Wittgenstein on several central philosophical problems studied and compared with that of Frege, James, and Russell. Topics include the picture theory of meaning, truth, skepticism, private languages, thinking, feeling, the mystical, and the ethical. *P—POI*

660. Ethics. (3) Systematic explanation of central ethical theories in the Western philosophical tradition. Such theories include Kantian deontology, utilitarianism, Aristotelian virtue ethics, and divine command theory.

661. Topics in Ethics. (3) *P—POI*

662. Social and Political Philosophy. (3) Systematic examination of selected social and political philosophers of different traditions, with concentration on Plato, Marx, Rawls, and Nozick. Topics include rights, justice, equality, private property, the state, the common good, and the relation of individuals to society. *P—POI*

670. Philosophy and Christianity. (3) Examination of the philosophical foundations of Christian thought and belief. Christian concepts of God and life everlasting, trinity, incarnation, atonement, prayer, sin, evil, and obligation.

671. Philosophy of Art. (3) Critical examination of several philosophies of art, with emphasis upon the application of these theories to particular works of art. *P—POI*

672. Philosophy of Religion. (3) Analysis of the logic of religious language and belief, including an examination of religious experience, mysticism, revelation, and arguments for the nature and existence of God. *P—POI*

673. Philosophy of Science. (3) Systematic and critical examination of major views concerning the methods of scientific inquiry, and the bases, goals, and implication of the scientific conclusions which result from such inquiry. *P—POI*

674. Philosophy of Mind. (3) Selection from the following topics: the mind-body problem; personal identity; the unity of consciousness; minds and machines; the nature of experience; action, intention, and the will. Readings from classical and contemporary sources. *P—POI*

675. Philosophy of Language. (3) Study of such philosophical issues about language as truth and meaning, reference and description, proper names, indexicals, modality, tense, the semantical paradoxes, and the differences between languages and other sorts of sign-systems. *P—POI*

681. Topics in Epistemology. (3) The sources, scope, and structure of human knowledge. Topics include: skepticism; perception, memory and reason; the definition of knowledge; the nature of justification; theories of truth. *P—POI*

682. Topics in Metaphysics. (3) *P—POI*

685. Seminar. (2-3) Offered by members of the faculty on specialized topics of their choice. With permission, may be repeated for credit. *P—POI*

Political Science and International Affairs

Undergraduate students are given preference in enrollment for courses in the Department of Political Science and International Affairs.

611. Political Parties, Voters, and Elections. (3) Examination of party competition, party

organizations, the electorate and electoral activities of parties, and the responsibilities of parties for governing.

617. Politics and the Mass Media. (3) Exploration of the relationship between the political system and the mass media. Two broad concerns are the regulation of the mass media and the impact of media on political processes and events.

618. Congress and Policymaking. (3) Examination of the composition, authority structures, external influences, and procedures of Congress with emphasis on their implications for policymaking in the U.S.

620. The American Presidency. (3) Emphasis on the office and the role; contributions by contemporary presidents considered in perspective.

629. Women and Politics. (3) Examines classical and contemporary arguments regarding the participation of women in politics as well as current policy issues and changes in women's political participation.

632. Politics in Russia and Eastern Europe. (3) Analysis of the political, economic, and social patterns of the region emphasizing the internal dynamics of the political and economic transition processes currently underway.

636. Government and Politics in Latin America. (3) Comparative analysis of the institutions and processes of politics in the Latin American region.

646. Politics and Policies in South Asia. (3) Survey of major issues relevant to politics and policy in India, Pakistan, Bangladesh, and Sri Lanka.

647. Islam and Politics. (3) Explores the interrelationship of Islam and politics in the contemporary world. The course has two main foci. The first deals with Islam as a political ideology which shapes the structure of political institutions and behavior. The second looks at Islam in practice by examining the interaction between Islam and the political systems of Iran, Pakistan, Saudi Arabia, and others.

650. Afghanistan, Pakistan, Iraq and U.S. Policy since 2001. (3) Broadly addresses the phenomena of U.S. involvement in two ongoing conflicts -- the Afghanistan war and the Iraq war. Focuses on the respective domestic and international politics and policies of the four main actors relevant to the conflicts: U.S., Afghanistan, Pakistan, and Iraq.

653. International Political Economy. (3) Analyzes major issues in the global political economy including theoretical approaches to understanding the tension between politics and economics, monetary and trade policy, North-South relations, environmentalism, human rights, and democratization.

654. U.S. Foreign Policy. (3) Analyzes the historical and theoretical perspectives shaping U.S. engagement with the world past and present. Applies this understanding to current problems in U.S. foreign Policy.

659. Palestine and the Arab-Israeli Conflict. (3) Explores the nature and scope of the conflict with particular emphasis on the time period post-1967 and the respective policies of the three most significant actors in the conflict: the U.S., Israel and Palestine.

663. U.S. Foreign Policy in the Middle East. (3) Critical analysis of U.S. foreign policy with respect to the Middle East since the second World War. Utilizes a case study method of instruction.

672. Democratic Theory. (3) Examines the historical and theoretical underpinnings of democracy and some of the critiques of those foundations. Focuses on understanding some of the major and

competing traditions of democracy theory and how key democratic concepts are reconceptualized within these various traditions.

673. Marx, Marxism and the Aftermath of Marxism. (3) Examination of Marx's indebtedness to Hegel, his early humanistic writings, and the vicissitudes of 20th century vulgar Marxism and neo-Marxism in the works of Lenin, Lukacs, Korsch, Horkeimer, Marcuse, and Sartre.

677. Feminist Political Thought. (3) Examines major themes, concepts and theories in feminist political thought. Themes explored include schools of feminist thinking, feminism's diverse expressions over time, theories of the interlocking systems of oppressions, and the connection between theory and practice.

678. Politics and Identity. (3) Investigates the ways in which concepts of identity have informed political norms, structure, and practices; the myriad forms identity takes (particularly gender, sexual orientation, class, race, religion, and ethnicity) drawing on examples from across the globe and theoretical approaches proposed for engaging differences.

687. Individual Study. (2 or 3) Intensive research leading to the completion of an analytical paper conducted under the direction of a faculty member. Students are responsible for initiating the project and securing the permission of an appropriate instructor. May be repeated for credit. *P—POI*

688. Directed Reading. (2 or 3) Concentrated reading in an area of study not otherwise available. Students are responsible for initiating the project and securing the permission of an appropriate instructor. May be repeated for credit if topic varies. *P—POI*

689. Internship in Politics. (2 or 3) Field work in a public or private setting with related readings and an analytical paper under the direction of a faculty member. Students are responsible for initiating the project and securing the permission of an appropriate instructor. Normally one course in an appropriate subfield is taken prior to the internship. *P—POI*

Romance Languages

French

623. Advanced Grammar and Stylistics. (3) Review and application of grammatical structures for the refinement of writing techniques. Emphasis is on the use of French in a variety of discourse types. Attention given to accuracy and fluency of usage in the written language.

629. Introduction to Business French. (3) Introduction to the use of French in business. Emphasizes oral and written practices, reading, and French business culture, as well as a comprehensive analysis of different business topics and areas.

660. Cinema and Society. (3) Study of French and Francophone cultures through cinema. Readings and films may include film as artifact, film theory, and film history.

661. Special Topics in French and Francophone Film Studies. (3) In-depth study of particular aspects of French and/or francophone cinema. Topics may include film adaptations of literary works, cinematographic expressions of social or political issues, selected filmmakers, theories, genres, historical periods, or cinematographic trends. May be repeated for credit for a maximum of 6 hours when topics vary.

663. Trends in French and Francophone Poetry. (3) Study of the development of the poetic genre with analysis and interpretation of works from each period.

664. French and Francophone Prose Fiction. (3) Survey of French prose fiction, with critical study of several masterpieces in the field.

665. French and Francophone Drama. (3) Study of the chief trends in French dramatic art, with reading and discussion of representative plays from selected periods: Baroque, Classicism, and Romanticism, among others.

670. Seminar in French and Francophone Studies. (3) In-depth study of particular aspects of selected literary and cultural works from different genres and/or periods. Topics vary from semester to semester. May be repeated for credit for a maximum of 6 hours when topics vary.

674. Topics in French and Francophone Culture. (3) Study of selected topics in French and/or francophone culture. Works will be drawn from different fields (sociology, politics, art, history, music, cinema) and may include journalistic texts, films, historical and other cultural documents. May be repeated for credit for a maximum of 6 hours when topics vary.

675. Special Topics in French and Francophone Literature. (3) Selected themes and approaches to French literature transcending boundaries of time and genre. May be repeated for credit for a maximum of 6 hours when topics vary.

681. French Independent Study. (1.5, 3) May be repeated for credit. *P—Permission of the department.*

Spanish

619. Advanced Grammar and Composition. (3) Advanced-level review of Spanish morphology and syntax applied to the refinement of writing techniques.

621. The Rise of Spanish. (3) The development of Spanish from an early Romance dialect to a world language. Study of ongoing changes in the language's sounds, grammar, and vocabulary system, with a focus on the effects of cultural history and relationships with other languages.

622. Spanish Pronunciation and Dialect Variation. (3) Description of, and practice with, the sounds, rhythm, and intonation of Spanish and the differences from English, with special attention to social and regional diversity. Strongly recommended for improving pronunciation. This course meets a N.C. requirement for teacher certification.

623. Advanced Grammar and Composition. (3) Advanced-level review of Spanish morphology and syntax applied to the refinement of writing techniques.

629. Special Topics in Hispanic Linguistics. (3) Investigation of key areas in Spanish languages research, such as dialectology, history, language acquisition, and usage.

631. Medieval Spain: A Cultural and Literary Perspective. (3) Examination of the literary, social and cultural themes, such as: Quests and Discoveries, Pilgrimage and the Act of Reading, Images of Islam, The Judaic Tradition in Spanish Literature, and Spiritual Life and Ideal.

632. The Golden Age of Spain. (3) Close analysis of literary texts, such as *Lazarillo de Tormes*, and study of the history of art, politics, and economics of the 16th and 17th centuries, with emphasis on themes such as the writer and society, humanism, the picaresque, Catholic mysticism, and power and politics.

633. 18th- and 19th-Century Spanish Literature and Culture. (3) Study of the major intellectual movements of the period: Enlightenment, Romanticism, Realism, and Naturalism in Spain through literary texts, essays, paintings, and music.

634. Voices of Modern Spain. (3) Study of the multifaceted cultural identity of contemporary Spain through different literary genres, art, and film.

635. Modern Spanish Novel. (3) Study of representative Spanish novels from the Generation of

1898 through the contemporary period.

636. Lorca, Dalí, Buñel: An Artistic Exploration. (3) Study of the relationship of these three Spanish artists through their writings, paintings, and films, respectively, and of their impact on the 20th century.

637. Lorca in the 20th Century. (3) Study of the life and works of poet, playwright, painter, and lecturer Federico García Lorca, within the social, cultural, literary, and artistic realities of the 20th century, including Modernism and Surrealism. Emphasis is on Lorca's treatment of minority cultures, including the Gypsy, the Arab, and homosexuals.

638. Love, Death, and Poetry. (3) Study of the representation of universal themes in Spanish poetry from different historical periods.

640. Film Adaptations of Literary Works. (3) Study of the cinematic and literary discourses through major Spanish literary works from different historical periods and their film adaptation.

641. Golden Age Drama and Society. (3) Study of the theatre and social milieu of 17th-century Madrid, where the works of playwrights such as Lope de Vega, Tirso de Molina, and Calderón de la Barca were performed. Includes analysis of texts and of modern stagings of the plays.

643. Cervantes: The Birth of the Novel. (3) Study of Don Quijote, the first modern novel, and several exemplary novels, and contemporary theoretical approaches to them. Considers related art, music, and film. Includes discussion of themes such as the development of prose fiction, the novel as a self-conscious genre, women and society, religion and humanism, nationalism, and imperialism.

644. The Debate about Woman in Late Medieval Spain. (3) Explores romantic love in the Iberian Peninsula in the 14th and 15th centuries focusing on the debate about woman as an index of social changes happening at the moment.

645. Medieval Pilgrimages. (3) Study of pilgrimage as transformative experience. Examines the dual experience of the physical journey, in particular to Santiago de Compostela, and the practice of reading as pilgrimage.

649. Special Topics. (1.5-3) Selected special topics in Spanish literature. May be repeated for credit. *P—POI*

651. Transatlantic Renaissance. (3) Study of the Spanish Golden Age period by reading and analyzing relevant peninsular and Colonial texts within the broader political, social and cultural contexts of the Spanish presence in the New World. Exposure to recent critical perspectives in early modern cultural studies.

652. Contemporary Theatre in Spain and Spanish America. (3) Study of contemporary Peninsular and Spanish-American theatre within its political, social, cultural, and aesthetic context.

653. Contemporary Women Novelists and their Female Characters. (3) Study of representative novels by women writers from Spain and Latin America, with emphasis on the representation of the female protagonist within her cultural context.

654. Transatlantic Enlightenment. (3) Study of the Enlightenment in Spain and Spanish America through analysis of texts within broader cultural and political contexts. Readings include primary sources from the 17th through 19th centuries and secondary sources from the late 18th century through current critical reexaminations of the concept of Enlightenment.

655. European-American Encounters, 1492 to the Present. Study of the 500-year tradition of representations of encounter between Spain and the Americas, with special attention to the ways the topic is used to define and redefine individual and collective identities. Primary texts include

narratives, plays, engravings, murals, films, and advertisements.

659. Special Topics. (3) Special topics in Transatlantic literature and culture. May be repeated for credit.

660. Colonial Spanish America. (3) Explores the early Spanish-American colonial period alongside contemporary intellectuals' attempt to return to and recover this historical past. Readings include 15th- and 16th-century codices, post-conquest indigenous writings, Iberian chronicles and letters, as well as 20th-century documents.

661. Cultural and Literary Identity in Latin American: From Colonial to Postcolonial Voices. (3) Study of a variety of texts from the 18th and 19th centuries dealing with political emancipation, nation-building, and continental identity.

662. Romantic Nationalism, Avant-garde Nihilism, and the Deconstruction of Utopia. (3) Study of Latin-American poetry, including symbolist, surrealist, and conversational poetry, "happenings," and artistic manifestoes. Politics, nation-building, liberation theology, and love are common themes.

663. Imagined "White" Nations: Race and Color in Latin America. (3) Study of anti-slavery narratives, 19th-century scientific racism, and 20th-century Negritude and "negrismo" movements. Exploration of race, the stratification of color, and ethnic images in Latin-American literature and culture.

664. Transgressing Borders: Identity in the Literature of Latin American and U.S. Latino Cultures. (3) A socio-historical study of theories on culture, sexual politics, and race in relation to literary texts, lyrics of popular music, and art of Latin America and the diaspora.

665. 20th-Century Spanish-American Theater. (3) Study of the Spanish-American dramatic production from the end of the 19th century to the present. Focuses on some of the main dramatic movements of the 20th century: realism, absurdism, avant garde, and collective theater.

666. Latin-American Cinema and Ideology. (3) Examination of major Latin-American films as cinematographic expressions of social and political issues.

667. The Social Canvas of Gabriel García Márquez and Pablo Neruda. (3) Exploration of the techniques used by two Nobel Prize winning writers to create a literary vision of Latin America. Special attention to humor, surrealism, and the grotesque, and both writers' assimilation of personal anxieties to their portrayal of a social world.

668. Spanish-American Short Story. (3) Intensive study of the 20th-century Spanish-American short story with emphasis on major trends and representative authors, such as Quiroga, Rulfo, Borges, Cortázar, Donoso, García Márquez.

669. Spanish-American Novel. (3) Study of the novel in Spanish America from its beginning through the contemporary period.

671. Contrastive Spanish/English Grammar and Stylistics. (3) Advanced study of structure and style in a variety of Spanish texts, with an in-depth approach to idiomatic expressions and some back/cross translation exercises.

672. Spanish-American Theatre: From Page to Stage. (3) Study of the transition of a dramatic work from text to performance and the role of Spanish-American theatre as a vehicle for cultural values and sociopolitical issues. Includes rehearsals for the public staging of selected one-act plays. Proficiency in Spanish and willingness to act on stage are required.

673. Literatures of the Mexican Revolution. (3) Explores 20th-century Mexican cultural production as it relates to the Mexican Revolution (1910-1920). Readings include novels, short stories,

popular poetry, and historiographic texts. Attention to Mexican muralism and cinema, and special emphasis on relationships between literature, history, and contemporary politics.

679. Special Topics. (1.5, 3) Selected special topics in Spanish-American culture and literature. *P—POI*

681. Spanish Translation. (3) Introduces translation strategies through practice, with emphasis on Spanish into English. Focuses on translating in domains such as social science, computing economics, the entertainment industry, banking, and journalism.

682. Spanish/English Interpreting. (1.5, 3) Introduction to strategies of interpreting from Spanish into English, primarily. Intensive lab practice course to develop basic skills in consecutive/escort/simultaneous interpreting. Some voice-over talent training is also included.

683. Medical-Scientific Translation. (3) In this elective course, students will develop and refine a practical translation skill set within the scientific and medical domains. In addition students will gain familiarity with textual conventions that govern source and target texts within these domains and deepen their understanding of both Spanish and English as language for special purposes. Apart from translation proper, students will also be able to analyze texts for register, style, tone and content to determine the most appropriate process to achieve the highest quality translation. Finally, students' research skills will improve through the examination of available resources and the creation of domain-specific resources.

684. Internships for Spanish Translation/Localization and Spanish Interpreting. (1.5-3) Under faculty supervision, a student undertakes a translation/interpreting project at a translation bureau or translation department of a company/public organization. A community service-oriented internship is preferred for interpreting.

685. Spanish for Medical Professions. (3) Study of terminology and sociocultural issues relevant to interlinguistic medical communication. Oral and written practice in medical context.

687. Spanish for Business. (3) Introduction to Spanish vocabulary and discourse in business. Emphasizes oral and written practices, reading, and Hispanic business culture as well as a comprehensive analysis of different business topics and areas. Two mid-term essays and final essays are required.

Sociology

634. Sociology of Education. (3h) An evaluation of the major theories and significant empirical literature, both historical and statistical, on the structure and effects of educational institutions.

635. Sociology of Health and Illness. (3) Analysis of the social variables associated with health and illness.

637. Aging in Modern Society. (3) Basic social problems and processes of aging. Social and psychological issues discussed. Course requirements include field placement in a nursing home or similar institution. *P—POI*

643. Sociology of Law. (3) Consideration is given to a variety of special issues: conditions under which laws develop and change, relationships between the legal and political system, the impact of social class and stratification upon the legal order.

660. Social Inequality. (3) Study of structured social inequality with particular emphasis on economic class, social status, and political power.

662. Work, Conflict, and Change. (3) Examination of the changing trends in the U.S. labor force,

the individual's view of work, and the effect of large organizations on white- and blue-collar workers. Use of some cross-cultural data.

663. Global Capitalism. (3) Analysis of industrial organization, including discussion of market relations and the behavior of firms, the structure of industrial development, and labor relations and the growth of trade unions.

698 Individual Study (1-3) Reading, research, or internship courses designed to meet the needs and interests of selected students, to be carried out under the supervision of a departmental faculty member. May be repeated for credit when topic varies.

Visual Storytelling Consortium

VSC 700. Fundamentals of Sports Storytelling. (4) The focus is on theory and practice of sports storytelling, including conceptualizing, writing, directing, editing and producing visual stories. Course assignments include production of three visual sports stories. Fundamentals of Sports Storytelling is one of two courses required for completion of a five-hour Summer Program in Sports Storytelling. The second course, Ethics and Problems in Sports Storytelling, must be taken concurrently. The course is open to undergraduates.

VSC 701. Ethics and Problems in Sports Storytelling. (2) The course provides a nuanced perspective on sport and society that includes an appreciation of the benefits and the origins of sport's popularity as well as an understanding of the emergent societal issues to be found in sports. More specifically, the student will learn how to write an effective editorial/blog entry on ethical issues in sports. Ethics and Problems in Sports Storytelling is one of two courses required for completion of a five-hour Summer Program in Sports Storytelling. The second course, Fundamentals of Sports Storytelling, must be taken concurrently. The course is open to undergraduates.

Women's and Gender Studies Program

Undergraduate students are given preference in enrollment for courses in the Women's and Gender Studies Program.

620AG. Research Seminar: Feminist Theory and Practice. (3) Examines the major themes and terminology in feminist thought, with focus on its diverse and multicultural expressions through time. Themes to be explored include schools of feminism, interlocking systems of oppression and the connection between theory and practice.

621. Interdisciplinary Seminar. (3) Research-centered study of questions raised by women's and gender studies on an interdisciplinary topic, such as women's health issues, international women's issues, perspectives on women and aging, lesbian and gay culture and theory, and women in the arts.

622AG. Introduction to Women's, Gender, and Sexuality Studies. (3) An interdisciplinary course that integrates materials from the humanities and the sciences, taught by WGS faculty representing at least two fields. Topics include critical methods and practical solutions, history and theory of women's, gender, and sexuality studies, women in culture and society, and cross-cultural issues of gender, ethnicity, social class, disability, and sexual orientation.

658. Mothers and Daughters: Literature and Theory. (3) Examines literature and feminist theories on motherhood and the mother-daughter relationship. Writers to be studied include Morrison, Rich, Allison, Danticat, and Walker. A cross-cultural perspective is taken.

677. Special Topics: Gender and Islam. (3) Considers the complicated relationship between gender, Islam, and identity, paying special attention to how gender roles are enacted, resisted, or transformed in relation to Islam. For example, the class will investigate how veiling informs women's

identities in both Islamic and secular nations. Drawing on ethnographic accounts, students explore the intersection of gender and Islam in daily life and its theological implications.

680AG. Sexuality, Law and Power. (3) This course will explore a wide variety of issues related to sexual identity and orientation, particularly as those issues continue to push the law to address the wide variations of patterns in which human beings relate. The course will look at the law as it both constricts societal development at times, and acts as a catalyst for radical social change at other times. We will look at the ways in which religion and popular morality shape the law and, in some instances, are shaped by it.

696. Independent Study. (1-3) Independent projects in women's studies, which either continue study begun in regular courses or develop new areas of interest. By prearrangement. May be repeated for credit.

JOINT DEGREE PROGRAMS OFFERED

Joint degree programs are offered in conjunction with other university professional schools (School of Medicine, Schools of Business, School of Law and Divinity School)

BS/A & MA Dual Degrees in Bioethics

(5 year program available to WFU undergraduate students)

Program Co-Directors

Nancy King and Ana Iltis

Overview

Sponsored by Wake Forest College and the WFU Graduate School of Arts & Sciences, the Bachelor of Sciences/Arts & Master of Arts in Bioethics can be completed in as little as 5 years (10 semesters + 1 summer). By allowing students who are admitted to the dual program to begin graduate bioethics coursework while enrolled through the College, students are able to earn two degrees in less time than it would take to earn the two degrees separately.

Undergraduate students must complete all requirements for the undergraduate program, including major, minor, and general requirements (generally, 120 credit hours). Students who are in a position to complete the 120 credit hours required for the undergraduate degree in fewer than the typical four years and are accepted into the dual degree program may take up to nine credit hours of graduate level bioethics courses while they are enrolled in the College. The Graduate School will accept those credit hours toward the Master of Arts in Bioethics degree if they are above and beyond the minimum 120 hours required to receive a BA/BS. The graduate credit hours earned toward the MA degree during the undergraduate years may not be part of the 120 credit hours required for the undergraduate degree.

It is anticipated that students accepted to the program will spend their first four years full-time in the College, followed by a year or more in the bioethics program (The year typically will consist of two semesters plus a summer for students who complete at least six hours of transferable graduate work during their undergraduate years). Because students must complete all of the requirements for the undergraduate degree independently of their Bioethics coursework, students will receive their BA/BS degrees when they complete their BA/BS graduation requirements. The MA will be awarded separately after completion of the MA requirements. The dual degree program will require undergraduates to enroll in 700-level bioethics courses. As part of their acceptance into the program, all accepted students will meet criteria for enrollment of undergraduate students in graduate courses. Students must complete all requirements for the Master of Arts in Bioethics degree.

Typically, students interested in the BA/BS & MA in Bioethics must apply no later than the spring semester of their junior year. Students should alert the Associate Director of the Master of Arts in Bioethics program of their intent to apply and follow the usual procedures for making an application for admission to a graduate program at the Graduate School of Arts & Sciences. In order to be considered eligible for admission, the candidate must take the Graduate Record Examination (GRE). Candidates may request, however, to submit verifiable test scores from another graduate or professional entrance examination in a relevant field (e.g. LSAT, MCAT, etc.). Only students in good academic standing according to the standards of Wake Forest College should apply.

To remain in the program, students must remain in good academic standing with both Wake Forest College and the Graduate School of Arts & Sciences.

BS/A & MS Neuroscience

(5 year program available to WFU undergraduate students)

Program Co-Directors

Carol Milligan and Wayne Silver

Overview

This program offers Wake Forest University undergraduates pursuing a B.S. or B.A. degree in Wake Forest College of Arts and Sciences with a minor in Neuroscience the opportunity to earn a research-oriented M.S. degree with concentration in Neuroscience with one additional year of study. The program builds on the existing Neuroscience Minor and utilizes existing course and research opportunities associated with the Graduate School's Neuroscience Program.

The goal is to provide highly motivated undergraduate students with sophisticated training in neuroscience, and the opportunity to build critical thinking and research skills. Students will gain graduate course credit and an enhanced research experience that will provide them with a competitive edge to apply to graduate or professional schools, or to pursue non-academic careers that require research expertise in the life sciences and Neuroscience.

Requirements

The minor requires a minimum of 17 hours, 9 of which must include the Neuroscience courses (200, 201 300, 391). At least one semester of research in neuroscience is required for the minor (NEU 391). The research can be conducted on the Reynolda campus or with investigators at the Wake Forest University School of Medical. The research project must be approved by a member of the Neuroscience Minor faculty. Eight hours must come from elective courses. One of the elective courses must come from outside the student's major department.

JD/MA in Bioethics

Program Co-Directors

Nancy King and Mark Hall

Overview

Under the joint auspices of the Wake Forest University School of Law and the Graduate School of Arts and Sciences, the JD/MA in Bioethics facilitates an interdisciplinary and comparative study of law and bioethics and encourages students whose academic or career interests require gaining competence in both disciplines. By allowing some law courses to count as electives toward the MA degree, as well as by allowing some graduate bioethics courses to count among the elective credits permitted within the JD curriculum, students are able to earn the joint degree in less time than it would take to earn the two degrees separately. The student in the JD/MA divides his/her time between the School of Law and the Bioethics Program and benefits not only from an array of course offerings from both curricula, but also from the social and general intellectual life of both academic programs.

Students may receive the joint degree in as little as seven semesters, usually registering with the School of Law for six semesters and with the Graduate School for at least one semester. The joint degree grants 12 hours of law credit for bioethics coursework and 6 hours of bioethics credit for law coursework. Typically, students spend their first year full-time in the law school, complete 12 bioethics hours during their 2nd and 3rd years of law school, and enroll for one semester full-time in the Bioethics program to complete an additional 6 hours of bioethics coursework and the thesis.

Admission to the joint JD/MA program is a two-tiered process. Students interested in the program must first apply separately to the School of Law and the Graduate School of Arts and Sciences and be accepted for admission by both schools. These applications do not need to be simultaneous, but they should indicate their intent to be considered for the joint degree program on their respective applications to the School of Law and the Graduate School. Alternatively, students may submit a separate application to enroll in the joint degree program if already admitted to either School. In order to be considered eligible for admission, the JD/MA candidate must take the Law School Admission Test (LSAT). The Graduate Record Examination (GRE) test is optional, however, and is waived on request. Final decision about admission to the program is made by a joint committee of the JD/MA program. Students should consult the prospectuses of both schools for information about tuition and financial assistance.

To continue in the program, students must remain in good academic standing in both the School of Law and the Graduate School of Arts & Sciences.

JD/MA in Religious Studies

Program Director

Jarrod Whitaker

Overview

The JD/MA in Religious Studies program facilitates an interdisciplinary and comparative study of law and religion and encourages students whose academic or career interests require gaining competence in both disciplines.

Interested students can combine the three-year law curriculum and the two-year MA curriculum into a four-year program. Students will first complete a year of work in the Department for the Study of Religions. Years 2 and 3 will be completed in the School of Law. For the 4th year, students will enroll in each school for one semester, completing any remaining degree requirements and elective courses that are joint-degree appropriate.

Law School Requirements

When undertaken as part of the joint JD/MA in Religious Studies program, the JD degree requires completion of 75 hours of law course work including the degree requirements prescribed by the law school for graduation.

Academic Advising

Students will be provided a faculty advisor from each school to help guide them through the program and its curriculum. To make the most of the degree program, students will meet with both advisors at least once during each semester.

JD/MA in Sustainability

Program Director

Dan Fogel

Overview

The Sustainability Graduate Programs and Wake Forest University School of Law have designed a new dual degree program to provide students a pathway for succeeding in professional roles where

legal scholarship and practice intersect with sustainability.

Students with the JD and MA in Sustainability will expand their potential work force networks, deepen their knowledge base, and cultivate leadership skills. Attorneys seeking to work in a sustainability related practice area will benefit greatly from foundational knowledge gained through coursework focusing on energy, environmental and sustainability related studies.

Plan of Study

This dual degree will require 78 hours of School of Law coursework, including requirements specific to the JD, and 22 hours of Graduate School of Arts and Sciences coursework and is designed to be completed in six semesters and one full summer session.

Admission

Candidates for the JD/MASus dual degree must apply both to the Graduate School of Arts and Sciences and the School of Law, following the admissions' requirements of the respective programs, and be accepted to each program in order to pursue a dual degree. A joint committee consisting of faculty and staff both from the School of Law and the Sustainability Graduate Programs will make final determination about an applicant's suitability for the dual degree.

Wake Forest students already enrolled in the JD program are encouraged to apply in the spring semester of their 1st year. Current students may apply after this time but completion of the program will not follow the traditional three year plan of study. Wake Forest students already enrolled in the School of Law JD degree program who decide to pursue the dual degree will complete an abbreviated application that includes a statement of interest and LSAT scores.

MD/MA in Bioethics

Program Co-Directors

Nancy King and Mark Hall

Overview

Under the joint auspices of the Wake Forest University School of Medicine and the Graduate School of Arts and Sciences, the MD/MA in Bioethics facilitates an interdisciplinary and comparative study of bioethics and medicine and encourages students whose academic or career interests require gaining competence in both disciplines. By allowing some graduate bioethics courses to count among the elective credits permitted within the MD curriculum, students are able to earn the joint degree in less time than it would take to earn the two degrees separately. By dividing their time between the School of Medicine and the Bioethics Program, students benefit not only from an array of course offerings from both curricula, but also from the social and general intellectual life of both academic programs.

The joint degree program grants 8 fourth-year medical school credits for doing a research thesis relating to bioethics coursework, which also counts 6 hours of bioethics credit toward the MA degree. Students accepted to the program spend four full years in medical school and two full semesters in the Bioethics program, for a total of 5 years. Typically, the Bioethics semesters come after the third year of medical school and the Bioethics thesis is completed during the 4th year of medical school (5th year of the overall program), during two non-clinical elective rotations.

Students usually apply to the MD/MA in Bioethics program during their 3rd year in the School of Medicine. Applicants must follow the general application procedures of the Graduate School of Arts & Sciences. The submission of test scores from the Graduate Record Examination (GRE), however, is waived on submission of valid scores from the Medical College Admission Test (MCAT).

Final decision about admission to the program is made by a joint committee of the MD/MA program. Students should consult the prospectuses of both schools for information about tuition and financial assistance.

To continue in the program, students must remain in good academic standing under the minimum standards of both the School of Medicine and the Graduate School of Arts & Sciences.

MD/MS in CPTS

Program Co-Directors

Bob Byington and Kathryn Weaver

Overview

Those interested in the MD/MS degree may choose to complete an extra year of training after the second year of medical school. Medical students may apply for admittance to the MS graduate program in the fall of their second year.

Accepted applicants are admitted to the MS program for their third year of study and complete required coursework for the MS degree in that year. Students rejoin medical studies in years 4 and 5, while they simultaneously complete a master's thesis project as the final requirement for the MS degree.

The MD/MS in Clinical and Population Translational Science is designed to develop competencies in clinical researchers interested in conducting translational research.

In addition to the master of science degree, an abbreviated CPTS Certificate is also available for medical students who will not have time to complete a thesis. The purpose and entrance requirements are identical to the master's program. Although a thesis is not required, students will need to complete at least 15 hours of CPTS coursework during their third year of medical school study, complete ethics training requirements and demonstrate competency in basic biostatistics.

MD/PhD

Program Director

Christopher Whitlow

Overview

An MD/PhD degree offers graduates outstanding opportunities in the new era of biomedical research of the 21st century. The invaluable perspective of an MD/PhD graduate positions the physician scientist as a crucial link in translating scientific research into improving human health and reducing disease. During the past decade, 62 percent of Nobel prizes in medicine and physiology were awarded to MD or MD/PhD researchers.

With the increasing sophistication of research tools, MDs without extensive formal research training rarely have the depth of knowledge needed to progress rapidly as a research scientist. The increasing pace of re-search, the need for knowledge in specific techniques, and the competition in funding have made it more difficult for MD clinicians to succeed in a research-intensive career. Optimal training is provided by combining an MD with a PhD academic program.

The MD/PhD program, a combined effort between the School of Medicine and the Graduate School of Wake Forest University, is an integrated program where neither the MD nor the PhD degree is compromised. The student gains the full perspective for identification and analysis of problems related to human health while receiving rigorous training in a basic or translational

research discipline—training which provides the depth of knowledge of scientific logic and techniques for an effective, exciting, and successful career in medical research.

The program seeks outstanding students who have already shown aptitude and enthusiasm for research.

Structure of the Program

The duration of the program typically is seven years. During the summer before entry into medical school, beginning in early June, students attend an orientation program to introduce faculty and available research opportunities. An eight-week research rotation is conducted with a selected member of the participating graduate faculty. This research rotation (and subsequent ones, if needed) familiarize students with faculty and their fields of expertise; usually one of these faculty are chosen as the student's graduate (PhD) adviser.

Years One and Two. The first two academic years are spent as a medical student. Phase I (seven months) introduces core biochemical knowledge, including development and structure of the human body (gross, microscopic, embryological, and radiological anatomy) and basic cellular functions (biochemistry, molecular biology and genetics, immunology, introduction to pathology).

Phase II (months 8-20) includes courses in systems pathophysiology (physiology, pharmacology, microbiology and pathology), and a two-month period for a second rotation in a lab of the selected graduate program in the summer after the first year.

Medicine as a profession, clinical decision making, and epidemiology studies are included in both Phases I and II.

During these years, the student usually attends a graduate seminar course. The seminar meets once a week and provides a continuing in-depth introduction to the chosen graduate discipline in addition to social and intellectual contact with other graduate students and faculty.

If possible, the student chooses a graduate adviser by the end of Phase II of the medical curriculum. Otherwise, the summer after Phase II may be used for another laboratory rotation, prior to choosing an adviser.

At the beginning of year three students will remain with their medical school class for a three month clinical experience. These three months are spent learning basic clinical skills on internal medicine rotations and introduce the students to the practice of medicine providing basic skills in completing the history and physical exam experience during the graduate school years in an outpatient clinic. These three months of training will also increase the flexibility for returning to medical school upon completion of the graduate degree. After completion of the three clinical months the students will then join the graduate school with the new cohort of graduate students.

Years Three through Five. During graduate school years the students will participate in a monthly outpatient clinical experience. Students rotate at a clinic for the underserved working with faculty and private practice physicians. Participation in this clinic not only helps to maintain clinical skills but gives the student experience with balancing research and clinical responsibilities.

The third year is spent taking advanced basic science courses and conducting research. Didactic coursework is intended to supplement the biomedical knowledge base built in the medical school curriculum. Program or departmental courses also provide a more discipline-specific focus and, therefore, depend on the chosen graduate program.

The duration of the dissertation research may vary but typically is completed in years three-to-five and, if needed, a portion of year six. The PhD dissertation is completed and defended prior to returning to clinical studies.

Years Six and Seven. The student completes eighteen months of required clinical rotations (Phase

III of the clinical curriculum) which include internal medicine, surgery, pediatrics, obstetrics, women's health, neurology, psychiatry, radiology, anesthesiology, family and community medicine, and emergency medicine. Four months of elective time are spent in other clinical experiences or may be used for completion of graduate studies prior to returning to the medical curriculum. This part of the schedule is tailored to the individual student with the approval of the graduate adviser, MD/PhD program director, and the associate deans for medical education and student services.

Conferring of Degrees. The PhD degree is conferred in the semester in which all requirements for that degree are met. The MD degree shall be awarded upon completion of the program.

Participating Graduate Programs

Track 1 - Physics

Track 2 - Chemistry

Track 3 - Biology

Track 4 - Molecular and Cellular Biosciences:

Biochemistry and Molecular Biology

Cancer Biology

Microbiology and Immunology

Molecular Medicine and Translational Science

Molecular Genetics and Genomics

Track 5 - Integrated Physiology and Pharmacology

Track 6 - Neuroscience

Track 7 - Biomedical Engineering

Mechanism of Application

Both the School of Medicine and the Graduate School evaluate the applicant's credentials. The MCAT is the required standardized test for all applicants.

Initial application is through the American Medical College Application Service (AMCAS). When the School of Medicine receives AMCAS applications, students are sent supplemental forms for application to the School of Medicine. The applicant should indicate interest in the combined MD/PhD program on the supplemental application. The School of Medicine supplemental packet requests an evaluation by the applicant's premedical advisory committee. For the MD/PhD program, the applicant should also include letters of evaluation specifically addressing his or her research experience and abilities.

This is a highly competitive, limited program. The two students per year who matriculate receive scholarships that cover tuition throughout the program. In addition to outstanding grades and MCAT scores, the applicant should provide evidence of enthusiasm and aptitude for research, with prior research experience beyond that of college courses. This is an important factor in evaluation of the application.

After the supplemental application packet, MCAT scores, and letter(s) of evaluation are received, the completed application is reviewed by the committees on admissions of the MD/PhD program. A small percentage of applicants are then asked to visit the University for interviews from October through March.

MDiv/MA in Bioethics

Program Co-Directors

Nancy King, and Mark Hall

Overview

Sponsored by the Wake Forest University School of Divinity and the Graduate School of Arts & Sciences, the MDiv/MA in Bioethics facilitates an interdisciplinary conversation between theology and bioethics and provides resources for students whose vocational aims require knowledge and/or competence in both disciplines.

The MDiv/MA can be completed in as little as seven semesters. A student typically completes two and one-half years of work (five semesters) primarily in the School of Divinity. The final two semesters are completed in the Bioethics Program but with some electives taken in the School of Divinity. Shared courses are joint degree appropriate, selected from a list of courses agreed upon by the School of Divinity and the Bioethics Program.

Admission to the joint degree program is a two-tiered process. Interested students must apply separately to the School of Divinity and the Graduate School of Arts and Sciences and be accepted for admission by both schools. These applications do not need to be simultaneous, but students should indicate on each application their desire to be considered for the joint degree program. Applications are reviewed separately by each program's admissions committee. Alternatively, students may submit a separate application to enroll in the joint degree program if already admitted to either School. Typically, students make application to the joint degree program by the time they complete one semester in either School. A joint admissions committee composed of members from both schools make final admissions decisions. The joint committee also oversees and reviews admissions policies for the joint degree. The Graduate Record Exam (GRE) is typically required for application to the Bioethics Program, but can be waived under certain circumstances which are outlined on the bioethics program website. The School of Divinity recommends, but does not require, GRE scores.

Students are required to follow the student handbook of the school through which he/she is enrolled. To continue in the program, a student must remain in good academic standing with both the School of Divinity and the Graduate School of Arts and Sciences.

MDiv/MA in Counseling

Program Co-Director (*Counseling*)

Bob Nations

Program Co-Director (*Divinity*)

Mark Jensen

Overview

Students in the dual degree program will spend the first two years of the four year program in the Divinity School. The second two years of the dual degree program will be spent satisfying the requirements of the Masters in Counseling full-time Reynolda Campus program.

Divinity Requirements

First Two Years. The Divinity School's regular Program of Study requires 51 Hours of core courses and 30 hours of general electives for a total of 81 hours. The program of study for dual degree students would include 48 Hours of core courses (with Art II requirement met in CPE and Multicultural Contexts requirement met either in Vienna or CNS Cultures course) and a minimum of 6 hours of electives in the Divinity School. The remaining elective credits for the MDiv are

satisfied by CNS courses in the second two years. .

Counseling Requirements

Second Two Years. The Department of Counseling's Program of Study requires 42 hours of Core Courses, 9 hours of Clinical Courses, and 9 hours in a Program Specialty Area for a total of 60 hours. The program of study for dual degree students would be the same as those students in the Counseling Program.

Upon successful completion of the counseling program, students will receive both the Masters of Divinity and the Masters of Arts in Counseling degrees.

Admissions

The Process. Up to three students per year will be admitted to the MDiv/MA-Counseling dual degree program. Applicants must be accepted for admission by both the Department of Counseling and by the Divinity School. Applicants are required to submit a separate application to each school by January 15. Applications for the Counseling Program are submitted through the Graduate School of Arts and Sciences at <http://graduate.wfu.edu>. Applications for the Divinity School are submitted directly to the Divinity School at <http://www.wfu.edu/divinity>.

MDiv/MAED in Education

Program Director

Leah McCoy

Overview

The School of Divinity (WFUSD) and the Department of Education offer a dual graduate degree that 1) promotes interdisciplinary conversation between theological education, public education, and community engagement; and 2) provides students pathways for developing skills and acquiring competencies necessary for achieving excellence in careers where religious leadership and education intersect. This degree provides distinctive vocational perspectives and opportunities not available separately in the education or divinity degree programs.

The dual degree curriculum includes foundational requirements from both divinity and education. It is estimated that the time required to complete the dual degree is seven semesters and two summer sessions. Students complete 56 credits of core requirements in MDiv courses and 39 credits of core requirements in MAEd courses. The total number of required credits is 95. Integrative components include an education internship in a context approved by the Master of Arts in Education program in conversation with WFUSD's Art of Ministry (internship) director and a capstone requirement that either through research or an advanced internship encourages students to consider connections between the two fields of study. Advisers from both degree programs work with students to determine an elective course strategy that most effectively prepares each student to succeed as a religious leader who is also a public educator.

Candidates for the dual degree must apply both to the Graduate School of Arts and Sciences and the School of Divinity, following the admissions' requirements of the respective programs, and be accepted to each program in order to pursue the dual degree. A joint committee consisting of faculty/staff representatives both from divinity and education will make final determinations about an applicant's suitability for the dual degree.

Typical Program Outline:

	<i>Fall</i>	<i>Spring</i>	<i>Summer</i>
Year One	Divinity	Divinity	Education (12 hrs)
Year Two	Mainly Education	Education	Education (6 hrs)
Year Three	Divinity	Divinity	
Year Four	Divinity		

Note: Year Two and Year Three are interchangeable.

MDiv/MA in Sustainability

Program Director

Dan Fogel

Overview

The MDiv/MA in Sustainability joint degree acknowledges the growing demand for professionals in religious leadership venues who have the knowledge and the skills to lead communities to respond to critical ecological and other social issues. Congregations and other religiously affiliated organizations are increasingly interested in sustainability concerns and seek leaders who can guide their efforts to respond to these concerns. Knowledge from the biological, physical, chemical, and earth sciences are critical to any working professional who designs and implements sustainability practices. The humanities and social sciences incorporate information about spirituality, religious beliefs, and an understanding and appreciation of our relationship to the natural world.

This degree is a collaborative project shared by the Wake Forest University Center of Energy, Environment, and Sustainability and the School of Divinity.

Plan of Study

The MDiv/MA in Sustainability joint degree is designed to be 96 credit hours completed in seven semesters plus one full summer session (based on full-time enrollment).

- 48 hours of required course work specific to the Master of Divinity degree

Biblical Studies

BIB 521 Old Testament Interpretation I	3 hours
BIB 522 Old Testament Interpretation II	3 hours
BIB 541 Introduction to New Testament	3 hours

New Testament Elective (choose one)

BIB 542 Interpreting New Testament Letters	
BIB 543 Interpreting New Testament Gospels	

One elective in Old or New Testament	3 hours
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Historical and Theological Studies

HIS 501	History of Christianity I	3 hours
HIS 502	History of Christianity II	3 hours
THS 501	Christian Theology	3 hours
	Ethics requirement	3 hours
	Theology elective	3 hours

Ministerial Studies

MIN 501	Art of Ministry I	2 hours
MIN 551	Homiletics and Worship	3 hours
	Spirituality requirement	1 hour
MIN 631	Ministry of Pastoral Care	3 hours

9 divinity credit hours from the following:

MIN561	Faith, Food & Health	3 hours
	Any ethics elective	3 hours
	Any leadership elective	3 hours
	Any church and community elective	3 hours

- 17 hours of required course work specific to the Masters of Arts in Sustainability degree

SUS 701	Global Human Systems	3 hours
SUS 703	Resource Management and Energy Science	3 hours
SUS 702	Sustainable Organizational Management	3 hours
SUS 704	Environmental Law and Policy	3 hours
SUS 705/706	Applied Sustainability	2 hours
	Any sustainability elective	3 hours

- 13 hours of required course work shared by the two degree programs; these courses constitute the integrative foundation of the joint degree:

Master of Divinity

MIN 601 and 602: Art of Ministry Internship (two semesters, 6 credit hours) – In consultation with advisers from both degree programs, students will complete an 8-10 hour per week internship in a setting in which they can utilize and explore sustainability concerns.

Master of Arts in Sustainability

Practicum in Applied Sustainability (2 credit hours, plus 1 hour divinity directed reflection = 3 hours total) – This course provides opportunities for students to experience sustainability in action in a variety of settings. Students will enroll in the course through the sustainability program and will be assigned a divinity faculty mentor to facilitate directed theological reflection on the experiences.

Research Thesis or Extended Practicum

(4 hours – summer term) – This requirement combines capstone courses from both degree programs. In this summer term, students will prepare a research thesis, under the guidance of a faculty advisor on a topic approved in advance by the sustainability program director and the academic dean of the School of Divinity. Alternatively, students may participate in a summer practicum or internship. If they select that option, they will meet with a faculty advisor periodically to discuss their internship, which will culminate with a written reflection on their experience submitted to a designated faculty person in one of the two programs.

- 18 hours of elective credit hours to be chosen by the student in either program.

ADMISSION

Candidates for the joint degree must apply both to the Graduate School of Arts and Sciences and the School of Divinity, following the admissions' requirements of the respective programs, and be accepted to each program in order to pursue a joint degree. A joint committee consisting of faculty and staff both from the School of Divinity and CEES will make final determinations about an applicant's suitability for the joint degree.

Current Wake Forest students already enrolled in the Master of Divinity degree program who decide to pursue the joint degree will complete an abbreviated application that includes a statement of interest and appropriate test scores.

MMS/PhD (PA & MMTS)

Program Co-Directors

K. Bridget Brosnihan and Gail Curtis

Overview

The MMS-PhD is a 5- to 7-year program that combines a Master of Medical Science in Physician Assistant Studies with a PhD in Molecular Medicine and Translational Science (MMTS) and is offered in conjunction with the Wake Forest University Graduate School of Arts & Sciences. The program targets students interested in clinical research, community research, and the translation of knowledge into improved human health. Graduates with the MMS-PhD will be basic scientists trained to function successfully in clinical environments and will have considerable professional flexibility. They can work as clinician scientists on teams conducting clinical trials, for example, or they can teach and do research within academic health centers.

Applicants for the MMS-PhD dual degree program must be accepted first into the PhD program through a separate admissions process to the Graduate School. The student can apply for admission to the PA program during the first, second, or third year of study in the PhD program and will begin the preclinical year in the PA program after completing the dissertation defense.

Potential applicants should note the following:

- Students with the MMTS PhD who were involved with translational research and attached to a physician mentor are considered to have met the PA program admission requirement of 1,000 patient/clinical contact hours.
- Because students with the MMTS PhD have completed a doctoral thesis, they are also considered to have met the PA program requirement to complete a Graduate Project.

PhD/MBA Program

Program Director

Dwayne Godwin

Overview

In addition to intensive doctoral training, the PhD/MBA program incorporates core knowledge of business and managerial skills to provide the student with a marketable, competitive advantage, whether the student finds employment in industry or academia. Graduates choosing to pursue a traditional tenure-track faculty position will have the managerial and business training to initiate and operate their own research laboratories and to collaborate more effectively with the private sector. Graduates choosing a non-traditional career path will be prepared to exercise their research training in management positions in the pharmaceutical industry, private foundations, government agencies, or university research and technology transfer offices.

Structure of the Program

The program is a synthesis of curricula from the Graduate School and the Evening MBA Program of the Babcock School, with specialized course-work and opportunities for industrial and business internships. The joint program is open to all PhD-granting departments or programs across all Wake Forest campuses. It has taken students approximately 5 years to complete the joint program, depending on the nature of the graduate research undertaken in the home program. The first year of the curriculum provides students with a core base of knowledge in biomedical sciences and includes training in the core competencies of the home graduate program. At the same

time students begin to be exposed to issues related to research and design, career development, and journal clubs. Laboratory rotations usually occur in this first year in accord with Track requirements. The students typically begin their dissertation research during the second year. At the end of the second year and before beginning MBA course-work, the student is required to take and pass a qualifying exam that will admit him or her to candidacy for the PhD.

A student enrolling in the PhD/MBA program will have 5-6 semesters of evening MBA courses added to his or her graduate degree requirements. Opportunities for industrial projects and internships are possible after ascent to PhD candidacy and during the MBA coursework phase. The PhD and MBA degrees are awarded simultaneously at the completion of all requirements for both degrees.

Application Process

Admissions are administered through the Graduate School of Arts and Sciences. Students wishing to enroll in the program must apply to both programs and meet the respective admissions requirements of the Graduate School of Arts and Sciences and the Babcock Graduate School of Management. Admission to the MBA portion of the program can occur separately after gaining admission to the home graduate program and after securing appropriate release from the home program for participation in the joint program (this is in the form of a letter from the thesis advisor cosigned by the program director). In addition to the application a copy of the letter should be submitted to Dr. Dwayne Godwin, Associate Dean, Graduate School of Arts and Sciences and Director, PhD/MBA program, c/o Tina M. Payne, Graduate School of Arts and Sciences. The Graduate Record Exam is accepted for admission to the joint program. Prospective students should also submit a one-page statement of interest indicating future plans for use of the joint degree, official transcripts from each college or university attended, and three completed recommendation forms.

Before admission to the program, the applicants are required to complete a personal interview with the PhD/MBA program director and the Wake Forest University Schools of Business. After the interview phase, the top applicants may be offered admission to the joint program.

CERTIFICATES OFFERED

Bioethics (BIE)

(General, Biomedical Research Ethics, or Clinical Bioethics)

Program Co-Directors

Nancy King and Mark Hall

Overview

The Graduate Certificate in Bioethics provides students with basic knowledge and skills that enable them to better address bioethics issues that arise in biomedical research, clinical practice, and health policy. The Graduate Certificate is a freestanding program of graduate study in which students attend the same classes as students in the Master of Arts in Bioethics graduate program.

In their first semester of study, all degree-seeking and Graduate Certificate students typically must enroll in at least one required course prior to or concurrently with taking any elective course or BIE 706/707: Bioethics Seminar.

Requirements

The Graduate Certificate requires 12 credit hours of course work with an average grade of B or

above. At least 9 credit hours must come from required courses in the MA in Bioethics program. There is no thesis requirement. All work must be completed within four years of the date of initial enrollment in the graduate program. Up to 3 hours of transfer credit may be considered in place of elective course work. Transfer credit acceptance is based on review and approval of grades, course syllabi, and other relevant information.

Admitted students may enroll in the general Graduate Certificate program or may specialize by enrolling in the Graduate Certificate in Clinical Bioethics or the Graduate Certificate in Biomedical Research Ethics. The specialized certificate options require particular courses within the general requirements described above. The Graduate Certificate in Clinical Bioethics requires students to enroll in BIE 705: Clinical Ethics for 3 of the 9 credit hours of required courses. The Graduate Certificate in Biomedical Research Ethics requires students to enroll in BIE 702: Biomedical Research Ethics for 3 of the 9 credit hours of required courses. Students in the specialized certificate programs may utilize elective courses designed to provide supervised observational and experiential opportunities in relevant settings.

Clinical and Population Translational Science (CPTS)

Bowman Gray Campus

Program Co-Directors

Kathryn Weaver

Overview

The objective of this certificate program is to provide training in epidemiology, biostatistics, and applied clinical and population research methods to health professionals, research professionals, and health sciences students, residents, and fellows. Students trained in the program will develop skills: 1) to develop meaningful and feasible research questions, 2) to design and implement studies to answer clinical and population research questions, 3) to communicate through grant applications, protocols, manuscripts, abstracts, and presentations, and 4) to collaborate productively in multi-disciplinary scientific teams. Courses are primarily taught by faculty within the Division of Public Health Sciences and are held on Tuesdays and Thursdays.

Interpreting and Translation Studies (ITS)

Program Co-Directors

Sally Barbour and Olgierda Furmanek

Overview

For students who are not able or ready to commit to earning a Master of Arts degree in interpreting and translation studies, but who would like to focus on an area of interest, the program offers four Graduate Certificates and one Post-Graduate Certificate in specialized areas. Pairing various certificates provides a comprehensive package for students to reach their career goals in a more flexible, customized manner. Credits from a certificate program can often be transferred to a graduate degree program. A student who chooses to complete three certificates can meet the requirements for an MA in Interpreting and Translation Studies.

Certificate Requirements

Students are required to complete 15 credit hours of instruction within four consecutive semesters. Credits from a certificate program can often be transferred to a graduate degree program. A

student who chooses to complete three certificates can meet the requirements for an MA in Interpreting and Translation Studies. The minimum GPA average required for graduation is 3.0.

Foreign Language or Special Skills Requirements for Certificates

The Graduate Certificate in Interpreting Studies, the Graduate Certificate in Translation Studies and the Graduate Certificate in Audiovisual Translation and Interpreting are language-specific. Applicants who do not have a college or high school degree from another country are required to take an online language proficiency assessment in their non-native language and may be subject to a written exam and/or oral interview. Proven interpreting experience is required for the Post-Graduate Certificate in Teaching of Interpreting.

Certificates Offered:

- Graduate Certificate in Interpreting Studies (language-specific)
- Graduate Certificate in Translation Studies (language-specific)
- Graduate Certificate in Audiovisual Translation and Interpreting (language-specific)
- Graduate Certificate in Intercultural Services in Healthcare
- Post-Graduate Certificate in Teaching of Interpreting (students holding an MA, MS, or MBA)

Medieval and Early Modern Studies (MDV)

(Departments of English, Romance Languages, Religion, History, Political Science and International Affairs, Philosophy, Music, Classics, Art History, Divinity School, German, Humanities, Art History)

Program Director

Herman Rapaport

Professors

Stewart Carter, Roberta Morosini, Gillian Overing, Mary Pendergraft, Gale Sigal, Harry Titus, Ulrike Wiethaus

Associate Professors

Bernadine Barnes, Michaelle Browsers, Jefferson Holdridge, Judy Kem, Sol Miguel-Prendes, Monique O’Connell, Olga Valbuena-Hanson, Neal Walls

Assistant Professors

Patrick Toner, Charles Wilkins

Adjunct Associate Professor

Darlene Rae May

Overview

The Interdisciplinary Graduate Certificate Program in Medieval Studies (GCPMS) is designed to allow MA students in English and Religion to both broaden their knowledge of and focus their studies on the medieval period. The GCPMS combines programmatic interdisciplinary coursework, training in the technical skills of medieval studies, and linguistic preparation. The program offers prospective and first-year MA students a competitive advantage in admission to doctoral programs. Students may be admitted to the program by permission of the directors when they are admitted to the graduate program in the department to which they apply or at any time during their first year.

Students must complete all graduate requirements for the MA in English or religion (separately listed in this bulletin under each department) and may take undergraduate courses in any participating department towards the certificate. (A listing of courses that satisfy the medieval studies minor can be found in the Wake Forest University Undergraduate Bulletin.) Courses satisfying the certificate may overlap with department graduate requirements, but acquiring the certificate requires coursework beyond that of the disciplinary MA.

Students are required to take a minimum of four additional courses (12 hours) with a medieval focus; these courses should represent two different disciplinary fields in addition to that of the candidate’s home department. In consultation with the program director, one or more of these

additional courses may be taken as directed reading or as medieval language courses. The graduate thesis must have a medieval focus, and the thesis committee should have at least two participating departments represented.

The GCPMS generally does not require more time to complete than the host MA program in English or religion. While students working towards the GCPMS are required to take four courses in medieval studies beyond the standard requirements of the departmental MA, some of those additional courses may be taken as an overload during the academic years or during the summer. Students are strongly encouraged to apply for extramural fellowships to study one or more summers at the international sites where a medieval studies curriculum is available (e.g., St Peter's College at Oxford [see the medieval studies minor in the Wake Forest University Undergraduate Bulletin for details]). A final mechanism is to request approval from the relevant departmental graduate committee to apply two of the courses taken toward completion for the MA degree toward the certificate program with the addition of relevant course-related materials.

Students in the GCPMS may avail themselves of many activities and opportunities including the medieval studies lecture series; the paper competition that rewards the winners with funding to the International Congress on Medieval Studies at Western Michigan University; the Gordon A. Melson Graduate Student Award in Medieval Studies, specifically awarded to an outstanding graduate student to attend the International Congress on Medieval Studies at Western Michigan University; the medieval studies summer program at St. Peter's College, Oxford; the annual Wake Forest Medieval Studies Student Society Conference, a student-organized interdisciplinary conference inviting participation from graduates and undergraduates from surrounding universities; the medieval section of the department's library in the Archie Ammons English Department Faculty Lounge; the establishment of internships and fellowships for *La corónica: A Journal of Medieval Spanish Language, Literature and Cultural Studies* (see the website at <http://college.holycross.edu/lacoronica>), edited by Professor Sol Miguel-Prendes, a medievalist in the Romance Language department.

Structural and Computational Biophysics (SCB)

(Programs of Biology, Chemistry, Computer Science, Mathematics, Molecular and Cellular Biosciences and Physics)

Program Director

Freddie R. Salsbury Jr

Professors

Rebecca Alexander, Edward E. Allen, Ulrich Bierbach,

Keith D. Bonin, James F. Curran, Larry W. Daniel, Martin Guthold,

David J. John, Daniel B. Kim-Shapiro, S. Bruce King, Douglas S. Lyles,

Gloria K. Muday, James Norris, Fred W. Perrino, Leslie B. Poole, Peter Santago,

Stan J. Thomas

Associate Professors

Thomas J. Hollis, W. Todd Lowther, Jed C. Macosko, V.,

Paul Pauca, Freddie R. Salsbury Jr., Brian W. Tague, William H. Turkett Jr.

Assistant Professors

Adam Hall, Derek Parsonage

Overview

The Interdisciplinary Graduate Track in Structural and Computational Biophysics (SCB) is designed to meet the need for scientists and educators with broad, interdisciplinary training in the quantitative biological, biochemical, and biomedical sciences. Students who successfully complete the SCB Track and degree requirements will receive a certificate in Structural and Computational Biophysics, as well as the degree in the program in which they matriculate. The Track is

implemented by collaboration among the programs of Biology, Chemistry, Computer Science, Mathematics, Molecular and Cellular Biosciences and Physics at Wake Forest University.

Following matriculation and at least one semester of coursework in a participating program (currently, Biology, Chemistry, Computer Science, Mathematics, Molecular and Cellular Biosciences and Physics), students can apply for admission to the SCB Graduate Track. Admission to the Track is initiated by meeting with the SCB program representative. The student will then submit a letter of intent and a Wake Forest University graduate transcript to their department representative who will present it to the SCB advisory committee. The letter of intent should express the student's interest in the SCB program, a proposed plan of study, and how the SCB program meets the student's career and academic goals. Following favorable evaluation, applicants may be recommended for admission by the SCB advisory committee, with final approval determined by the Graduate School. Prior to admission, it is recommended that applicants complete coursework in introductory chemistry, introductory biology, introductory biochemistry, molecular biology, or cell biology, calculus-based physics, and programming in a high-level language; however, all applicants should meet the prerequisites for the individual graduate degree program to which they are applying (physics, chemistry, biology, mathematics, molecular and cellular biosciences or computer science).

Students in the Interdisciplinary Graduate SCB Track must complete all graduate degree requirements in the individual department to which they were admitted. (The official degree requirements for the PhD in Physics, Biology, Chemistry, or programs under the Molecular and Cellular Biosciences Track or the MS in Computer Science or Mathematics are described under the department listing.) In addition, at least 15 hours of the student's graduate coursework should consist of courses approved as part of the SCB Track (listed in this bulletin), including a general, introductory SCB course and two hours of journal club credit. At least one course must be at the 700 level. Students must take at least two graduate hours in each of the curriculum areas: chemistry/biochemistry, computer science/mathematics, and biophysics. All students in the SCB Track must complete and defend a PhD dissertation (or MS thesis for computer science or mathematics) that involves original, interdisciplinary research in the area of structural and computational biophysics or computational biology; broadly defined. The dissertation committee will consist of members from at least three participating SCB departments. All students must successfully complete a course in scientific ethics. Each semester, several seminars from the participating departments will be designated as SCB discussion group seminars. Students in the Track are required to attend these seminars.

Students in the SCB Track have access to state-of-the-art equipment and facilities in multiple departments, including the Wake Forest Structural Biology Facility (csb.wfu.edu), the DEAC Linux cluster (deac.wfu.edu), and well-equipped research laboratories in biophysics, biochemistry, and biomedical engineering.

The Interdisciplinary Graduate Track in Structural and Computational Biophysics began in 2005. Information on the program and links to faculty research interests can be accessed at scb.wfu.edu.

Courses of Instructions

Courses listed in this bulletin are examples and are those already approved for the Interdisciplinary Graduate Track in Structural and Computational Biophysics at Wake Forest University. Other courses may be allowed by the SCB Track director. Course descriptions can be found under the department which administers the course.)

SCB-Specific Courses

SCB 701. Structural and Computational Biophysics Journal Club. (1) Seminal and current publications in structural and computational biophysics are read and discussed. *P—Admission to the SCB*

graduate track or POI.

SCB 710. Research Topics in Structural and Computational Biophysics. (1) Lectures and discussions on research topics in the field of structural and computational biophysics and biology. Topics depend on the specialty of the instructors in a given semester. *P—Admission to the SCB graduate track or POI.*

Curriculum Area 1. Chemistry/Biochemistry

General prerequisites: Two semesters of undergraduate chemistry and one semester of undergraduate biochemistry or molecular biology; one semester of organic chemistry is considered ideal, but is not required for most courses. (If additional prerequisites are required, they are listed individually by course.)

CHM/PHY 641. Fundamentals of Physical Chemistry. (3 or 4)

BIO 672. Molecular Biology. (3 or 4)

BIO/CHM 670. Biochemistry: Macromolecules and Metabolism. (3)

BIO/CHM 670L. Biochemistry Laboratory: Macromolecules and Metabolism. (1)

MCB 701 Molecular and Cellular Bioscience A (1-6)

MCB 711 Biological Systems and Structures (2)

Curriculum Area 2. Physics

General prerequisites: Two semesters of undergraduate physics. (If additional prerequisites are required, they are listed individually by course.)

PHY 607. Biophysics. (3)

PHY 625. Biophysical Methods Laboratory. (1) *C—PHY 607.*

PHY 685. Bioinformatics. (3) *P—Introductory courses in biology, chemistry, and molecular biology or biochemistry or permission of instructor; also listed as CSC 685, though requirements and prerequisites are different.*

PHY 620. Physics of Biological Macromolecules. (3) *P—PHY 651 or CHM 641, or POI.*

Curriculum Area 3. Computer Science/Mathematics

General computer science prerequisites: Programming in a high level language. (If additional prerequisites are required, they are listed individually by course.)

CSC 621. Database Management Systems. (3)

CSC 631. Object-oriented Software Engineering. (3)

CSC 646. Parallel Computation. (3)

CSC 652. Numerical Linear Algebra. (3)

CSC/MTH 626. Introduction to Numerical Methods. (3)

CSC 671. Artificial Intelligence. (3)

CSC 685. Bioinformatics. (3)

CSC 721. Theory of Algorithms. (3)

CSC/MTH 753. Nonlinear Optimization. (3) *P—Computer Science 655.*

CSC/MTH 754. Numerical Methods for Partial Differential Equations. (3) *P—CSC 655 or MTH*

655.

MTH 605 Applied Multivariable Mathematics (4)

Mth 606 Advanced Mathematics for the Physical Sciences (3)

MTH 652. Partial Differential Equations. (3)

any of MTH 654-667 excluding 661 (3)

MTH 750 Dynamical Systems (3)

Sustainability (SUS)

Program Director

Dan Fogel

Professors

Miles Silman, Abdou Lachgar, Keith Bonin, Dilip Kondepudi,
Alan Palmiter, Robert Whaples, Dick Schneider, Sid Shapiro, John Knox

Associate Professors

David Phillips, Saylor Breckenridge, Justin Catanoso

Assistant Professors

Ron Von Burg, Judith Madera, Steven Folmer,
Michael Gross, Rob Erhardt

Research Professors

Bailey Green

Associate Faculty

Dedee DeLongpre Johnston, Amy Wallis,
Vanessa Zboreak, Mark Curtis, Rebecca Dickson

Overview

The Graduate Certificate in Sustainability Program is a twelve credit hour certification that consists of the four core courses of the Master of Arts in Sustainability and can be obtained on a stand-alone basis or in conjunction with another master's program. This track provides students with exposure to sustainability issues in the natural sciences, social sciences, humanities, business management, law, and policy. Candidates of the Graduate Certificate in Sustainability Program will utilize our program as a mechanism for adding value to their professional endeavors while simultaneously satisfying the urgent societal need for highly knowledgeable leaders in the field of sustainability.

Students wishing to change from the certificate program to the master's program will be expected to qualify for and apply to move into the full master track. Successful completion of the Graduate Certificate Program in Sustainability does not guarantee admission to the Master of Arts in Sustainability program.

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The Graduate Council (3-year terms)

(Expires)

Dr. Dwayne Godwin	Dean	dgodwin@wakehealth.edu	
Dr. Brad Jones	Dean	jonesbt@wfu.edu	
Dr. Ralph D'Agostino	Public Health Sciences	rdagosti@wakehealth.edu	2017
Dr. R. Mike Furr	Psychology	furrm@wfu.edu	2018
Dr. Timothy Howard	Center for Genomics	tdhoward@wakehealth.edu	2016
Dr. David John	Computer Science	djj@wfu.edu	2017
Dr. Hui-Wen Lo	Cancer Biology	hlo@wakehealth.edu	2018
Dr. Leah McCoy	Education	mccoy@wfu.edu	2018
Dr. Steve Messier	Health & Exercise Science	messier@wfu.edu	2016
Dr. Gloria Muday	Biology	muday@wfu.edu	2017
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2016

Dr. W. Edward Swords	Microbiology/Immunology	wswords@wakehealth.edu	2017
Dr. Steve Walker	Neuroscience	swalker@wakehealth.edu	2016

Graduate Faculty Representatives to the University Senate (4-year terms)

Dr. Larry Daniel	Biochemistry	ldaniel@wakehealth.edu	2017
Dr. Mark Welker	Chemistry	welker@wfu.edu	2017

The Graduate Faculty

Please visit the Graduate School's website (<http://graduate.wfu.edu/faculty/directory.html>) for a current list of all graduate faculty with their year of appointment and department affiliations.

The Administration

Year following name indicate year of appointment to current position.

Administration—Reynolda Cabinet

Nathan O. Hatch (2005, 2005)	President
AB, Wheaton College; AM, PhD, Washington (St. Louis)	
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Andrew R. Chan (2009, 2009)	Vice President for Career Development
BA, MBA, Stanford	
James J. Dunn (2009, 2009)	Vice President and Chief Investment Officer
BS, Villanova	
John D. McConnell, MD (2008, 2010)	CEO, WFU Baptist Medical Center
BA, University of Kansas; MD, Loyola (Stitch School of Medicine)	
B. Hof Milam (2010, 2010)	Senior Vice President for Finance and Administration and CFO
BS, MBA, Wake Forest	
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BA, JD, Wake Forest	
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BA, Brandeis; MA, University of Southern California	
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BA, University of Washington	
Ronald D. Wellman (1992, 1992)	Director of Athletics
BS, MS, Bowling Green State	

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Dwayne Godwin (2010)	Dean
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Bradley T. Jones (2010)	Dean
BS, Wake Forest; PhD, Florida	

School of Medicine

Edward Abraham (2011)	Dean, Wake Forest University School of Medicine
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MBA, San Jose State University; MD, University Toronto (Canada)	

C. Randall Clinch	Associate Dean, Academic Accreditation
BS, College of New Jersey DO, University of Medicine and Dentistry of New Jersey - School of Osteopathic Medicine	
David D. Grier (2012, 2012)	Associate Dean, Admissions and Student
BS, Wofford College	Financial Services
MD, Medical University of SC-Charleston	
Stephen Kritchevsky	Associate Dean, Research Development
MSPH, PhD, University of North Carolina-Chapel Hill	
Brenda Latham-Sadler (1990, 2002)	Associate Dean, Student Inclusion and Diversity,
BS, Pace; MD, Wake Forest	
Michael P. Lischke	Associate Dean, Continuing Medical Education
BA, MPH, Emory; EdD, Temple	Director, Northwest AHEC
Bret A. Nicks	Associate Dean, Global Health
BS, Western Washington; MD, University of Washington; MHA, UNC-Chapel Hill	
Mary Claire O'Brien	Associate Dean, Academic Affairs
BA, LaSalle University; MD, Temple University	
Mitchell Sokolosky	Associate Dean, Graduate Medical Education
BS, MD, Temple	
Lynn Wagenknecht	Associate Dean, Interdisciplinary Research
BS, Lenoir Rhyne College; MPH, Dr.PH, Alabama School of Public Health	
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BA, Stonehill College; MS Northeastern University	
Dwayne Godwin	Dean, Graduate Programs in Biomedical Science
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