

Graduate  
School of  
Arts and  
Sciences  
2000/2001

**Wake Forest**

BULLETIN OF WAKE FOREST UNIVERSITY

Cover Photograph: Luke Burnett, Tom Perrault, and Anita McCauley (left to right), students in the neurobiology and anatomy program, are analyzing electrophysical response properties of neurons in the brain.

*Photography by Lou Davis, Biomedical Communications, Bowman Gray Campus, Wake Forest University School of Medicine.*

New Series  
June 2000  
Volume 95, Number 5

GRADUATE SCHOOL 2000 / 2001

Arts and Sciences  
Biomedical Sciences



## Wake Forest University

*BULLETIN of Wake Forest University (USPS 078-320) is published eight times a year in February, April, May, June (two issues), and July (3 issues) by the University Editor's Office, Wake Forest University, P.O. Box 7205 Reynolda Station, Winston-Salem, NC 27109-7205. Periodicals postage paid at Winston-Salem, NC, and additional mailing offices. POSTMASTER: Send address changes to Bulletin of Wake Forest University, Dean of the Graduate School, P.O. Box 7487 Reynolda Station, Winston-Salem, NC 27109-7487.*

# 2000-2001 Academic Calendars

## Reynolda Campus

### Fall Semester 2000

August 28-29	Monday-Tuesday	Registration for all students
August 30	Wednesday	Classes begin
September 13	Wednesday	Last day to add courses
September 15	Friday	Deadline for filing statement of intent to graduate December 16
September 27	Wednesday	Last day to drop courses
October 20	Friday	Fall holiday
November 1	Wednesday	Last day to submit thesis to graduate office for review of format
November 12-14	Monday-Tuesday	Pre-registration for Spring 2001
November 22-26	Wednesday-Sunday	Thanksgiving holiday
December 8	Friday	Classes end
December 11-16	Monday-Saturday	Examinations
December 13	Wednesday	Final copies of thesis due for December graduation
December 16	Saturday	Graduation

### Spring Semester 2001

January 15	Monday	Martin Luther King Jr. holiday
January 16	Tuesday	New student registration
January 17	Wednesday	Classes begin
January 31	Wednesday	Last day to add courses
February 14	Wednesday	Last day to drop courses
February 16	Friday	Deadline for filing statement of intent to graduate May 21
March 10-18	Saturday-Sunday	Spring break
April 9	Monday	Last day to submit thesis to graduate May 21 (to the Graduate School for review of format)
April 13	Friday	Good Friday holiday
May 2	Friday	Classes end
May 7-12	Monday-Saturday	Examinations
May 11	Friday	Final copies of thesis due for May graduation
May 20	Sunday	Hooping Ceremony
May 21	Monday	Commencement

### Summer Semester 2001

May 29-July 3		Summer Session I
July 5-August 10		Summer Session II
August 10	Friday	Graduation

# 2000-2001 Academic Calendars

## Bowman Gray Campus

### Fall Semester 2000

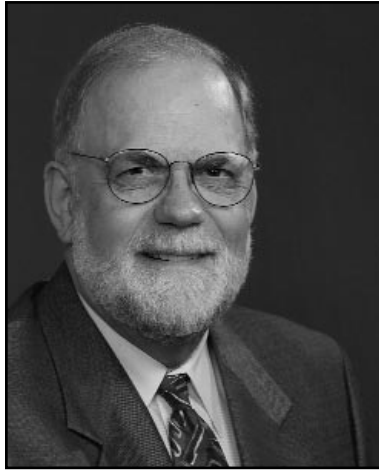
August 3-4	Thursday-Friday	New student orientation/registration
August 7-11	Monday-Friday	Ethics program—new students
August 7-24	Monday-Thursday	Biochemistry techniques course
August 30	Wednesday	Classes begin
September 4	Monday	Labor Day holiday
September 13	Wednesday	Last day to add courses
September 27	Wednesday	Last day to drop courses
October 6	Friday	Graduate School career day
November 3	Friday	Last day to submit thesis to graduate December 16 (to Graduate School office for review)
November 22-24	Wednesday-Friday	Thanksgiving recess
December 1	Friday	Last day to defend to graduate December 16
December 8	Friday	Classes end
December 11-15	Monday-Friday	Examinations
December 14-15	Thursday-Friday	Registration for spring 2001
December 16	Saturday	File intent to graduate
December 19	Tuesday	Graduation
		Grades due

### Spring Semester 2001

January 17	Wednesday	Classes begin
January 31	Wednesday	Last day to add courses
February 14	Wednesday	Last day to drop courses
March 12-16	Monday-Friday	Spring recess
April 9	Monday	Last day to submit thesis to graduate May 21 (to Graduate School office for review)
April 13	Friday	Good Friday Holiday
May 2	Wednesday	Classes end
May 4	Friday	Last day to defend to graduate May 21
May 7-11	Monday-Friday	Examinations
May 10-11	Thursday-Friday	Registration for summer session 2001
May 17	Thursday	Grades due
May 20	Sunday	Hooding Ceremony
May 21	Monday	Graduation

### Summer Semester 2001

May 23	Wednesday	Summer session begins
June 8	Friday	Last day to add/drop courses
June 22	Friday	Last day to submit thesis to graduate August 10
July 12-13	Thursday-Friday	Registration for returning students fall 2001
July 27	Friday	Last day to defend to graduate Aug. 10
August 3	Friday	Summer session ends
August 9	Thursday	Grades due
August 10	Friday	Graduation



Dear Prospective Student:

Thank you for your interest in the graduate programs offered through the Graduate School of Arts and Sciences of Wake Forest University. The Graduate School offers courses of study leading to master's and doctor of philosophy degrees on the Reynolda and Bowman Gray campuses of the University.

Wake Forest University provides graduate students outstanding opportunities for individualized instruction in disciplinary and interdisciplinary study with a nationally and internationally recognized faculty. Excellent facilities and extensive library resources create an intellectually stimulating environment in which to pursue a graduate education.

This bulletin provides an overview of the University and Graduate School. Information on each of the graduate programs is provided. For additional information, I encourage you to visit our home page at [www.wfu.edu/graduate](http://www.wfu.edu/graduate), to contact the Graduate School office on either campus, or the department or program of your interest. I also invite you to visit our campuses and meet with the faculty, staff, and graduate students of Wake Forest University.

Sincerely,

A handwritten signature in black ink, appearing to read "Gordon A. Melson". The signature is fluid and cursive, with a large initial "G" and "M".

Gordon A. Melson, Ph.D.  
Dean of the Graduate School

## *Programs of Study*



The Graduate School conducts programs on the Reynolda Campus (undergraduate and associate graduate programs) and the Bowman Gray Campus (location of the Wake Forest University School of Medicine). The PhD programs in biology, chemistry, and physics, and masters-only programs in eleven disciplines, ranging from accountancy to religion, are located on the Reynolda Campus. In addition, the masters of arts in liberal studies program enables the college-educated adult student to pursue graduate study in the liberal arts. On the Bowman Gray and associated campuses of the medical school, the Graduate School offers PhD programs in biomedical sciences and masters programs in comparative medicine, clinical epidemiology and health services research, and molecular medicine. The Graduate School also offers the combined MD/PhD with the Wake Forest University School of Medicine and the PhD/MBA with the Babcock Graduate School of Management. Listed on the following pages are the degrees offered.

Program	Degrees(s)	Director	E-mail Address
Accountancy	MSA	Dr. T. Baker	bakert@wfu.edu
Biochemistry	PhD	Dr. L. Daniel	ldaniel@wfubmc.edu
Biology	MS, PhD	Dr. R. Kuhn	kuhnray@wfu.edu
Cancer Biology	PhD	Dr. S. Akman	akman@wfubmc.edu
Chemistry	MS, PhD	Dr. S. King	kingsb@wfu.edu
Clinical Epidemiology & Health Services Research	MS	Dr. L. Wagenknecht Dr. M. Naughton	lwgnkcht@wfubmc.edu naughto@wfubmc.edu
Communication	MA	Dr. A. Mitra	ananda@wfu.edu
Comparative Medicine	MS	Dr. C. Shively	cshively@wfubmc.edu
Computer Science	MS	Dr. S. Thomas	sjt@wfu.edu
Education:			
Teacher Education	MAEd	Dr. L. McCoy	mccoy@wfu.edu
Counselor Education	MAEd	Dr. S. Gladding	stg@wfu.edu
Master Teacher Fellows	MAEd	Dr. L. McCoy	mccoy@wfu.edu
English	MA	Dr. O. Valbuena	valbue01@wfu.edu
Health & Exercise Science	MS	Dr. A. Marsh	marshap@wfu.edu
Liberal Studies	MALS	Dr. C. Solano	solano@wfu.edu
Mathematics	MA	Dr. E. Allen	allene@wfu.edu



Program	Degrees(s)	Director	E-mail Address
MD/PhD		Dr. D. Bass	dbass@wfubmc.edu
Medical Engineering	PhD	Dr. P. Santago	ps@medeng.wfubmc.edu
Microbiology and Immunology	PhD	Dr. D. Lyles	dlyles@wfubmc.edu
Molecular and Cellular Pathobiology	PhD	Dr. J. Parks	jparks@wfubmc.edu
Molecular Genetics	PhD	Dr. M. Lively	mlively@wfubmc.edu
Molecular Medicine	MS, PhD	Dr. F. Chilton	fchilton@wfubmc.edu
Neurobiology & Anatomy	PhD	Dr. M. Wallace	mwallace@wfubmc.edu
Neuroscience	PhD	Dr. R. Oppenheim	roppenhm@wfubmc.edu
Pharmacology	PhD	Dr. K. Vrana	kvrana@wfubmc.edu
PhD/MBA		Dr. D. Godwin	dgodwin@wfubmc.edu
Physics	MS, PhD	Dr. G. Holzwarth	gholz@wfu.edu
Physiology	PhD	Dr. K. Vrana	kvrana@wfubmc.edu
Psychology	MA	Dr. C. Seta	seta@wfu.edu
Religion	MA	Dr. K. Hoglund	hoglund@wfu.edu

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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.

Founded in 1834 by the Baptist State Convention of North Carolina, the school opened its doors to students on February 3 as Wake Forest Institute, with Samuel Wait as principal. It was located in the forest of Wake County, North Carolina, on the plantation of Calvin Jones, near which the town of Wake Forest later developed.

Rechartered in 1838 as Wake Forest College, it is one of the oldest institutions of higher learning in the state. It was exclusively a college of liberal arts for men until 1894, when the School of Law was established. The School of Medicine, founded in 1902, offered a two-year medical program until 1941. In that year the school was moved from the town of Wake Forest to Winston-Salem, became associated with the North Carolina Baptist Hospital, and was renamed the Bowman Gray School of Medicine in honor of the benefactor who made possible the move and expansion to a full four-year program. In 1997 the name was changed to the Wake Forest University School of Medicine.

In 1942 Wake Forest admitted women as regular undergraduate students.

A School of Business Administration was established in 1948 and for over two decades offered an undergraduate program

of study in business. In 1969 the Babcock Graduate School of Management was formed and the professional program for undergraduates was phased out. On September 12, 1980, the undergraduate program in business and accountancy was reconstituted as the School of Business and Accountancy. In 1995, the name was changed to the Wayne Calloway School of Business and Accountancy. The Division of Graduate Studies was established in 1961. It 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 Winston-Salem. The Divinity School was established in 1999. The summer session was inaugurated in 1921.

In 1946 the Trustees of Wake Forest College and the Baptist State Convention of North Carolina accepted a proposal by the Z. Smith Reynolds Foundation to relocate the non-medical divisions of the College in Winston-Salem, where the School of Medicine was already established. The late Charles H. Babcock and his wife, the late Mary Reynolds Babcock, contributed a campus site, and building funds were received from many sources. Between 1952 and 1956 the first fourteen buildings were erected in Georgian style on the new Winston-Salem campus. In 1956 the College moved all operations, leaving the 122-year-old campus in the

town of Wake Forest to the Southeastern Baptist Theological Seminary.

The decade that followed was the College's most expansive, and in 1967 its augmented character was recognized by the change in name to Wake Forest University. Today enrollment in all schools of the University stands at over 6,000. Governance remains in the hands of the Board of Trustees, and development for each of the six schools of the University is augmented by Boards of Visitors for the undergraduate College, the Calloway School of Business and Accountancy, the Graduate School, the School of Law, the Babcock Graduate School of Management, the Divinity School, and the Wake Forest University School of Medicine. A joint board of University trustees and trustees of the North Carolina Baptist Hospital is responsible for the Medical Center, which includes the hospital and the medical school. Alumni and parents' organizations are also active at Wake Forest, and support by the Z. Smith Reynolds Foundation and other foundations and corporations is strong and continuing.

Wake Forest's relationship with the Baptist State Convention is an important part of the school's heritage. Wake Forest's founders proposed to establish an institution that would provide education under Christian influences. Wake Forest and the Convention have a fraternal, voluntary relationship under which Wake Forest is autonomous in governance. The University is an associate member of the Convention's Council on Christian Higher Education. Wake Forest receives some financial and intangible support from Convention-affiliated churches.

The College, the undergraduate Wayne Calloway School of Business and Accountancy, the Graduate School, the

School of Law, the Babcock Graduate School of Management, and the Divinity School are located on the Reynolda Campus in northwest Winston-Salem. The Wake Forest University School of Medicine is about four miles away, near the city's down-town on what is known as the Bowman Gray Campus. 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 Olin Physical Laboratory, housing the physics department, opened in the fall of 1989. Made possible by a grant from the F. W. Olin Foundation, Inc. of New York, the 32,000 square-foot building is the site of a physics program offering hands-on research and a significantly enlarged laser physics lab.

The undergraduate faculties offer courses of study leading to the baccalaureate in over forty departments and interdisciplinary areas. The School of Law offers the juris doctor degree and the Babcock Graduate School of Management the master of business administration degree. In addition to the doctor of medicine degree, the School of Medicine offers, through the Graduate School, programs leading to the master of science and doctor of philosophy degrees in the biomedical sciences. The Graduate School also confers the master of arts, master of arts in education, master of arts in liberal studies, master of science in accountancy, master of science degree in the arts and sciences, and the doctor of philosophy degree in biology, chemistry, and physics. The Divinity School offers the master of divinity degree.

## 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 Association of Southeastern Research Libraries and in the Association of College and Research Libraries. They rank among the top schools in the Southeast in library expenditures per student.

### Reynolds Campus

The Wake Forest libraries hold over one million volumes in print, many thousands of subscriptions to periodicals and serials, over one and a half million microforms, more than 150,000 government documents, as well as growing media collections. Access is provided to thousands of electronic sources, further strengthening research opportunities.

Facilities in the Z. Smith Reynolds Library include an Information Technology Center with multimedia viewing and editing and a lab for student use. All-night study rooms are available to students with a key-card. Group study rooms are also provided. The Professional Center Library, combining the Law Library and the Babcock Management Library, is housed in the Worrell Professional Center, which opened in 1993.

The libraries share an online catalog which may be consulted at terminals in the buildings, from the campus network or remotely through a modem. The Reference

Department of the Z. Smith Reynolds Library provides a complete range of reference services including online searching, tours, presentation to individual classes, and assistance with directed and independent studies. Reference tools are available in electronic and print formats. Many electronic resources are made available by the library. Interlibrary loan service is available for Wake Forest students, faculty, and staff at no charge. The library provides a wide variety of computer training opportunities and classes.

Special collections in the Reynolds Library include the Rare Books Collection and the Ethel Taylor Crittenden Baptist Historical Collection. The Rare Books Collection, greatly enhanced by the donation of rare and fine books of the late Charles H. Babcock, emphasizes American and British authors of the late nineteenth and early twentieth centuries. Among such collections are those of Mark Twain, Gertrude Stein, William Butler Yeats and T.S. Eliot. There is also an extensive Anglo-Irish literature collection. The Baptist Historical Collection contains significant books, periodicals, manuscripts, and church records relating to North Carolina Baptists as well as a collection of the personal papers of prominent ministers, educators, and government officials. The Wake Forest College/University Archive is also maintained in this area.

A limited number of carrels in the library can be assigned to graduate students. These carrels offer privacy and quiet.

## Bowman Gray Campus

The Coy C. Carpenter Library of the Medical Center is located on the first floor of the medical school's James A. Gray Building. 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, monographs, audiovisuals, and computer software are included. The holdings of the library are accessed via a computer-based catalog system.

The collection contains 147,937 volumes and includes approximately 1,740 medical and related scientific journal titles, more than 2,600 audiovisuals, and over 300 online journal and textbook subscriptions. 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 librarians at the Carpenter Library offer computer-based literature searches, often referred to as online searches. By using MEDLINE and other databases in medicine, the physical and life sciences, social sciences, business, and more, the librarians prepare computer-generated bibliographies on specific search topics as requested. The library also offers access to MEDLINE, MICROMEDEX (clinical drug information), TOMES (toxicology, occupational medicine and the environment), and other databases.

Document delivery services and interlibrary loans are provided. Current Awareness services include monthly computer-generated bibliographies and a daily table-of-contents service.

The library's Learning Resources Center offers complete classroom facilities for individual and group instruction. Microcomputers, interactive laser disk configurations, audiovisual hardware, and computer software are continually being upgraded and improved to meet the needs of the user.

## Information Systems

Information Systems supports University instruction, research, and administrative needs. The campus computer network offers high-speed connectivity from all residence hall rooms, all offices, and many classrooms and public areas.

Graduate students may purchase or lease IBM ThinkPad computers through the University. These computers are similar to those issued to undergraduate students as part of the University's technology initiative. Incoming graduate students will receive further information concerning this prior to their enrollment.

These laptop 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. The programs include Microsoft Office, electronic mail, and Internet and library browsing, research, analytical, and development tools. A large variety of instructional, classroom, and research resources are accessible through the campus network. These include the library's CD-ROM network, OCLC FirstSearch, and other digital and data resources.

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.

Information Systems also supports an extensive online information system that includes documentation, class schedules and grades, Universitywide activity calendars, the Wake Forest University Libraries information system, and the electronic version of the Old Gold and Black. The Wake Forest Information Network (WIN), a secure campus Intranet, provides faculty, staff, and student databases and directories, an alumni directory, an online ride board and used textbook exchange, and customizable links to news, weather, and research sites.

The University has an extensive collection of computing facilities that serve both academic and business needs. A Hewlett-Packard series 3000/979, a 3000/969, and thirty-four Windows NT servers provide for business computing needs. Three IBM SP/2s provide messaging, systems management, Intranet, and scientific and other research needs. These SP/2s contain seven, nine, and twelve computing nodes respectively. The twelve-node SP/2 complex performs supercomputing applications in the sciences. Fifty-nine Windows NT servers provide for file and print services and courseware. A Windows NT server and an

IBM H50 provide library services. These systems are available to students, faculty, and staff twenty-four hours a day through network and dial-up connectivity.

Information Systems supports and maintains the University's high speed, switched FDDI (fiber distributed data interface), Gigabit Ethernet, and Fast Ethernet campus network. This network currently connects all academic and administrative buildings and provides robust interconnectivity for independent building Ethernet networks. Each residence hall room is equipped with two switched Ethernet connections.

Wake Forest has a 155 megabit ATM (asynchronous transfer mode) connection to the Internet. Through this connection, Wake Forest has access to CRAY and IBM SP2 supercomputers located at the MCNC/North Carolina Supercomputing Center in the Research Triangle and to all the premier research networks in the world, including Internet II, Abilene, and the VBNS (Very high performance Backbone Network Service). Wake Forest is also working closely with the North Carolina Research and Education Network on other advanced networking technologies.

Information Systems also provides telephone and cable television services to the students, faculty, and staff of Wake Forest University. All residence hall rooms are equipped with telephone jacks and cable TV connections. Local dial service for the campus and Winston-Salem area is provided as part of the housing package. Students who wish to place long distance calls over the University telephone network can apply for services at the



Telecommunications Service Center located in Room 255, Information Systems.

Cable television, while providing a recreational outlet, plays an important role by providing access to campus information and educational offerings. Cable channel 2 is the Wake Forest University information channel, providing information and a calendar of campus events. WAKE Radio, a student-run station, provides background music for this channel. Channel 17 carries SCOLA, a non-profit educational service that features television programming from more than fifty different countries in their original languages.

Information Systems provides assistance by telephone, and supports walk-in customers, from 8 a.m. until midnight, Monday through Thursday; 8 a.m. until 5 p.m. on Friday; and 4 p.m. until midnight on Sunday. Hours vary during summer terms, inter-sessions, and on holidays. A voice mail retrieval system is activated on weekends and during holiday breaks to respond to emergency calls.

## Recognition and Accreditation

Wake Forest University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools (1866 Southern Lane, Decatur, Georgia; telephone number [404] 679-4501) to award bachelor's, master's, and doctoral degrees.

The Wake Forest University School of Medicine is a member of the Association of American Medical Colleges and is on the approved list of the Council on Medical Education of the American Medical Association. The School of Law is a member of the Association of American Law Schools 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 Council of the North Carolina State Bar. The Babcock Graduate School of Management, the Wayne Calloway School of Business and Accountancy, and the accountancy program are accredited by the American Assembly of Collegiate Schools of Business. The program in counseling leading to the master of arts in education degree is accredited by the National Council for the Accreditation of Teacher Education. The Master of Arts in Liberal Studies program is a member of the Association of Graduate Liberal Studies Programs. The Divinity School prospectus and master of divinity degree were approved by the Commission on Colleges in July 1999 for inclusion in the University's accreditation. The Divinity School is also in the process of being reviewed for accreditation by the Association of Theological Schools.

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, and the Council of Graduate Schools in the United States; the Southern Association of Colleges and Schools, the Southern Universities Conference, and the Council of Southern Graduate Schools; and the North Carolina Association of Colleges and Universities and the North Carolina Association of Independent Colleges and Universities. In addition, many offices of

the University are members of associations which focus on particular aspects of university administration.

Wake Forest has chapters of the principal national social fraternities and sororities, professional fraternities, and honor societies, including Phi Beta Kappa and Sigma Xi. There is an active chapter of the American Association of University Professors on campus.

### 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 eighty-six 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, 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 in the ORISE Catalog of Education and Training Programs, which is available at <http://www.orau.gov/orise/resgd.htm>, or by calling either of the contacts below.

ORAU's Office of Partnership Development seeks opportunities for partnerships and alliances among ORAU's members, private industry, and major federal facilities. Activities include faculty development programs, such as the Ralph E. Powe Junior Faculty Enhancement Awards, the Visiting Industrial Scientist Program, and various services to chief research officers.

For more information about ORAU and its programs, contact Dr. Gordon A. Melson, ORAU Counselor for Wake Forest University, at (336) 758-5301; or Ms. Monnie E. Champion, ORAU Corporate Secretary, at (865) 576-3306; or the ORAU Home Page at <http://www.orau.gov>.

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Application materials, as well as the online application process, are available on the Web at <http://www.wfu.edu/graduate>.



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 regularly offered 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 institutionwide 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 new 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

*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 now comprised of seven constituent parts: two undergraduate institutions: Wake Forest College and the Wayne Calloway School of Business and Accountancy; the Graduate School; and four professional schools: the School of Law, the Wake Forest University School of Medicine, the Babcock Graduate School of Management, and the Divinity School. 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.

The Graduate School, operating within the framework of these principles, seeks to provide a community of faculty and advanced students dedicated to teaching, research, and productive scholarship. Through graduate programs in the arts and sciences and the basic medical sciences, an effort is made to expand the frontiers of knowledge and to keep abreast of man's understanding of the rapidly changing human environment. As a significant feature of the educational process, students are encouraged to develop initiative, resourcefulness, and responsibility required of those who become independent intellectual leaders in their chosen fields of endeavor.

### Administration

The Graduate School is administered by a dean, an associate dean, and a Graduate Council composed of three 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 or the Wayne Callo-way School of Business and Accountancy faculty (Reynolda Campus) and six are members of the Wake Forest University School of Medicine faculty (Bowman Gray Campus).

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Application materials, as well as the online application process, are available on the Web at <http://www.wfu.edu/graduate>.

# Procedures



All students are responsible for familiarizing themselves with the portions of this bulletin which 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.

## Dates for Applying

The deadline for applications is February 1, although early application is encouraged. Students normally matriculate at the beginning of the fall semester. Students in the Master Teachers Fellows Program matriculate in early June.

## How to Apply

Application materials, as well as the online application process, are available on the Web at <http://www.wfu.edu/graduate>.

## Financial Assistance

On the Reynolda Campus, tuition scholarships, fellowships, teaching assistantships, and research assistantships are available to qualified students. On request, individual departments or the dean of the Graduate School will supply information regarding levels of support. Assistantships and fellowships include full-tuition scholarships as part of the grant. An assistantship includes a tuition scholarship plus compensation for services rendered. Assistants work from twelve to fifteen hours per week and carry a normal load of courses.

Acceptance of a Fellowship, 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 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. A need for financial assistance may be noted on the application form. 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 positions available to qualified graduate students. Duties include overseeing operations of a residence hall and supervising undergraduate residence hall advisers. Compensation includes \$6,750 for ten months, a comfortably furnished apartment with utilities, a small meal allowance, and potential tuition scholarships (per approval of the dean of the Graduate School of Arts and Sciences). Please note that such scholarships are not available to students enrolled in law, MBA, divinity, medical, and MALS programs. Interested students are urged to send a cover letter, resume, and three letters of recommendation to the Associate Director of Residence Life and Housing, Wake Forest University, P.O. Box 7749 Reynolda Station, Winston-Salem, NC 27109-7749.

A number of full-tuition scholarships and research grants are available for Reynolda continuing students for the summer sessions. Interested persons should contact their respective departments.

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 may include tuition scholarships.

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.

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.

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

Unclassified (non-degree seeking) and provisionally accepted students are not eligible for financial aid.

## Admission

*Eligibility.* Undergraduates in their senior year and graduates of accredited colleges or universities 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. Medical students who have satisfactorily completed, or will complete by the end of the spring semester, at least one year of the medical curriculum may apply for admission to 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 must 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.

*Graduate Record Examinations.* All applicants (except for the master of arts in liberal studies [MALS], the master of science in accountancy program, and the combined MD/PhD program) are required to submit scores on the General Test and the Subject Test\* of the Graduate Record Examinations (GRE) administered by the Educational Testing Service, P.O. Box 6000, Princeton, New Jersey 08541-6000 (<http://www.ets.org>). Usually these examinations are taken in the fall of the student's senior year.

*\*The Subject Test is a requirement in all of the departments for which a specific test is given. Applicants in other departments may wish to strengthen their applications by submitting scores on the Subject Test in a related field. For example, the biology test would give an indication of ability to do graduate work in neurobiology and anatomy.*

*Graduate Management Admission Test.* Applicants to the master of science in accountancy program are required to submit Graduate Management Admission Test (GMAT) scores. The GMAT is administered in January, March, June, and October by the Educational Testing Service, P.O. Box 6103, Princeton, New Jersey 08541-6103. Applicants are encouraged to sit for the October test and should request a copy of the GMAT Bulletin of Information and Registration Form at least two months in advance of their intended

testing date. When applying to take the GMAT, applicants should enter 5933 (the Wake Forest master of science in accountancy code number) in item 16 of the GMAT registration form.

*Test of English as a Foreign Language.* Applicants from non-English speaking countries must submit satisfactory scores, minimum of 550 total (650 for the MALS program), on the Test of English as a Foreign Language administered by the TOEFL Program of the Educational Testing Service. The TOEFL bulletin of information and registration form can be obtained at American embassies and consulates, offices of the United States Information Service, United States educational commissions and foundations abroad, and at binational centers. Students unable to obtain a bulletin from one of the above should write to: Test of English as a Foreign Language, P.O. Box 6155, Princeton, New Jersey 08541-6155, USA. Administrations of TOEFL are coordinated with the GRE and are available in most countries. Correspondence should be initiated at least three months before the testing date.

*Personal Interviews.* Although not required of all students, personal interviews are encouraged and may be specified as a requirement for some programs.

*Transfer Students.* Applicants for the master's degree who have completed a portion of their graduate training in another institution are eligible for admission but may not transfer for credit more than six semester hours of course work. This limitation does not apply to applicants for the PhD degree.



## 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 (including the appropriate Subject Test if one is given) or GMAT scores (for an individual applying to the master of science in accountancy program), and good recommendations may apply for regular admission. The master of arts in liberal studies program (MALS) has a separate and distinct set of application procedures. For further information, write to the MALS Program Director, Wake Forest University, P.O. Box 6103 Reynolda Station, Winston-Salem, NC 27109-6103.

*Provisional Status in a Degree Program.* Those who may be awaiting GRE or GMAT scores or at the time of application have grades slightly below those specified for regular admission may apply for provisional admission. A student deficient in required undergraduate courses in the intended field of graduate study may apply in this category. Provisional status is limited to not more than one semester of full-time study or its equivalent in part-time study.

*Unclassified Graduate Student.* Applicants seeking courses for graduate credit but not wishing to work for a graduate degree may apply for admission as unclassified or non-degree students. The GRE and some of the letters usually expected from former professors may be waived as requirements for unclassified status. Applicants are required to complete the front of the application form, submit the application fee, meet the immunization requirements, and submit an

official transcript at least one month prior to matriculation. Departmental approval is required.

## 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 course work, including thesis research, is considered a full-time student. Students registered as “thesis only” or “graduate fee only” may be considered full-time. (This means 0 credit hours.)

*Part-Time Status.* A student registered for less than the above amount of course work is considered a part-time student. Each department will determine whether it is possible to pursue a degree program on a part-time basis. If a department is willing to accept a part-time student, that department, the student, and the dean of the Graduate School shall enter into a letter of agreement specifying the terms on which the individual may satisfy the program’s requirements on a part-time basis.

## Tuition and Fees

The following 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.

## 2000-2001 Fee Schedule

FULL-TIME TUITION (MINIMUM 9 HOURS)	\$19,800
PART-TIME TUITION PER HOUR	\$650
AUDIT FEE PER HOUR PART-TIME STUDENTS	\$30
SUMMER SESSION	
REYNOLDA CAMPUS (per semester hour)	\$350
BOWMAN GRAY CAMPUS (per semester)	\$300

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 \$30 per semester or \$15 for each term of the summer session.

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.

*Reynolda Campus.* Students pay a fee at the time of graduation which covers the binding of five copies of the thesis or dissertation, a cap and gown, and a standard diploma.

*Bowman Gray Campus.* Students pay a \$35 fee at the time of graduation which covers the cost of binding the thesis or dissertation and the rental of academic regalia.

Doctoral candidates on both campuses pay \$55 at the time of graduation to have abstracts of their dissertation published in *Dissertation Abstracts International*.

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, consult the human resources office. Wake Forest grants a one-half tuition rate for educators teaching full-time in public schools or state-approved non-public schools. These concessions do not apply to study in the schools of law, medicine, management, or to the master of science program in accountancy.

Graduate students enrolled for full-time residence credit are entitled to full privileges regarding libraries, laboratories, athletic contests, student publications, the Student Union, the University Theatre, the Secrest Artists Series of Wake Forest University, and the Student Health Service. Part-time students are entitled, after paying tuition, to the use of the libraries and laboratories, but not to the other privileges mentioned above. They may, however, secure admission to athletic events and concerts and the other privileges listed above by paying an activity fee of \$166 per semester.

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 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 pages 23-25 of the 2000-2001 Wake Forest undergraduate bulletin for the Return of Program Funds policy.

NUMBER OF WEEKS ATTENDANCE*	PERCENTAGE OF TOTAL TUITION TO BE REFUNDED
1	100%
2	75%
3	50%
4	25%

\* *Counting from the first day of registration; fractions of a week count as a full week.*

## Housing Services

The Graduate School does not require that students live in University housing. Most students make their own arrangements for housing off campus. The Office of Residence Life and Housing (Benson 218) serves as an information center for individuals who wish to advertise rooms, apartments, and houses for rent or sale. It also provides a place for students to list information if they are interested in finding a roommate to share expenses. Off-campus facilities are not screened. The University serves only as an information source and does not assume responsibility for placement, lease agreements, or landlord-tenant relations.

Graduate students who live in University housing are expected to follow the regulations and conditions governing occupancy as stated in the lease or contract agreement. Bowman Gray campus students may apply for a Medical Foundation apartment or secure housing in other facilities near the Medical Center.

It is advisable to make housing arrangements as early as possible as space is very limited for both single and married students. For information regarding available off-campus University housing on the

Reynolda campus, students should contact Thomas King, real estate manager, (336) 758-5584.

## Food Services

The Wake Forest dining service offers a variety of locations where students can use their dining money. Seven dining locations on the Reynolda campus offer a variety of food options and atmospheres: The Reynolda Cafeteria (The Pit), The Benson Food Court, Shorty's, The Magnolia Room, The IS Food Court, and two convenience stores (The Sundry and North). Cafeterias and fast-food services are also available on the Bowman Gray campus.

A dining account is a declining balance account available with your student I.D. card. Money can be added to the account during the semester with a deposit of \$25 or more cash, check, or money order or \$100 or more with MasterCard or Visa. For additional information, please contact ARAMARK Dining Services, P.O. Box 7393 Reynolda Station, Winston-Salem, NC 27109-7393 or stop by the ARAMARK offices at 31C Reynolda Hall.

## Student Health Service

### *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, sports medicine clinic, pharmacy, laboratory, referral to specialists, confidential HIV testing, and travel information. A full staff is available by appointment during clinic hours: 8:30 a.m. to noon, 1:30 to

4:00 p.m., Monday through Friday. A limited staff is available for urgent and in-patient care twenty-four hours a day, seven days a week, when school is in session during the academic year. The services of the staff are covered by tuition. There is a charge for medicines, laboratory tests, some supplies and services, and observation care. Reynolda Campus graduate students are eligible for treatment if a "WFU Health Information Summary and Immunization Form" is complete and on file at the Student Health Service.

Documentation of immunizations required by the University and the State of North Carolina (as described on this page) must be received by July 1. All Wake Forest students are required to have health insurance. Wake Forest offers student group insurance at a reasonable cost. Information concerning the insurance will be mailed directly to your home address. If you do not receive the information, call ABCO: 1-800-222-5780.

*Confidentiality.* Information about a student's health is not released to University officials, friends, family members, or therapists and physicians not involved in the student's immediate care, without the student's permission.

*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 (10) years after the last treatment, after which time they are destroyed. Immunization records are kept longer.

## Immunization Policy

### *Reynolda Campus*

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 health summary form provided by the Student Health Service* in order to assure correct identification of the student. Acceptable documentation is a statement signed by the appropriate official(s) having custody of the records of immunization, such as a physician or county health department director, or a certificate from a student's former school containing the approved dates of immunizations.

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

### *Required:*

- 1. Tetanus and Diphtheria (Td).** Students must document a Td immunization series and a booster within ten years of enrollment.
- 2. Rubeola (Measles).** Students must document two doses of live virus measles vaccine given at least 30 days apart, on or after their first birthday (after 3/21/63\*) unless (a) they have a physician's certificate which states that they have had measles prior to January 1, 1994, (b) they were born prior to 1/1/57, or (c) they have documentation of a titer indicating they are immune.
- 3. Rubella (German Measles).** Students must document that they have had one dose of live virus vaccine on or after their

first birthday (after 6/9/69\*) unless (a) they have documentation of a titer indicating they are immune, or (b) they will be fifty years old before they enroll. History of the disease is not acceptable.

**4. Mumps.** Students must document that they have had one dose of live virus mumps vaccine on or after their first birthday (after 12/28/67\*) unless (a) they were born before 1/1/57, or (b) they have documentation of a titer indicating they are immune. History of the disease is not acceptable.

**5. Polio.** Students must document that they have had trivalent polio vaccine unless they will be eighteen years old or older when they enroll. A booster is recommended for students traveling to countries where polio is endemic.

**6. Tuberculin skin test.** The test is required within twelve months of the University registration date. If the student is known to be tuberculin-positive or if the test result is positive, attach record of treatment.

*\* Indicates date the vaccine was licensed by the FDA. Combination vaccines have different licensure dates.*

*Recommended:*

**1. Hepatitis B.** A three-dose series of the vaccine is recommended by the Centers for Disease Control.

**2. Varicella.** The two-dose series. Discuss with your health care provider.

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.

Questions regarding these requirements should be directed to the Student Health Service at (336) 758-5218.

## Student Health Service

### *Bowman Gray Campus*

Students are assigned to physicians 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 faculty serve as student's physicians. The Wake Forest University 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.

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 are encouraged to choose QualChoice, a managed care plan offered by the medical school, that would require minimal out-of-pocket expenses. Information on this plan will be forwarded to you for your consideration.

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

### *Bowman Gray Campus*

#### *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.

**1. Tetanus and Diphtheria (Td).** Students must document a booster less than ten years old.

**2. Rubeola (Measles).** Students must document two doses of live virus measles vaccine, given at least thirty days apart, on or after their first birthday (after 3/21/63\*). If they were born prior to 1/1/57, they must have documentation of a titer indicating that they are immune, or documentation of vaccination with live virus vaccine.

**3. Rubella (German Measles).** Students must document that they have had one dose of live virus vaccine on or after their first birthday (after 6/9/69\*), or they must have documentation of a titer indicating they are immune. History of the disease is *not* acceptable.

**4. Mumps.** Students must document that they have had one dose of live virus mumps vaccine on or after their first birthday (after 12/28/67\*), or if they were born before 1/1/57 they must have documentation of a titer indicating they are immune.

**5. PPD tuberculin skin test** is required; a tine test will not be accepted. The test must have been done after March 1999. If the student is known to be tuberculin-positive or if the test result is positive, attach record of treatment and chest x-ray results.

**6. Hepatitis B.** A three-dose series of the vaccine is recommended (not required).

*\* Indicates date the vaccine was licensed by the FDA. Combination vaccines have different licensure dates.*

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.

## Vehicle Registration

All students residing on the Reynolda campus and Bowman Gray campus (including all student and faculty apartments, satellite housing, language and theme houses) must register vehicles they are operating day or night, whether or not owned by the operator. Students enrolled in less than nine hours, including audit and thesis courses, may register vehicles for a reduced fee.

All vehicle registrations must be completed within twenty-four hours from the time the vehicle is first brought to campus

or the next business day. Vehicles are registered at the Office of Parking Management on the Reynolda campus, 8:30 a.m.-4:00 p.m., Monday-Friday. Proof of ownership must be presented to verify a license plate when applying for parking decals. For more information, telephone (336) 758-6123 or (336) 758-5048, 8:30 a.m.-4:00 p.m., Monday-Friday.

University Police and Student Shuttle Service provide safe rides when requested by dialing 758-5591.

Bowman Gray campus students may sign up for paid-monthly parking at orientation or by contacting the human resources department. Those who take classes on the Reynolda campus, including audit and thesis credit, or use other facilities, may register their vehicles at no charge.

## University Identification Cards

### *Reynolda Campus*

All students are required to obtain an ID card and to have it with them at all times while on campus. Cards may be obtained from the Deacon One-Card Office, Room 218, Benson Center, between the hours of 8:30 a.m. to 5:00 p.m., Monday-Friday. For further information, call 758-1949 or 758-4214.

### *Bowman Gray Campus*

Arrangement is made with Human Resources during orientation for each student to obtain a photo identification card.

## Career Services

The Office of Career Services (CS) offers a full range of career services, including job search guidance; internship opportunities; full-time vacancy listings; library resources and a computer program which helps students identify career interests. Other services include workshops which teach resume writing, interviewing and job search skills.

Students enrolled in graduate programs are encouraged to consult the CS office as early as possible regarding the services described above.

The Career Services office is located in 8 Reynolda Hall (Reynolda Campus). Office hours are 8:30 a.m.-5:00 p.m., Monday-Friday. The office resources are available on a walk-in basis and individual appointments may be made in person or by calling (336) 758-5902.

## University Counseling Center

The University Counseling Center, located in 118 Reynolda Hall (Reynolda Campus), provides short-term counseling, psychological testing, and consultation. All services are confidential, and no fees are charged to students. The Center offers counseling for a variety of concerns such as personal adjustment, managing stress, developing career plans, and relationship issues. The Center is open Monday-Friday from 8:30 a.m. to 5:00 p.m. Psychological emergencies after hours are handled in cooperation with the Student Health Service.

## 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.

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)
AUD	AUDIT
DRP	OFFICIAL DROP (NOT COUNTED AS HOURS ATTEMPTED)
NC	NO CREDIT
NR	GRADE NOT REPORTED
WD	WITHDREW (NOT COUNTED AS HOURS ATTEMPTED)
WP	WITHDREW PASSING (NOT COUNTED AS HOURS ATTEMPTED)
WF	WITHDREW FAILING (NOT COUNTED AS HOURS ATTEMPTED)
S	SATISFACTORY PROGRESS ON THESIS RESEARCH
U	UNSATISFACTORY PROGRESS ON THESIS RESEARCH
RPT	COURSE REPEATED (SEE REPEATING A COURSE)

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 on record. Incomplete grade forms are available in the appropriate Graduate School office.

*Minimum Grade Requirements.* A student whose cumulative grade point average (GPA) falls below 2.5 is required to withdraw from the Graduate School at the close of the semester in which this condition occurs. 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. Thesis credit does not enter into the GPA.

Individual departments may require a higher grade point average than 2.5 for continuation. If there is such a requirement, it is stated in the departmental policies. Students also may be asked to withdraw for failure to make satisfactory progress in research.



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.

*Repeating a Course.* Beginning with fall 1999 courses, a graduate student may repeat a course once in which a B- or lower grade has been received and with the permission of the student's graduate program director and the course instructor. 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 dean of the Graduate School and the department concerned, 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 obtained in the appropriate Graduate School office.

*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 \$30 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.

*Leave of Absence.* A leave of absence may be granted by the dean of the Graduate School upon recommendation by the respective department or program. The student must submit a leave request in writing, be in good academic standing, and complete any forms required by the Graduate School for courses in progress.

*Withdrawal from the University.* During the first month of a semester, a student may withdraw from the University without having a grade recorded for courses in progress. The official record is WD. Withdrawal procedures should be initiated in the appropriate Graduate School office. After the one-month period, students who withdraw with permission are assigned grades of WP in courses in which they are doing passing work or WF in courses in which their work is below passing level. A student who withdraws without the approval of the dean of the Graduate School and the department concerned is assigned grades of F for all courses in progress. Withdrawal forms may be obtained from the appropriate Graduate School office.

### 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. A full statement will be provided to each student at the time of his or her initial matriculation.

### 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 University Technology Transfer Service.

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Application materials, as well as the online application process, are available on the Web at <http://www.wfu.edu/graduate>.

# Requirements for Degrees



## Degrees Offered

The Graduate School of Arts & Sciences offers graduate programs leading to the master of arts, master of arts in education, master of arts in liberal studies, master of science, master of science in accountancy, and doctor of philosophy degrees. For a description of the programs, see Courses of Instruction. "Instructions for the Preparation of Theses and Dissertations" may be obtained in the graduate office. All candidates who receive graduate degrees in August, December, or May are expected to attend the May Commencement of that school year unless excused by the dean of the Graduate School.

## Foreign Language/Special Skill

Some programs may require students to demonstrate a reading knowledge of an appropriate foreign language or competence in a special skill such as statistics or computer programming and operation. Refer to each program's statement to see if there is such a requirement and, if so, how it may be satisfied.

## Admission to Candidacy

Admission to graduate standing does not necessarily commit the student or the University to a program of study leading to a graduate degree. Students who wish to become candidates for degrees must file applications for candidacy with the dean of the Graduate School. It must be done at least three months before the graduate degree is conferred.

## Minor Program in Biomedical Sciences

A certified minor, indicated as such on the official transcript, may be obtained in some departments and in interdisciplinary programs within the biomedical sciences (Bowman Gray campus) by completing twelve semester hours of course work, including specific courses as required by individual departments and programs. Program directors of individual departments should be consulted for details.

## Requirements for the Master of Arts Degree

Programs of study leading to the master of arts degree are offered in English, mathematics, psychology, religion, and communication. The degree is awarded to candidates who complete a minimum of twenty-four semester hours of faculty-approved course work 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 thirty required for graduation are allotted. Students may earn additional credit for thesis research, but such hours may not be substituted for the twenty-four hours of course work required.

*Residence Requirements.* The minimum residence requirement is one academic year or three summer sessions. In practice, most students in the arts require at least a summer session in addition to the academic year, and most science students require two years. In all cases, work for the degree must be completed within six calendar years of the date of initial enrollment in the Graduate School.

*Course Requirements.* At least twelve of the twenty-four hours in course work (not counting thesis research) required for the degree must be in courses numbered 700 or above. The remaining twelve hours may be in either 600-level or 700-level courses. Credit may be allowed for as many as six hours of graduate work transferred from another institution, but the minimum residence requirement is not thereby reduced.

*Thesis Requirement.* Six of the thirty hours required for the MA degree are allotted for the thesis. Although six semester hours of credit are recorded when a thesis is approved, no letter grade other than S or U is ever assigned for the courses titled Thesis Research. 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 a first and second reader). The student should confer with the program director concerning the membership of the committee.

*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, such as computer programming. Refer to each program's statement to see if there is such a requirement and, if so, 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 with one additional semester's work.

*Final Examination.* The examining committee for the thesis shall consist of at least three members of the graduate faculty. The committee shall be appointed by the dean of the Graduate School and may include one member from outside the student's department or program. With the approval of his or her adviser, a student may recommend a faculty member from outside the department or program to serve on the examining committee. The thesis adviser must justify the participation of external experts who are not members of the graduate faculty on the basis of research, publications and/or professional activities. If the external expert is to be a voting and signing member of the examining committee, the adviser must communicate to the dean of the Graduate School, in writing, the qualifications of the external expert. The examination covers the thesis and knowledge in related areas and is conducted at least ten days prior to graduation. A student may be reexamined only once.

## Requirements for the Master of Arts in Education Degree

Graduate work in the Department of Education is offered leading to the master of arts in education degree. Full time Teacher Education students complete the program in one academic year if they enter during the first summer term. Students enrolled on a part-time basis may require

three years or longer to complete the degree. Counselor Education students require two years 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:

*thirty-three semester hours of approved course work in Teacher Education, or a minimum of forty-eight hours of approved course work in Counselor Education, with an overall average grade of at least a B on all courses attempted. The course requirements must be completed in courses numbered 600 or above, with at least half of the total number of required hours in course numbered 700 or above.*

*research competence in Teacher Education that includes a set of three courses that culminate in a research study or statistics competence in Counselor Education demonstrated by passing an exam developed by program faculty.*

In addition to qualifying for admission to the Graduate School, candidates for the master of arts in education degree seeking a North Carolina Class G Teacher's License must possess a North Carolina Class A Teacher's License or its equivalent. Master Teacher Fellows and School Counseling students are not required to hold a teacher's license to enter the program.

## Requirements for the Master of Arts in Liberal Studies Degree

The master of arts in liberal studies (MALS) is designed for mature adults who wish to pursue advanced studies in the liberal arts. Graduate liberal studies courses,

designed particularly for the program, address broad subjects from interdisciplinary and multicultural perspectives. Admission to the program requires a B average in undergraduate work or the equivalent, two recommendations, an essay, and a personal interview. The GRE is not required. The program requires an application fee of \$25 but does not require an admission deposit.

The MALS degree is awarded to candidates who complete twenty-seven hours of faculty-approved course work with an average grade of B or above on all courses attempted and an acceptable thesis/project for which three hours of credit toward the thirty required for graduation are awarded.

A minimum of twelve of the twenty-seven hours of course work must be chosen from the interdisciplinary courses particularly designed for the liberal studies program; a student may take all nine required courses from these specially designed offerings. 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 degree.

A student may take six years to complete the master of arts in liberal studies. There is no residence requirement. A student may transfer a maximum of six credits (two courses) from another MALS program or from an appropriate graduate program, at the discretion of the director.

The MALS thesis project may be a traditional research paper, a creative work, oral history, or field study; or it may take another form approved by the MALS Committee. Like other graduate students, MALS students make an oral presentation and defense of their completed thesis or project.

## Requirements for the Master of Science Degree

The master of science degree is offered on the Reynolda campus by biology, chemistry, computer science, health and exercise science, and physics. On the Bowman Gray campus, it is offered by clinical epidemiology and health services research, comparative medicine, and molecular medicine.

**Residence Requirement.** In general, a minimum of twelve months of full-time work or its equivalent in residence is required for the master's degree. For students who have already completed a part of their graduate work, appropriate adjustment of the residence requirement can be made by the Graduate Council. 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 thirty semester hours of graduate credit. This minimum requirement can include no more than six hours of research. Sixteen hours of lectures, conferences, or examinations, or thirty-two hours of laboratory work are equivalent to one semester hour of credit.

Students who have completed at least one year of medical study in the Wake Forest University School of Medicine can offer certain courses in the medical curriculum for credit. Students desiring to transfer from another graduate school are not allowed more than six semester hours of credit for previous course work, except in unusual cases and upon approval of the Graduate Council.

The course of study consisting of classes, seminars, and research is compiled by a group including the student, the student's adviser, 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. At least twelve semester hours must consist of graduate courses exclusive of courses included in the medical curriculum or 600-level courses on the Reynolda campus.

**Thesis Requirement.** If a thesis is required, it embodies the results of the student's research. 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 will be 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. A minimum of five copies must be printed. Three copies become the property of the University. An abstract of approximately 200 words is also required.

**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 such as statistics or computer programming. See each department's statement to see if there is such a requirement and, if so, how it may be satisfied.

**Ethics in Science Requirement for Biomedical Sciences (Bowman Gray Campus).** The successful completion of a program in scientific ethics is required prior to admission to degree candidacy. This requirement may be fulfilled by participating in the one-week (four-lecture hours) Ethics in Science program offered by the Graduate School or by satisfactory completion of one of several approved

departmental electives which incorporate extensive discussion of scientific ethics. The Graduate School non-credit program is offered at the outset of each fall semester, and participation in the program is noted on the official transcript. A list of approved departmental electives may be obtained from the Graduate School. MS students in other disciplines have the option of participating in this program.

*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 by one additional semester's work.

*Final Examination.* The examining committee for the thesis shall consist of at least three members of the graduate faculty. The committee shall be appointed by the dean of the Graduate School and may include one member from outside the student's department or program who represents the Graduate Council and who serves as chair of the committee. With the approval of his or her adviser, a student may recommend an external member to serve on the examining committee. The thesis adviser must justify the participation of an external expert who is not a member of the graduate faculty on the basis of research, publications and/or professional activities. If the external expert is to be a voting and signing member of the examining committee, the adviser must communicate to the dean of the Graduate School, in writing, the qualifications of the external expert. The examination covers the thesis and knowledge in related areas and is conducted at least ten days prior to graduation. A student may be reexamined only once.

## Requirements for the Master of Science Degree in Accountancy

The master of science degree in accountancy is offered by the Wayne Calloway School of Business and Accountancy on the Reynolda Campus. The degree program does not offer specialized concentrations or tracks. All students participate in intensive course and seminar work preparatory to careers in auditing, financial accounting, managerial accounting, and taxation.

*Residence Requirement.* A minimum of one academic year of full-time work in residence is required for the master of science degree in accountancy. In practice, most students require at least one summer session in addition to the academic year, and, depending on an individual's academic background, a full two years may be required to complete the degree.

*Course Requirements.* Students in the master of science in accountancy program are required to take a minimum of thirty semester hours of graduate credit. At least twelve of the thirty hours must be in courses numbered 700 or above. The remaining eighteen hours may be in either 600-level or 700-level courses. Credit is allowed for as many as six hours of graduate work transferred from institutions accredited by the American Assembly of Collegiate Schools of Business. For information on specific course requirements and sequencing, contact the Wayne Calloway School of Business and Accountancy.

*Degree Candidacy.* A student is admitted to degree candidacy by the dean of the Graduate School after recommendation by the dean of the Wayne Calloway School of Business and Accountancy.

## Requirements for the Doctor of Philosophy Degree

Programs of study leading to the doctor of philosophy degree are offered in biochemistry, biology, chemistry, cancer biology, medical engineering, molecular and cellular pathobiology, molecular genetics, molecular medicine, microbiology and immunology, neurobiology and anatomy, neuroscience, physics, 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.* Specific course requirements are not prescribed. Course work is arranged by the student's advisory committee with the approval of the departmental or program graduate committee to provide mastery of appropriate fields of concentration. The advisory committee is appointed by the chair of the department or the program director and consists of the student's adviser and two other members of the department or program. Teaching experience during the period of study is encouraged.

*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 such as statistics or computer programming and operation. See each department's statement to see if there is such a requirement and, if so, how it may be satisfied.

*Ethics in Science Requirement for Biomedical Sciences (Bowman Gray Campus).* The successful completion of a program in scientific ethics is required prior to the preliminary examination. This requirement may be fulfilled by participating in the one-week (four-lecture hours) Ethics in Science program offered by the Graduate School or by satisfactory completion of one of several approved departmental electives which incorporate extensive discussion of scientific ethics. The Graduate School non-credit program is offered at the outset of each fall semester, and participation in the program is noted on the official transcript. A list of approved departmental electives may be obtained from the Graduate School. PhD students in other disciplines have the option of participating in this program.

*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. 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 and must have satisfied any foreign language or special skills requirement.

*Dissertation.* Under the supervision of an advisory committee, the candidate prepares a dissertation embodying the results of investigative efforts in the field of concentration. A final copy of the dissertation must be submitted by the candidate 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 will be 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. Programs announcing the date of the examination should not be distributed by the candidate until it is determined by the chair of the examining committee that the dissertation is defensible and that the examination will take place as scheduled. A minimum of five copies of the dissertation must be printed. Three copies become the property of the University.

At the time the dissertation is submitted, an abstract of 350 words or less must be submitted in duplicate for publication in *Dissertation Abstracts International*. A nonrefundable dissertation fee of \$55 covers the cost of this service. Other agencies of publication are encouraged, but such publication does not remove the requirement for submission of the abstract to *Dissertation Abstracts International*.

*Final Examination.* The examining committee for the dissertation 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 or a faculty member chosen by the chair; the student's adviser; another member of the major department, a representative from a related area from within or outside the department and a member from outside the major department who represents the Graduate Council and who serves as chair of the committee. With the approval of his or her adviser, a student may recommend a faculty member from outside the department or program to serve on the examining committee. The dissertation adviser must justify the participation of external experts who are not members of the graduate faculty on the basis of research, publications and/or professional activities. If the external expert is to be a voting and signing member of the examining committee, the adviser must communicate to the dean of the Graduate School, in writing, the qualifications of the external expert. Other faculty members may attend the final examination and participate in the questioning. The examination covering the student's major field of concentration and the dissertation is held no later than ten days before graduation.

Two weeks prior to the final examination, the candidate must have prepared fifty copies of his or her doctoral program. A distribution list for the programs is available in the appropriate graduate office.

After the examination of the degree candidate, the chair shall ask each of the members of the examining committee whether the candidate has passed unconditionally, passed upon rectifying deficiencies, or failed.

*Unconditional Pass.* If all committee members agree that the student has passed unconditionally, there is consensus to pass the examination. The committee members shall sign the title sheet and the student shall be recommended for award of the degree.

*Pass Upon Rectifying Deficiencies.* If reservations are expressed by committee members, the chair of the committee shall ensure that the reservations are communicated to the student and the dean of 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. The committee members shall sign the title sheet, and the student shall be recommended for award of the degree.

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

## The MD/PhD Degree Program

In the past, the clinician scientist has provided an invaluable perspective for research related to human health and disease.

The clinician approaches biomedical problems with a different viewpoint from most researchers trained in classical PhD programs. The special value of this perspective is supported by the fact that, during the past decade, 62 percent of Nobel prizes in medicine and physiology were awarded to the MD or MD/PhD researchers. However, MDs, trained even in the most prestigious institutions, rarely have the depth of research training provided in the standard PhD academic program. In recent years the increasing pace of research, the need for knowledge of specific techniques, and the competition for research funds have made it progressively more difficult for MD clinicians to succeed in a research-intensive career.

The MD/PhD program is a combined effort of the Medical School and the Graduate School of Wake Forest University. In this integrated program, 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 and also gains rigorous training in a basic discipline, which provides the depth of knowledge of scientific logic and techniques to provide 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 will be seven years.

During the summer before entry into medical school, beginning on June 15, the students will attend an orientation program to introduce faculty and available research opportunities. An eight-week research rotation will be conducted with a selected

member of the participating graduate faculty. This (and subsequent, if needed) research rotation familiarizes the student with specific faculty and their fields of expertise; usually one of these faculty will be chosen as the student's graduate (PhD) adviser.

The first two academic years will be spent as a medical student. Phase I (7 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). Medicine as a Profession, Clinical Decision Making, and Epidemiology extend between both Phases I and II. 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.

During these years, for most of the graduate programs, the student will also attend a graduate seminar course which meets once per week and provides continuing in-depth introduction to the chosen graduate discipline, in addition to social and intellectual contact with the other graduate students and faculty.

If possible, the student will choose a graduate adviser by the end of Phase II. If necessary, the summer after Phase II may be used for another laboratory rotation, prior to choosing an advisor.

The third year will be spent taking advanced basic science courses and conducting research. The specific courses to be taken will depend on the graduate program.

The duration of the dissertation research may vary but typically will be

completed in years three-to-five years and, if needed, a portion of year six. The PhD dissertation will be completed and defended prior to returning to clinical studies.

During years six and seven, the student will complete 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 will be spent in other clinical experiences or may be used (during the fall of year six) for completion of graduate studies. This part of the schedule is tailored to the individual student with the approval of the graduate advisor, MD/PhD program director, and the associate deans for medical education and student services.

The MD and PhD degrees will be awarded simultaneously at the completion of all requirements for both degrees.

#### *Graduate Programs:*

The participating graduate programs are described in detail in the Bulletin of the Graduate School of Wake Forest University and include the following:

*Biochemistry*

*Biology*

*Cancer Biology*

*Chemistry*

*Medical Engineering*

*Microbiology and Immunology*

*Molecular and Cellular Pathobiology*

*Molecular Medicine*

*Molecular Genetics*

*Neurobiology and Anatomy*

*Neuroscience*

*Pharmacology*

*Physics*

*Physiology*

### *Mechanism of Application:*

Both the Medical School and the Graduate School will 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 Medical School receives AMCAS applications, students will be sent supplemental forms for application to the Medical School. The applicant should indicate interest in the combined MD/PhD program on the supplemental application. Applicants who indicate interest in the MD/PhD program on the supplemental application will be sent an application form to the program. The medical school 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 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 will be 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, the Medical School, and the Graduate School. A small percentage of applicants are then asked to visit the University for interviews from October through March.

### *For more information, contact:*

David A. Bass, MD, DPh  
Director, MD/PhD Graduate Program  
Wake Forest University  
School of Medicine  
Medical Center Boulevard  
Winston-Salem, NC 27157-1054

Phone: 336-716-2697

E-mail: dbass@wfubmc.edu

### **The PhD/MBA Degree Program**

There is a growing realization that graduate education must adapt to new economic and societal realities. With a significant proportion of new PhDs going to work in the private sector, graduate education should impart a broader range of skills to prepare students for a changing employment climate. At the same time, the PhD should retain the rigor of an original research experience that makes it a world model. The Wake Forest University Graduate School of Arts and Sciences, in conjunction with the Babcock Graduate School of Management, has initiated an innovative course of study leading to the PhD/MBA. The program is available through the Department of Neurobiology and Anatomy.

In addition to intensive doctoral training, the PhD/MBA program incorporates a 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 effectively initiate and operate their own research laboratories, and to interface more effectively with the private

sector. Graduates choosing a non-traditional career path will be prepared to exercise their research training in management-level 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. It is estimated that it will take students approximately six years to complete the joint program. The first year of the curriculum will provide students with a core base of knowledge in biomedical sciences that will include biochemistry, physiology, cellular and molecular biology, and neuroscience. At the same time students will begin to be exposed to issues related to research and design, career development, and journal clubs. Laboratory rotations will also occur in this first year. The students begin their dissertation research during the second year. At the end of the second year, and before beginning MBA course work, the student must take and pass a qualifying exam that will admit him/her to candidacy for the PhD. A student enrolling in the PhD/MBA program would have 5-6 semesters of evening MBA courses added to his/her graduate degree requirements. The PhD and MBA degrees will be awarded simultaneously at the completion of all requirements for both degrees.

*Application Process:*

Admissions will be 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. It should be indicated on the application that the student is applying to the combined program. In addition to the general requirements of the Graduate School of Arts and Sciences, the Babcock Graduate School of Management requires completion of the GMAT (General Management Aptitude Test). 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 candidates will complete a personal interview with individuals from the Department of Neurobiology and Anatomy, the Babcock School, and the PhD/MBA Program Committee. After the interview phase, the top candidates may be offered admission to the graduate school.

*For more information, contact:*

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or Carolanne Milligan, PhD  
PhD/MBA Program Directors  
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Anatomy  
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or [milligan@wfubmc.edu](mailto:milligan@wfubmc.edu)

# Courses of Instruction



Odd-numbered courses are normally taught in the fall and even-numbered courses in the spring. Exceptions are noted after the course descriptions. 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. Many entries show the name of the professor who teaches the course.

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.

## Accountancy

### *Reynolda Campus*

Terry A. Baker, Director of Graduate Program in Accountancy  
Professors John Dunkelberg, Dale R. Martin, Thomas C. Taylor,  
Ralph B. Tower, Jack E. Wilkerson Jr.  
Associate Professors S. Douglas Beets, Jonathan E. Duchac,  
Paul E. Juras, Page West  
Assistant Professors Debra Jessup, Patricia A. Lobingier,  
William Marcum, Yvonne Hinson

The Wayne Calloway School of Business and Accountancy offers a program leading to the master of science degree in accountancy. This program is designed to prepare students for careers in professional accounting and requires the completion of thirty hours of graduate credit, including a minimum of twelve hours in courses numbered at the 700-level or above. Students must have a passing grade in all course and seminar work and a B average or higher for graduation.

**621. Advanced Management Accounting.** (3) Advanced study of management accounting topics including strategic and operational decisions, behavioral issues related to budgeting, transfer pricing, performance measurement, and contemporary issues in accounting for management planning and control.

**631. Federal Taxation of Corporations, Estates, and Trusts.** (3) A review of federal taxation principles associated with the organization, operation, and dissolution of corporate partnership and tax-exempt organizations. Introduction to federal estate and gift taxes and to income taxation of trusts and estates. P—Admission to master of science in accountancy program.

**632. Advanced Topics in Taxation.** (4) A review of advanced tax topics including consolidated tax returns, international transactions, multistate corporate taxation, and family tax planning. P—Accounting 631.

**633. Tax Policy and Planning.** (1.5) An examination of current tax policy issues and the effects of taxes on investment alternatives. P—Business 237. *Hinson*

**Bus. 633. Investment Analysis.** (3) Study of investment alternatives, expected returns, and corresponding risks; valuation of stocks and bonds applying both fundamental and technical analysis; survey of past and current methods of stock selection techniques, including portfolio considerations. P—Business 231 or permission of instructor.

**Bus. 634. Multinational Financial Management.** (3) Analysis of the international aspects of managerial finance. Emphasis upon institutional factors influencing capital acquisition and allocation. P—Business 231 or permission of instructor.

**Bus. 635. Financial Institutions and Markets.** (1.5) A thorough examination of the role of financial intermediaries in a free market economy and the functions of the financial institutions within money and capital institutions. Topics include asset, liability, and capital management, the regulatory environment, and special topics. Special topics may include risk management techniques utilizing proprietary insurance to neutralize the effects of risk inherent in daily life: termination or suspension of earnings, liability exposures, and potential losses of real and personal property values. P—Business 231. *Marcum*

**Bus. 636. Financial Derivatives.** (1.5) Futures, options, and swaps are the three most important types of financial derivatives, and they are linked by a common pricing framework. This course emphasizes the use of these derivatives in risk management but includes speculative strategies that can be implemented with them. P—Business 231 or permission of instructor.

**Bus. 638. Financial Statement Analysis.** (2) A study of the techniques used to analyze and interpret the information in corporate financial statements. Emphasis is placed on 1) accounting methods used in the preparation of financial statements, (2) implications of

management's accounting choices for evaluation of corporate performance by creditors and investors, and (3) linkages among financial statement items. P—Business 232 or permission of instructor.

**651. Accounting Information Systems.** (1.5) A study of the design and operation of accounting systems including the revenue, expenditure, and administrative transaction cycles. Emphasis is placed upon the necessary controls for reliable data.

**652. Introduction to Auditing.** (4) An examination of basic auditing concepts and practices, and the auditor's professional responsibilities. Emphasis is placed upon auditing standards and the auditing procedures commonly used in public accounting.

C—Accounting 651. P—At least a C in Accounting 212; admission to master of science in accountancy program.

**Bus. 671. Strategic Management.** (4) This course focuses on the derivation of competitive advantage by organizations. The course emphasizes the activities of general managers who are responsible for the shape, character, and direction of the total enterprise. Course content includes analyzing the effects of industry and competitive environments on the firm, determining the basis upon which organizations compete, formulating and implementing integrative strategic action plans which enhance competitive performance, and strategic leadership. Emphasis is placed on applying principles of competitive analysis and strategic planning to case studies of domestic and international business situations, and in the use of computer simulations. P—Business 211, 221, 231, and 241.

**677, 678. Individualized Reading and Research.** (Credit to be arranged) Directed study in specialized areas of accountancy. P—Admission to master of science in accountancy program.

**690. Professional Accounting Internship.** (3) Professional accounting field work under the direction of a faculty member, in a public accounting firm, corporate enterprise, or not-for-profit organization. Students gain relevant practical experience which builds on prior course work and provides an experiential knowledge base for course work in the fifth year. P—Admission to master of science in accountancy program.

**714. Seminar in Financial Reporting.** (4) An examination of a variety of financial reporting topics, including revenue recognition, income taxes, pensions and postretirement benefits, leases, accounting changes and error analysis, interim and segment reporting, and the statement of cash flows. P—At least a C in Accounting 212.



**715. Financial Accounting Research and Analysis.** (4) An examination of contemporary financial accounting and reporting issues using a case approach. Students are introduced to available research tools and databases, examine and analyze a number of cases, prepare written reports, and make oral presentations. Research and analysis are conducted individually and in small groups. P—Accounting 714.

**730. Tax Research Methods.** (1) A survey of the methods and resources used by tax practitioners in researching compliance and planning issues. P—Business 237 or permission of instructor.

**734. Estate and Gift Taxation.** (1.5) A review of taxation of gratuitous transfers under the federal estate and gift tax code and under state inheritance gift tax law. Analysis of tax planning and compliance issues. P—Business 237 or permission of instructor.

**754. Advanced Auditing and Assurance Services.** (4) A study of current issues, practices, and techniques related to auditing and assurance services. Students will utilize available research materials, databases, personal auditing experience, and practitioner sources to address relevant issues. Emphasis is placed upon analysis, teamwork, writing, and presentation skills. P—Admission to master of science in accountancy program, Accounting 652, or permission of instructor.

**Bus. 762. Business Law for Accountants.** (3) An introduction to law and a study of substantive law applicable to business transactions, including contracts, agency, property, the Uniform Commercial Code, and business organizations, with emphasis on areas with auditing and accounting implications.

**780. Accounting Research Methods and Resources.** (2) An introduction to research methods and resources used to investigate issues and problems arising in a professional accounting environment. P—Admission to master of science in accountancy program.

**791. Professional Accountancy Colloquium.** (2) A seminar course that would reflect back on the internship experience and would examine current issues facing the accountancy profession. The course would allow students to share and discuss issues and problems faced during the internship and would utilize speakers and readings to stimulate discussion.

# Biochemistry

## *Bowman Gray Campus*

William H. Gmeiner, Chair

Professors Donald W. Bowden, H. Alexander Claiborne,  
Carol C. Cunningham, Larry W. Daniel, William H. Gmeiner,  
Mark O. Lively, Linda C. McPhail, Lawrence L. Rudel,  
Peter B. Smith, Michael J. Thomas, Robert L. Wykle  
Associate Professors Roy R. Hantgan, Charles S. Morrow,  
Fred W. Perrino, Leslie Poole, Alan J. Townsend  
Assistant Professors Zheng Cui, Derek Parsonage, Suzy V. Torti  
Instructors Shannon Bailey, Susan Sergeant  
Associates Richard A. Anderson, David A. Bass,  
Floyd Chilton, Jamal Ibdah, Gregory L. Kucera,  
Douglas S. Lyles, John S. Parks, Gregory S. Shelness,  
Mary G. Sorci-Thomas, Reidar Wallin, Kenneth T. Wheeler Jr.,  
Richard Weinberg, Mark Welker

The graduate training program of the Department of Biochemistry is designed to prepare students for careers of investigation and teaching in biochemistry and in related sciences that involve biochemical 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 are offered.

To provide a broad, firm basis for advanced work, the initial phase of the student's program generally includes the courses Metabolism and Bioenergetics, Intracellular Signaling, Molecular Biology, Proteins and Enzymes, Biochemical Techniques, Literature Seminar, Structural Biology, Introduction to Biochemical Research, and any courses needed to correct areas of deficiency. Specialization and depth are provided through pertinent advanced courses in biochemistry, including sections of special topics in biochemistry and selected courses in other departments. The student also participates in the department's program of research seminars.

Thesis research under the supervision of a faculty member may be pursued in various areas of biochemistry, including enzymology, NMR structure determination of macromolecules, membrane structure and function in excitable tissues, relation of lipid and protein metabolism and of protein-lipid association to membrane structure and function, immunochemistry of enzymes, biological oxidations and bioenergetics, molecular genetics and nucleic acid function, biophysics, biochemical pharmacology of anticancer agents, leukocyte metabolism and function, signal transductional 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 graduate program was begun in 1941, and the PhD degree has been offered since 1962.

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

**702, 703. Introduction to Biochemical Research.** (1-5) Conferences on biochemical literature, the planning and execution of research, and the interpretation and presentation of experimental results. To put these principles into practice, individualized laboratory projects are carried out under the supervision of staff members. *Daniel, Staff*

**705. Metabolism and Bioenergetics.** (3) Lectures and problem sessions that focus on the production and storage of metabolic energy within cells. Contemporary concepts concerning the organization and cellular regulation of metabolic pathways will also be presented. P—General and organic chemistry, general biology, and permission of instructor. Concurrent registration in or completion of BICM 713, Proteins and Enzymes, is strongly recommended. *Cunningham, Staff*

**706. Intracellular Signaling.** (2) 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 will provide in-depth coverage of each topic with emphasis on recent advances and current literature. P—705. *McPhail, Staff*

**707. Biochemical Techniques.** (2) Theory and application of selected important biochemical laboratory techniques. Lectures and problems. P—or C—691, 705, or equivalent exposure to biochemistry. *Poole, Staff*

**708. Structural Biology.** (3) An examination of the physical principles that enable a biomedical scientist to determine the structure and to study the interactions of macromolecules. Topics include mathematics of data reduction, molecular graphics, structural characterization techniques (electron microscopy, x-ray diffraction, nuclear magnetic resonance), hydrodynamic properties of macromolecules, optical and NMR spectroscopy. Application of these techniques to proteins, nucleic acids, and lipids will be presented in an integrated lecture, literature discussion, and problem-solving format. P—One semester of undergraduate physical chemistry, fundamentals of calculus. *Hantgan, Staff*

**709. Membrane Biology.** (3) Membrane biogenesis including (1) regulation of phospholipid, cholesterol, and prostaglandin metabolism; (2) lipid biophysics; (3) polypeptide insertion and post-translational processing of membrane proteins; analysis of membrane structure using biochemical and biophysical approaches; advanced topics on membrane transport and the role of the membrane in tissue bioenergetics. P—Biochemistry 705 or permission of instructor. Offered in even-numbered years. *Staff*

**712. Immunochemistry.** (2) Structures of antibodies and their synthesis, the structure of antigenic determinants, complement, qualitative and quantitative techniques. The course attempts to provide a working knowledge of immunochemistry as a basic research tool in

biochemistry and to introduce the student to the structural components of antibodies and antigens which make it possible to develop such a diverse repertoire of specific antibodies during the immune response. P—691, 705, or equivalent. Offered in even-numbered years. *Staff*

**713. Proteins and Enzymes.** (3) Examination of the basic physical and chemical principles underlying protein structure and enzyme mechanisms, with an emphasis on quantitative concepts. This material is followed by in-depth study of protein assembly and interactions, as well as the application of recombinant DNA technology to specific structural and mechanistic questions. P—Organic chemistry, physical chemistry is strongly recommended. *Claiborne, Hantgan, Poole*

**714. Instrumental Techniques.** (3) This course will present theory and technical aspects of instrumentation currently employed in the biological sciences. Experience will be 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 permission of instructor. It is highly recommended but not required that the student have a foundation in electronics equivalent to Physiology 791. Offered in odd-numbered years. *Thomas, Staff*

**715, 716. Special Topics in Biochemistry.** (1-9) An advanced conference course that considers various areas of current interest or rapid development. Topics currently covered are (a) biochemistry of excitable tissue, 1 hour (*Smith*); (b) membrane biology, 1 hour (*Staff*); (c) biochemical genetics, 1 hour (*Staff*); (d) bioactive lipids, 1 hour (*Daniel, Wykle*); (e) oxidative mechanisms, 1 hour (*Claiborne*); (f) bioenergetics, 1 hour (*Cunningham*) [(e) and (f) may be taken together]; (g) experimental cancer chemotherapy, 1 hour (*Townsend*); (h) mechanistic enzymology and kinetics, 1 hour (*Poole, Parsonage*). Additional topics will be developed depending on the interests of students and staff. P—705 or equivalent.

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

**721. Biochemistry of Inflammation.** (3) This course offers intensive study of the morphology, biochemistry, and functions of cells (neutrophils, platelets, monocytes/macrophages, eosinophils, basophils) and humoral factors (antibodies, complement, coagulation, arachidonate metabolites, etc.) involved in inflammation. For each topic, lectures will emphasize specific classic and recent research approaches. Offered in odd-numbered years. *Bass*

**731. Molecular Biology.** (1,3) A survey of the fundamentals of molecular biology. Included are fundamentals of microbial genetics and discussions of nucleic acid structure and mutagenesis, DNA replication and recombination, transcription and control of gene expression and protein translation (1 hr). The introduction is followed by an advanced

treatment of these topics, and discussions of mammalian genetics and immunogenetics with emphasis on current trends in research. P—BICM 705 or current enrollment in 705. *Perrino, Brewer, Staff*

**732. Molecular Biology.** (3) Detailed lectures and discussion surveying the analysis of cellular processes, oncology, atherosclerosis, and development by the experimental approaches of molecular biology. Emphasis is on eukaryotic systems and review of pertinent research literature. P—BICM 731. *Perrino, Brewer, Staff*

**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 will be placed on the search for genes which 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. P—Molecular Genetics/Biochemistry/Microbiology-Immunology 731 or permission of instructor. *Bowden*

## Biology

*Reynolda Campus*

Herman E. Eure, Chair  
Wake Forest Professors Gerald W. Esch, Raymond E. Kuhn  
Charles H. Babcock Chair of Botany William K. Smith  
Professors Carole L. Browne, Robert A. Browne,  
William E. Conner, James F. Curran, Ronald V. Dimock Jr.,  
Herman E. Eure, Hugo C. Lane, Wayne L. Silver, Peter D. Weigl  
Associate Professors David J. Anderson, Kathleen A. Kron, Gloria K. Muday  
Assistant Professors Miriam Ashley-Ross, Miles Silman,  
Brian W. Tague, Clifford Zeyl  
Visiting Assistant Professor A. Daniel Johnson  
Adjunct Professors J. Whitfield Gibbons, Terry C. Hazen  
Adjunct Assistant Professor Jennifer C. Waters Shuler

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 work 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 course work 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. Departmental graduate committee: R. Kuhn (chair), D. Anderson, K. Kron, C. Zeyl, and one graduate student.

## For Advanced Undergraduates and Graduate Students

**601-605. Topics in Biology.** (1-4) Seminar and/or lecture courses in selected topics, some involving laboratory instruction. *Staff*

**607. Biophysics.** (3) An 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 will be emphasized.

- 611. Genetics.** (3) A lecture course on the use of genetic analytical methods to establish the principles of inheritance and the mechanisms of gene function. Covered topics include mechanisms of genetic change, the genetics of development, and population genetics. P—Biology 112, 113, and 214. *Curran, Zeyl*
- 612. Genetics.** (4) A lecture and lab course on the use of genetic analytical methods to establish the principles of inheritance and the mechanisms of gene function. Covered topics include mechanisms of genetic change, the genetics of development, and population genetics. The lab will include projects involving classical and current techniques of genetic investigation. Labs—3 hours. P—Biology 112, 113, and 214. *Curran, Zeyl*
- 614. Evolution.** (3) Analysis of the theories, evidences, and mechanisms of evolution. *Eure*
- 615. Population Genetics.** (4) A 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. The lectures will present both an introduction to theoretical studies and discussion of molecular and phenotypic variation in natural populations. *Zeyl*
- 620. Comparative Anatomy.** (4) A study of the vertebrate body from an evolutionary, functional, and developmental perspective. Labs emphasize structure and function, primarily through the dissection of representative vertebrates. *Ashley-Ross*
- 621. Parasitology.** (4) A survey of protozoan, helminth, and arthropod parasites from the standpoint of morphology, taxonomy, life histories, and host/parasite relationships. *Esch, Eure*
- 622. Biomechanics.** (4) An 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. *Ashley-Ross*
- 623. Animal Behavior.** (4) A survey of laboratory and field research on animal behavior.
- 626. Microbiology.** (4) The structure, function, and taxonomy of microorganisms with emphasis on the bacteria. Covered special topics include microbial ecology, industrial microbiology, and medical microbiology. The lab emphasizes microbial diversity through characterizations of isolates from nature. *Curran*
- 631. Invertebrates.** (4) Systematic study of invertebrates, with emphasis on functional morphology, behavior, ecology, and phylogeny. *Dimock*
- 633. Vertebrates.** (4) Systematic study of vertebrates, with emphasis on evolution, physiology, behavior, and ecology. Laboratory devoted to systematic, field, and experimental studies. *Weigl*

**635. Insect Biology.** (4) A study of the diversity, structure, development, physiology, behavior, and ecology of insects. *Conner*

**638. Plant Systematics.** (4) A 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. *Kron*

**639. Principles of Biosystematics.** (4) An 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. *Kron*

**640. Ecology.** (4) Interrelationships among living systems and their environments. Structure and dynamics of major ecosystem types. Contemporary problems in ecology. *Weigl*

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

**642. Aquatic Ecology.** (4) A course 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 C. M. Allen Biological Station. *R. Browne, Esch*

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

**647. Physiological Plant Ecology.** (3-4) A course designed to provide a fundamental understanding of how different plants have adapted to the stresses of their respective habitats. Limitations to growth and reproduction due to inadequate sunlight, temperature, water, and soil nutrients will be addressed. Much of this information comes from studies in harsh or extreme environments such as deserts, the alpine, the arctic tundra, and tropical forest. The course provides a background for understanding mechanisms of evolution, as well as future impacts of global change (elevated CO<sub>2</sub> and global warming) on plant ecology. *Smith*

**648. Physiological Plant Ecology Lab.** (1) A weekly, three-hour lab designed to introduce students to the broad array of portable field instrumentation now available in this research area. Instruments for measuring photosynthesis, respiration, water relations, and plant microclimate at remote field locations (e.g. mountaintops) will be emphasized. Gas exchange and micrometeorological instrumentation, data logging and analysis, and natural (stable) isotope analysis will be included. *Smith*



**651. Vertebrate Physiology.** (4) A lecture and laboratory course which discusses and demonstrates the principles of bioelectricity and biomechanics. Regulatory principles and the physiology of the cardiovascular, respiratory, and renal systems of vertebrates are covered. *Lane*

**654. Endocrinology.** (3) A lecture course which explores the evolution of hormones and endocrine glands, and the physiology of the main hormonal pathways of vertebrates. *Lane*

**655. Avian Biology.** (4) A lecture and laboratory course emphasizing ecological and evolutionary influences on the physiology, behavior, and population biology of birds. Includes taxonomy of the world's major bird groups. *Anderson*

**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. *C. Browne*

**662. Immunology.** (3) A study of the components and protective mechanisms of the immune system. *Kuhn*

**663. Sensory Biology.** (3) A lecture course which 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. *Silver*

**664. Sensory Biology.** (4) A lecture and laboratory course which 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. *Silver*

**665. Biology of the Cell.** (4) A lecture and laboratory course on recent advances in cell biology. Lectures will 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 laboratory will introduce basic techniques in cell biology and lead to an independent project. *Tague*

**666. Human Evolution.** (3) Investigation of primate and human evolution, both in anatomy and in behavior. P—Permission of instructor. *Weaver*

**670. Biochemistry.** (3) A lecture course introducing the principles of biochemistry, with an emphasis on the experimental approaches which elucidated these principles. Major topics

will include structure, function, and biosynthesis of biological molecules, analysis of enzyme function and activity, and regulation of metabolic pathways. *Muday*

**671. Biochemistry Laboratory.** (1) A laboratory course introducing the principles of biochemistry, with an emphasis on approaches to isolation and analysis of both proteins and nucleic acids. Lab—three hours. P— or C—Biology 670. *Muday*

**672. Molecular Biology.** (4) An analysis of the molecular mechanisms by which stored information directs cellular development. Emphasis will be placed on storage and transmission of genetic information, regulation of gene expression, and the role of these processes in development. The laboratory will focus on modern techniques of recombinant DNA analysis. *Muday*

**673. Techniques in Electron Microscopy.** (4) An introduction to the electron microscope as an experimental tool in biology. Includes instruction in common techniques used in the field and lecture on recognition and interpretation of cellular ultrastructure. *C. Browne, Waters Shuler*

**676. Ichthyology.** (4) A comparative study of the structure/function, classification, and phylogeny of fish. *Eure*

**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. Lab includes local field trips and discussion of primary literature. Several weekend field trips. *Silman*

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

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

**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. P—Permission of instructor. *Staff*

**697. Seminar in Biology.** (3) Consideration of major biological topics through intensive reading and discussions. *Staff*

## For Graduate Students

**701-708. Topics in Biology.** (1-4) Seminar courses in selected topics, some involving laboratory instruction. At least one offered each semester. *Staff*

**711, 712. Directed Study in Biology.** (1,1) Reading and/or laboratory problems carried out under and by permission of a faculty member. *Staff*

**715. Foundations of Physiology.** (1-4) A course covering classical and current topics and techniques in comparative physiology. Format will vary from seminar to a full laboratory course. *Staff*

**725. Experimental Plant Science.** (1,2) A graduate course in plant science that meets twice weekly in a seminar format. Both classical and current topics in plant biology will be covered. *Kron, Muday, Smith, Tague*

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

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

**737. Molecular Techniques in Evolution and Systematics.** (4) Lectures will focus on molecular approaches to solving evolutionary and systematic problems. Laboratories will focus on molecular techniques, including allozyme electrophoresis, mitochondrial, plastid, and nuclear DNA restriction fragment length polymorphism analyses, gene amplification, direct and/or cycle sequencing, and randomly amplified polymorphic DNAs. *R. Browne, Kron*

**740. Physiological Ecology.** (4) Intensive study of the sensitivity and behavioral responses of organisms to environmental cues. *Dimock*

**744. Ecological and Evolutionary Genetics.** (3) Principles of genetics in the context of ecological and evolutionary studies, including micro- and macro-evolutionary processes. *R. Browne*

**757. Techniques in Mathematical Biology.** (3) This course seeks to give 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 will be taught and refreshed, but knowledge of basic calculus is required. *Silman, Anderson, Baxley*

**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. Laboratory experiments introduce students to basic methods in immunological research. *Kuhn*

**763. Cellular and Molecular Interactions Between Hosts and Parasites.** (3) The course will examine the responses of animal hosts in attempting to immunologically and non-immunologically reject/control both endo- and ectoparasites and responses of these parasites to the host environment. The course will consist of lectures and student presentations and require a comprehensive review article by students. *Kuhn*

**764. Sensory Biology.** (4) A lecture and laboratory 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 laboratory project implementing the scientific method and designed to produce new knowledge is required. *Silver*

**775. Microscopy for the Biological Sciences.** (4) An introduction to the use of transmitted, fluorescence, and confocal light microscopy, and electron microscopy, in the biological sciences. Lecture topics will include applications of the various types of microscopy, imaging components in the microscopes, theory of image formation, contrast generation using differential interference (DIC) and Phase light microscopy and the use of fluorophores in light microscopy. Hands-on laboratories will teach students the proper use and care of microscopes, image processors, and cameras. Students will learn methods of recording and presenting images, with an emphasis on video and digital cameras, image processing software, and options for printing and storing digital images. Students conducting independent research will be encouraged to bring their own samples for analysis. *C. Browne, Waters Shuler*

**777. Biophysical Ecology.** (4) A course 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, will be 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. *Smith*

**782. Behavioral Ecology.** (3) A 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. *Anderson*

**791, 792. Thesis Research.** (1-9) *Staff*

**793. Summer Research.** This is a course for summer research by continuing graduate students working with their adviser. *Staff*

**891, 892. Dissertation Research.** (Hours open) *Staff*

## Cancer Biology

*Bowman Gray Campus*

Frank M. Torti, Chair  
Professors Steven A. Akman, Arthur Frankel, Frank M. Torti  
Associate Professor Mark S. Miller, Vijayasaradhi (Vijay) Setaluri,  
Gary Schwartz, Andrew Thorburn  
Assistant Professors Scott D. Cramer, Jennifer Hu,  
Costas Koumenis, G.L. Prasad, James Vaughn,  
Research Assistant Professor Yoshiaki Tsuji

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. The graduate program was begun in 1997.

**701. Carcinogens, DNA Damage and Repair.** (3) This course will cover the identification and reaction mechanisms of environmental carcinogens, DNA damage and mutagenesis by endogenous and exogenous mechanisms, and nucleotide excision repair, base excision repair, and mismatch repair. P—Undergraduate courses in organic chemistry and biochemistry. *Miller*

**703. Molecular Pathogenesis of Cancer.** (2) This course will review the discovery, biochemistry, and function of oncogenes and tumor suppressor genes, signal transduction pathways, and regulators of the cell cycle, including cyclins, cyclin-dependent kinases and inhibitors. Both normal function and dysfunction relating to cancer will be covered. P—Familiarity with basic biochemistry, molecular biology, and cell biology. *Tsuji*

**704. Cell Biology of Breast and Prostate Cancer.** (3) The focus of this course will be on breast and prostate cancer, two of the most prevalent carcinomas. The course will cover hormones and cancer, the role of growth factors and receptors, regulation of growth and differentiation, epithelial-stromal interactions, and mechanisms of invasion and metastasis. Students will be required to give an oral presentation in one of the above areas and write a comprehensive review. P—Undergraduate biochemistry and Cancer Biology 703. *Cramer*

**707. Topics in Cancer.** (1) A weekly lecture series. Each week throughout the fall and spring semesters, a different topic in the clinical presentation, course, and treatment of

human malignancies is presented. This course is designed to be a comprehensive overview of clinical oncology for clinical medical and radiation oncology fellows and cancer biology graduate students. *Akman, Staff*

**708. Molecular Targets of Cancer Therapy.** (3) This course will cover basic principles and recent advances in cancer chemotherapy, tumor immunology, and cancer gene therapy. *Vaughn, Setaluri*

**711. Advanced Topics in Cancer Biology.** (1) This course 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 will lead a discussion of key experimental findings. Broad participation from faculty, postdoctoral fellows, and graduate students is encouraged. *Miller, Staff*

**724, 725. Research in Cancer Biology.** The cancer biology department offers opportunities for investigation in a variety of the facets of cancer biology under the guidance of staff members. *Staff*

## Chemistry

*Reynolda Campus*

Bradley T. Jones, Chair

Wake Forest Professors Roger A. Hegstrom,

Willie L. Hinze, Mark E. Welker

Professors Dilip K. Kondepudi, Gordon A. Melson,

Ronald E. Noftle, Robert L. Swofford

Associate Professors Bradley T. Jones, Abdessadek Lachgar

Assistant Professors Ulrich Bierbach, Christa L. Colyer,

Steven C. Haefner, S. Bruce King, Richard A. Manderville

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, inorganic, organic, and physical chemistry. Research plays a major role in the graduate program. Since the number of graduate students is not large, 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, 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, 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 course work 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 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. Departmental graduate committee: Kondepudi (chair), Colyer, Haefner, King, Lachgar, Manderville, Hegstrom.

## For Advanced Undergraduates and Graduate Students

**\*623. Organic Analysis.** (4) The systematic identification of organic compounds. P—Chemistry 222.

**\*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—641.

**\*641, 642, 644. Physical Chemistry.** (3 or 4) Fundamentals of physical chemistry. P—Mathematics 112. C—Physics 113-114.

**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 will vary. Seven week courses. P—CHM 642 or 644, 661, or permission of instructor.

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

**681, 682. Chemistry Seminar.** Discussions of contemporary research. Attendance required of all graduate students and all chemistry majors. No credit.

For Graduate Students

**701. Mathematical Methods in Physical Chemistry.** (3) A survey of mathematical methods used in classical and statistical thermodynamics, kinetics, and quantum chemistry. *Staff*

**711, 712. Directed Study in Chemistry.** (1 or 2, 1 or 2) Reading and/or laboratory problems carried out under supervision of a faculty member. P—Permission of graduate committee. *Staff*

**721. Advanced Organic Chemistry.** (3) An accelerated survey of organic reactions and mechanisms. *King, Manderville, Welker*

**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 organometallic chemistry and organometallic reaction mechanisms. Uses of transition-metal complexes in organic synthesis. *Welker*

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

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

**734. Advanced Analytical Chemistry.** (3) Principles and practical applications of analytical methods, with particular emphasis on modern spectral methods, electroanalytical methods, and chemical separations. *Hinze, Jones, Colyer*

**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. *Hinze, Jones, Colyer*

**737. Electrochemical Processes.** (3) Principles of electrochemical methods, ionic solutions, and electrochemical kinetics. *Colyer, Hinze, Jones, Nofhle*

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

*\*Departmental graduate committee approval required.*



- 746. Chemical Kinetics.** (3) Kinetics and mechanisms of chemical reactions; theories of reaction rates. *Swofford, Kondepudi*
- 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. *Kondepudi*
- 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. *Noftle*
- 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. *Bierbach, Haefner, Melson*
- 763. Solid State Chemistry and Its Application.** (3) Principles of solid state chemistry. Applications to the design and synthesis of new materials with important technological applications such as superconductors, superacids, ion exchangers, semiconductors and ferromagnets. *Lachgar*
- 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. *Bierbach, Haefner, Lachgar, Noftle*
- 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. *Bierbach*
- 771. Quantum Chemistry.** (3) The quantum theory and its application to the structure, properties, and interactions of atoms and molecules. P—344 or its equivalent. *Hegstrom*
- 791, 792. Thesis Research.** (1-3, 1-3) *Staff*
- 793. Summer Research.** *Staff*
- 829. Tutorial in Organic Chemistry.** (3) *King, Manderville, Welker*
- 830. Heterocyclic Chemistry.** (3) A survey of the major groups of heterocyclic compounds. Modern applications of heterocycles. *King*
- 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. *Welker*
- 833. Advanced Reaction Mechanisms.** (3) Detailed analysis of mechanisms with emphasis on characterization of transition state structure. *Manderville*
- 834. Chemical Equilibria and Related Topics.** (3) Theory of electrolytic solution equilibria as applied to chemical analysis and review of statistical treatment of data. *Hinze*
- 838A. Advances in Analytical Chemistry—Thermal Analysis.** (2 or 3) Theory, principles, and selected applications of thermal methods of analysis, including thermogravimetry, thermometric titrations, and differential scanning calorimetry. *Hinze*
- 838B. Advances in Analytical Chemistry—Physical Methods of Measurements.** (2 or 3) Theory, principles, and analytical applications of selected physical measurements, including determination of molecular weight distributions and reaction rate methods in chemical analysis. *Hinze*
- 838C. Advances in Analytical Chemistry—Lasers in Chemistry.** (2 or 3) Introduction and investigation of the link between chemistry and lasers. Topics will include modes of laser operation, laser-based probes, and laser-induced chemical change. *Jones, Swofford*
- 838D. Advances in Analytical Chemistry—Luminescence Spectroscopy.** (2 or 3) Instrumentation, methods, and applications of molecular luminescence spectroscopy. *Hinze, Jones, Swofford*
- 839. Tutorial in Analytical Chemistry.** (2 or 3) *Colyer, Hinze, Jones*
- 843. Tutorial in Advanced Kinetics.** (3)
- 844. Tutorial in Thermodynamics/Statistical Mechanics.** (3) *Kondepudi*
- 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. *Swofford*
- 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. *Kondepudi, Hegstrom*
- 861. Analytical and Inorganic Applications of Electrochemistry.** (3) Principles and practice of electrochemistry. Applications to the identification and quantification of chemical compounds and the determination of reaction mechanisms. *Jones, Nofhle*

**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. *Bierbach, Haefner, Melson*

**863. Crystallography.** (3) Crystal structure determination using powder and single crystal x-ray diffraction. *Haefner, Lachgar*

**869. Tutorial in Inorganic Chemistry.** (3) *Bierbach, Haefner, Nofle, Lachgar*

**879. Tutorial in Theoretical Chemistry.** (3) *Hegstrom*

**891, 892. Dissertation Research.** (Hours open) *Staff*

## Clinical Epidemiology and Health Services Research

*Bowman Gray Campus*

Gregory L. Burke, Chair  
Professors David G. Altman, Gregory L. Burke,  
Robert P. Byington, John R. Crouse III, Mark A. Hall,  
Charles F. Longino Jr., Robert L. Michielutte,  
Timothy M. Morgan, Stephen S. Rich, Sally A. Shumaker  
Associate Professors Roger T. Anderson, Douglas L.  
Case, Ralph B. D'agostino Jr., Cam E. Enarson,  
David C. Goff, David M. Herrington, Claudine  
Legault, Douglas W. Levine, Michael E. Miller,  
Michelle J. Naughton, Sara A. Quandt, Electra D.  
Paskett, Stephen Rapp, David M. Reboussin, Mary  
Ann Sevick, Lynne E. Wagenknecht, Mark Wolfson  
Assistant Professors Ronny A. Bell, Elizabeth Dugan,  
Gregory W. Evans, Sharon A. Jackson,  
Beth A. Reboussin, Beiyao Zheng  
Adjunct Faculty Gerardo Heiss, Bradley Wells

The master of science degree in clinical epidemiology and health services research is administered through the Department of Public Health Sciences. This program is open to individuals with advanced degrees, such as the MD, DVM, ScD, PhD or DDS, who are seeking training in clinical and outcomes research.

The program is also appropriate for qualified applicants with at least a B.A. or B.S. in a social science, public health, or other health-related area. Previous experience in a health-related field is highly desirable.

The graduate program is built on the foundations of epidemiology, biostatistics, and health services research. Course work exposes students sequentially to the principal steps

in the process of scientific investigation. The combination of epidemiology and health services research provides students with a comprehensive overview of health care states from their etiology through the provision of health care services. Specifically, the objectives of the program are to: 1) provide students with training in conceptual/theoretical frameworks, research methodologies, and statistical methods essential to the design and conduct of clinical and health services research; and 2) provide training in the measurement of health outcomes, such as morbidity and mortality, health-related quality of life, medical treatment or intervention effectiveness, health services utilization, and health economics. In addition to course work, all students complete a thesis project under the direction of a thesis committee. Students may initiate original data collection or analyze existing data sets.

All applicants must provide GRE or MCAT scores. For an applicant already affiliated with Wake Forest University as faculty, staff, or student, a letter of recommendation from the chair and/or faculty adviser of the applicant's major department is required.

While a minimum of twelve months of full-time work or its equivalent in residence is required for the master's degree, this program will normally require two years. It is feasible to extend the program from two to three years. Part-time status is not acceptable at this time. Students may matriculate only at the beginning of the fall semester each year.

The master of science degree in clinical epidemiology and health services research was initiated in the fall of 2000. It is one of a small number of similarly structured master's degree programs in the United States, placing it on the cutting edge of graduate education.

**710. Introduction to Health Services Research and the Health Care System.** (3) This course will provide an introduction to health services research and an overview of the changing health care delivery system in both the public and private sectors. Students will be provided with information about the organization and delivery of health care services in the United States, international systems of health care, and health care reform, including health care policies enacted to promote the health of the public. P—Permission of instructor. *Staff*

**711. Health Economics.** (3) This course is intended to provide an understanding of how economic theory and analysis are applied to health care in the United States. Students will review microeconomic theory and the empirical health economics literature. The role of health policy and the various economic incentives that operate in the health care environment will be reviewed. Students will also gain basic skills in cost-benefit and cost-effectiveness analysis. P—Permission of instructor. *Staff*

**712. Medical Outcomes.** (3) This course will introduce students to theory and methodologies used to evaluate the impact and effectiveness of health care interventions. The emphasis will be placed on how to assess a range of health outcomes including: morbidity and mortality, adverse effects, quality of care, health services utilization, health-related quality of life, patient satisfaction, and psychometric considerations in the use of outcomes instruments. P—Permission of instructor. *Staff*

**720. Introduction to Epidemiology.** (3) The course is an introduction to the history, basic concepts, and methods of epidemiology. Topics include measurement of disease prevalence, incidence, effect, and sensitivity/specificity analyses. The following study designs are reviewed: prospective, case-comparison, cross-sectional, and clinical trials. P—Permission of instructor. *Staff*

**721. Epidemiology Laboratory.** (1) This course accompanies CEHS 701, providing a structured learning environment for the completion of laboratory projects that complement the basic material of CEHS 720. Projects include a review of the pertinent literature related to the distribution and determinants of diseases in human populations. Others involve calculations of rates and proportions, effect size, and measures of association. P—Student must be enrolled in CEHS 720 in concurrent semester, or permission of instructor. *Staff*

**722. Advanced Epidemiology and Clinical Trials.** (3) The course builds on CEHS 720 and addresses specialized topics such as bias, confounding, effect modification, and dose response. The course also focuses on clinical trials methodology, including study design, inclusion/exclusion and screening issues, interventions, recruitment, retention and compliance, masking, trial organization and execution, data collection and quality control, ethical issues and trial monitoring, meta-analyses, and the impact of clinical trials on medical practice. P—CEHS 720 and 721 or permission of instructor. *Staff*

**723. Advanced Epidemiology and Clinical Trials Laboratory.** (1) The course accompanies CEHS 722. Students will complete laboratory projects on topics covered in CEHS 722, including confounding, dose response, and methodological issues related to the conduct of clinical trials. P—Students must be enrolled in CEHS 722 in the concurrent semester, or permission of instructor. *Staff*

**730. Introduction to Statistics.** (3) The course is an introduction to statistical concepts and basic methodologies that are prevalent in biomedical literature. It includes discussion of such topics as descriptive statistics, probability, sampling distributions, hypothesis testing, simple linear regression, correlation, one-way analysis of variance, categorical data analysis, and nonparametric methods. P—Permission of instructor. *Staff*

**731. Biomedical Research Computing.** (2) The course provides an introduction to statistical programming, including data input, data set creation, mathematical algorithms, and procedures for analysis. This course is taught in a computer laboratory where course topics are demonstrated and explored using a variety of research computing software tools, including SAS. P—Working knowledge of the basic operations of a personal computer or permission of instructor. *Staff*

**732. Applied Linear Models.** (3) The topics of the course include simple and multiple linear regression, experimental design, analysis of variance and covariance, and repeated measures analysis. Emphasis is given to proper application and interpretation of statistical methods and results. P—CEHS 730 or permission of instructor. *Staff*

**733. Applied Linear Models Laboratory.** (1) This course accompanies CEHS 732. Students will complete short exercises and statistical computing assignments using the analytic methods taught in Applied Linear Models. Focus will be on building skills in using software packages for data analysis and in the appropriate interpretation of results. P—Student must be enrolled in CEHS 732 in concurrent semester or permission of instructor. *Staff*

**734. Applied Statistical Methods.** (3) This course will provide students with advanced knowledge of statistical techniques to analyze health outcomes data. Topics to be covered include categorical data and survival analysis with detailed overviews of logistic regression and Cox's proportional hazards regression. Selected topics of special interest to the students will also be covered. Emphasis is given to proper application and interpretation of statistical methods and results. P—CEHS 730 and 732 or permission of instructor. *Staff*

**740. Research Design and Methodology.** (4) This course will provide students with detailed knowledge of research design methodologies commonly used in health research. Topics to be covered include ethical issues in research, true and quasi-experimental designs, community trials, evaluation research, surveys, sampling, data collection, instrument design, recruitment, retention, and protocol adherence. P—Permission of instructor. *Staff*

**741. Research Grant Preparation.** (3) This course is designed to provide students with the knowledge and skills to develop grant proposals to pursue funding in their areas of interest. Topics covered in the course are: the role of external funding in biomedical research; how to identify public and private sources of funding; required components in any type of grant submission; and human subjects and budgeting considerations. During the course, students will develop a research proposal for peer review and critical discussion. P—Permission of instructor. *Staff*

**750. Thesis Research.** (1-6)

**760. Health Services Research Project.** (1-3) Students will undertake a health services research project under the sponsorship of a faculty member. Requirements include attending research seminars and presenting an oral final report. P—Permission of instructor. *Staff*

**761. Topics in Epidemiology.** (1-3) This course concentrates on various content areas of epidemiology, including cardiovascular disease, cerebrovascular disease, diabetes, cancer and cancer control, and renal disease, among others. P—Permission of instructor. *Staff*

**762. Topics in Analysis.** (1-3) In this course, students report on and discuss advanced statistical issues and procedures in biomedical journals and texts. Topics will be chosen to provide both a broad overview of current statistical analyses and to pertain specifically to students' research interests. P—Permission of instructor. *Staff*

**763. Topics in Public Health Sciences.** (1-3) This course includes a wide range of topics, including the design of field and community studies, behavioral and social factors in health, quality of life issues, health policy and analysis, and health services research, among others. P—Permission of instructor. *Staff*

**764. Topics in Health Services Research.** (1-3) This course addresses varied topics in health services research which are not studied in required courses, or which further the investigation of topic areas begun in required course work.

## Communication

*Reynolda Campus*

Michael David Hazen, Chair  
Professor Michael J. Hyde, University Professor of Communication Ethics  
Professors Michael David Hazen, Jill Jordan McMillan  
Associate Professors John Llewellyn, Allan Loudon, Ananda Mitra,  
Randall G. Rogan, Margaret D. Zulick  
Assistant Professors Mary Dalton, Betty La France, Eric Watts

The Department of Communication offers graduate study leading to the MA degree. The minimum requirement is thirty semester hours of work, six of which are allotted for the thesis.

The program requires a core of courses in general theories and research methodology and then allows students to take courses in context areas such as 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 six hours of thesis work and a minimum of twenty-four hours of coursework, of which six hours may be in electives outside the department.

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. Graduate courses taken to fulfill the research skill requirement may not count toward the required thirty hours for the MA.

Students who enroll for the master's degree are expected to have a strong undergraduate background in the discipline or in related areas. Teaching experience may be accepted in partial fulfillment of the background requirement. The student who has certain deficiencies in undergraduate training may be asked to complete undergraduate requirements at the University while studying for the degree.

Although it is possible to obtain the MA degree in one calendar year, most students find it advantageous to take two academic years to complete the program.

The program began in 1969. Departmental graduate committee: Rogan (director), Hazen, La France, Loudon, Zulick.

For Advanced Undergraduates and Graduate Students

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

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

**602. Argumentation Theory.** (3) An examination of argumentation theory and criticism; emphasis on both theoretical issues and social practices. Offered in alternate years. *Hazen, Zulick*

**603S. Directing the Forensics Program.** (1-3) A pragmatic study of the methods of directing high school and college forensics. Laboratory work in the High School Debate Workshop. Summer only. *Staff*

**604. Freedom of Speech.** (3) An examination of the philosophical and historical traditions, significant cases, and contemporary controversies concerning freedom of expression. Offered in alternate years. *Llewellyn, Zick*

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

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

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

**635. Survey of Organizational Communication.** (3) An overview of the role of communication in constituting and maintaining the pattern of activities that sustain the modern organization. *Llewellyn, McMillan*

**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. Offered in alternate years. *McMillan*

**637. Rhetoric of Institutions.** (3) A study of the communication practices of institutions as they seek to gain and maintain social legitimacy. Offered in alternate years. *Llewellyn*

**640. American Rhetorical Movements to 1900.** (3) Examines the interrelation of American rhetorical movements through the nineteenth century by reading and analyzing original speeches and documents, with emphasis on antislavery and women's rights. *Zulick*



- 641. American Rhetorical Movements since 1900.** (3) Examines the interrelation of American rhetorical movements in the twentieth century by reading and analyzing original speeches and documents. Among the movements addressed are labor, civil rights, student radicals, and women's liberation. *Watts, Zulick*
- 642. Political Communication.** (3) Study of electoral communication including candidate and media influences on campaign speeches, debates, and advertising. Offered in alternate years. *Louden*
- 645. Mass Communication Theory.** (3) Theoretical approaches to the role of communication in reaching mass audiences and its relationship to other levels of communication. *Mitra*
- 646. Film Theory and Criticism.** (3) A study of film aesthetics through an analysis of the work of selected filmmakers and film critics. P—Permission of instructor. *Dalton*
- 647. Film History to 1945.** (3) A survey of the developments of motion pictures to 1945. Includes lectures, readings, reports, and screenings. *Dalton*
- 648. Film History since 1945.** (3) A survey of the development of motion pictures from 1946 to present day. Includes lectures, readings, reports, and screenings. *Dalton*
- 649. Communication and Technology.** (3) An exploration of how communication technologies influence the social, political, and organizational practices of everyday life. *Mitra*
- 650. Intercultural Communication.** (3) An introduction to the study of communication phenomena between individuals and groups with different cultural backgrounds. Offered in alternate years. *Hazen, Mitra, Rogan*
- 651. Comparative Communication.** (1.5, 3) A comparison of communicative and rhetorical processes in the United States 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. *Hazen*
- 670. Special Topics.** (1-4) An examination of topics not covered in the regular curriculum. *Staff*
- 680. Great Teachers.** (3) An intensive study of the ideas of three noted scholars and teachers in the field of communication. Students will interact with each teacher during a two- or three-day visit to Wake Forest. *Staff*

## For Graduate Students

**720. Empirical Research Methods.** (3) An introduction to empirical research designs, research methodology, and computer-based statistical analyses used in empirical communication research. *La France, Mitra, Rogan*

**752. Contemporary Rhetorical and Communication Theory.** (3) An introduction to theory building in human communication and rhetoric, with a survey and evaluation of major contemporary groupings of theorists. Approaches studied are those which emphasize the symbol (George Herbert Mead and Kenneth Burke), human relations (Martin Buber), the media (Marshall McLuhan), and systems (Norbert Wiener). *Hazen*

**753. Seminar in Persuasion.** (3) A study of contemporary social science approaches to persuasion theory and research. Influence is examined with interpersonal, social, and mass media contexts. *La France, Louden*

**754. Rhetorical Criticism.** (3) The study of critical approaches to the role of rhetoric in contemporary society, with emphasis on methodology. *Llewellyn, McMillan, Watts, Zulick*

**763, 764. Proseminar in Communication.** (1,1) An introduction to graduate study in communication. *Rogan*

**773. Seminar in Interpersonal Communication.** (3) A study of recent research and theoretical developments in dyadic communication. Methodology examined includes conversational analysis, field, and experimental approaches. *La France, Rogan*

**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. *Llewellyn, McMillan*

**780. Special Seminar.** (1-3) The intensive study of selected topics in communication. Topics may be drawn from any theory or content area of communication, such as persuasion, organizational communication, or film. *Staff*

**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. *Staff*

**791, 792. Thesis Research.** (1-9) *Staff*

# Comparative Medicine

*Bowman Gray Campus, Friedberg Campus*

Pathology (Section on Comparative Medicine)

Richard W. St. Clair, Section Head

Professors Michael R. Adams, Bill C. Bullock,

Thomas B. Clarkson Jr., Jay R. Kaplan, John S. Parks,

Lawrence L. Rudel, Carol A. Shively,

Richard W. St. Clair, William D. Wagner

Associate Professors Paul A. Dawson, Iris J. Edwards,

Gregory S. Shelness, Mary Sorci-Thomas, Mary Lou Voytko,

Janice D. Wagner, Jeanne M. Wallace, J. Koudy Williams

Assistant Professors Robert Brommage, J. Mark Cline,

Randolph L. Geary, Cynthia J. Lees,

Thomas C. Register, Richard W. Young

Adjunct Associate Professor Stephen B. Manuck

Adjunct Assistant Professor Dondin Sajuthi, Scott A. Washburn

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).

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), lipoprotein metabolism, matrix and cell biology, behavioral biology and reproductive medicine, comparative pathology, and osteopathology.

There is an active interest in the biology and diseases of nonhuman primates. A colony of approximately 1,000 nonhuman primates of several species is maintained to provide ample material for students interested in nonhuman primate biology. A large colony of specially bred pigeons is maintained for atherosclerosis research. In addition, specialized colonies of rodents and other species also are used in Wake Forest University's biomedical research programs.

The MS degree has been offered since 1964.

**703. Diseases of Laboratory Animals.** (3) A course in which the 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 placed 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. P—DVM or MD degree or permission of instructor. Offered in odd-numbered years. *J.M. Wallace, Staff*

**704. Advance Topics in Cardiovascular Science.** (3) A comprehensive review (from the cell to clinical studies) of the cardiovascular research done at Wake Forest University School of Medicine. Topics include: hypertension, atherosclerosis, stroke, heart failure, women and heart disease. *Williams*

**706. Animal Models in Biomedical Research.** (5) 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. P—permission of instructor. Offered in even-numbered years. *J. Wagner, Staff*

**708. Medical Primatology.** (3) Acquaints the student with the biology, laboratory management, behavior, and diseases of the nonhuman primates of biomedical interest. Emphasis is placed on both: 1) the clinical manifestations, diagnosis, and management of diseases that are the principal causes of morbidity and mortality in laboratory primates; and 2) those aspects of social structure and colony management that contribute to susceptibility and resistance to such diseases. The course also considers issues relating to the psychological well-being of laboratory primates. P—Permission of instructor. Offered in even-numbered years. *Adams, Kaplan*

**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. *Staff*

**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. *Staff*

**713, 714. Research.** The department offers research in a variety of topics in comparative medicine, including research in preparation for the master's thesis and the doctoral dissertation. *Staff*

# Computer Science

*Reynolda Campus*

Jennifer J. Burg, Chair  
Reynolds Professor Robert J. Plemmons  
Associate Professors Jennifer J. Burg, Daniel Cañas,  
David J. John, Stan J. Thomas, Todd C. Torgersen  
Assistant Professors Yaorong Ge, Paul F. Hemler

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 either a terminal master's degree or preparation for PhD work at another institution.

## The Master of Science in Computer Science

In addition to the graduate school admission requirements, students entering the graduate program must have completed computer science course work in the areas of: 1) programming in a high-level language such as Pascal, C, or C++, 2) assembly language programming and basic computer organization, and 3) data structures. They must also have completed mathematics courses equivalent to: 1) two semesters of calculus, 2) discrete mathematics, 3) linear algebra, and 4) probability and statistics. In certain circumstances, students who have not fulfilled some admission requirements may be admitted conditioned upon their completing the required courses while in the program.

The requirements for the MS degree may be met in either of two ways depending upon whether or not a thesis is submitted. The courses Computer Science 601, 602, 701, 702 are identified as the core courses for the MS degree.

For the MS degree without thesis, thirty-three semester hours are required. The course work 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 Computer Science 791, 792.

The MS degree with thesis requires thirty semester hours including six hours of thesis research (Computer Science 791, 792). The course work must include the twelve-hour core. The remaining twelve hours are elected from computer science courses with at least six of these hours from 700-level courses.

With the approval of the graduate adviser, graduate courses may be taken in related areas to fulfill requirements; however, no more than six such hours may count for the thesis option.

This program began in 1991. Current information on the program and links to faculty interests can be accessed through <http://www.cs.wfu.edu/>.

## Computing Resources

The department supports UNIX-based workstations, file servers, and personal computers in a local area network, with high-speed access to the Internet. Access is also available to

University computing facilities, supercomputers at the North Carolina Supercomputing Center, and other specialized computing equipment.

### For Advanced Undergraduates and Graduate Students

**601. Software Engineering.** (3) The principles and methods for the specification, design, and validation of large software systems. Topics may include formal specification techniques, design techniques, programming methodology, program testing, proofs of program correctness, software reliability, and software management.

P—Computer Science 235.

**602. Operating Systems.** (3) The study of algorithms for sequencing, controlling, scheduling, and allocating computer resources. P—Computer Science 211 and Computer Science 235.

**620. Object-oriented and Visual Programming.** (3) A study of encapsulation, inheritance, polymorphism, aggregates, and code reuse in object-oriented programming, along with an introduction to visual and multimedia programming. P—Computer Science 277 or permission of instructor.

**623. Computer Graphics.** (3) A study of software and hardware techniques in computer graphics. Topics include line and polygon drawing, hidden line and surface techniques, transformations, and ray tracing. P—Computer Science 235 and Mathematics 121.

**626. Numerical Linear Algebra.** (3) Numerical methods for solving matrix and related problems in science and engineering. Topics will include systems of linear equations, least squares methods, and eigenvalue computations. Special emphasis given to parallel matrix computations. Beginning knowledge of a programming language such as Pascal, FORTRAN, or C is required. Credit not allowed for both Mathematics 626 and Computer Science 626. P—Mathematics 112 and Mathematics 121.

**630. Computer Communications.** (3) A study of the operation, design, and analytic modeling of computer communication and networking systems. P—Computer Science 211.

**655. Introduction to Numerical Methods.** (3) Numerical computations on modern computer architectures; floating point arithmetic and round-off error. Programming in a scientific/engineering language (C or FORTRAN). Algorithms and computer techniques for the solution of problems such as roots of functions, approximation, integration, systems of linear equations and least squares methods. Credit not allowed for both Mathematics 655 and Computer Science 655. P—Mathematics 112, Mathematics 121, and Computer Science 111.

**661. Selected Topics.** (1,2, or 3) Topics in computer science which are not studied in regular courses or which further examine topics begun in regular courses. P—Permission of instructor.

**672. Compilers.** (3) A study of techniques for compiling computer languages including scanning, parsing, translating, and generating code. P—Computer Science 211 and Computer Science 235.

**674. Database Management Systems.** (3) An introduction to large-scale database management systems. Topics include data independence, database models, query languages, security, integrity, and concurrency. P—Computer Science 235.

**679. Artificial Intelligence.** (3) An introduction to problems in artificial intelligence. Techniques of representation and heuristic search in areas such as problem solving, pattern recognition, theorem proving, and information processing. P—Computer Science 236.

**681. Individual Study.** (1 or 2) A course of independent study directed by a faculty adviser. By prearrangement.

### For Graduate Students

**701. 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.

**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.

**724. Image Processing.** (3) Basic techniques in image processing including image formation and corruption models, digitization, Fourier domain methods, enhancement, restoration, and tomographic reconstruction. P—Computer Science 701. *Ge, Hemler*

**725. Pattern Recognition.** (3) A study of statistical pattern recognition techniques and computer-based methods for decision making, including discriminant functions, feature extraction, and classification strategies. The emphasis will be on applications to medical image analysis. P—Permission of instructor. *Ge, Hemler*

**727. Computer Vision.** (3) Techniques for extracting features from images: optimal thresholding, 2D and 3D feature measurement, graph isomorphism and graph matching methods. P—Mathematics 113 and Computer Science 725. *Ge, Hemler*

**743. Topics in Operating Systems.** (3) Issues in operating system development; resource management, queuing theory, concurrent processing, and languages for operating system development. P—Computer Science 602. *Cañas*

**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 will be examined and a comparison made of various techniques for both unconstrained and constrained optimization problems. Credit not allowed for both Mathematics 753 and Computer Science 753. P—Mathematics 113 and Computer Science (or Mathematics) 655. *Plemmons*

**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. P—Mathematics 113 and either Computer Science 655 or Mathematics 655. *Baxley, Jiang, Plemmons, Robinson*

**755. Parallel Algorithms.** (3) This course gives 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 will be given access to a variety of machines. P—Computer Science 655. *John, Plemmons, Torgersen*

**772. Compiler Optimization.** (3) Design and implementation of optimizing compilers. Optimization techniques, parallelizing transforms, and comparative examples from the literature. P—Computer Science 672. *Torgersen*

**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. P—Mathematics 112 and Mathematics 121. *Thomas*

**779. Topics in Artificial Intelligence.** (3) Advanced topics in artificial intelligence. Individual projects will be assigned. P—Computer Science 679. *Burg, Thomas*

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

**791, 792. Thesis Research.** (1-9) *Staff*



# Education

## *Reynolda Campus*

Joseph O. Milner, Chair  
Wake Forest Professor Patricia M. Cunningham  
Professors John P. Anderson, Samuel T. Gladding, John H. Litcher,  
Joseph O. Milner, Linda N. Nielsen, Leonard P. Roberge  
Associate Professors Robert H. Evans, Donna A. Henderson,  
Leah P. McCoy, Mary Lynn Redmond, Loraine M. Stewart  
Assistant Professors Ann C. Cunningham, Debbie W. Newsome, Laura J. Veach  
Adjunct Assistant Professors Alan S. Cameron,  
Marianne A. Schubert, Elizabeth H. Taylor  
Instructors Johnne Armentrout, Pamela Karr

The Department of Education offers professional graduate programs in two areas: teacher education and counselor education. The goals and requirements for each of 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 fourteen months can earn the MA in education and both the A and G secondary teaching licenses.

### Teacher Education Program

*Graduate Secondary Teacher's License.* The MA in education degree is awarded to the candidate with a North Carolina Class A Teacher's License or its equivalent who successfully completes a minimum of thirty-three semester hours in professional education and in concentration courses in biology, chemistry, English, French, history, mathematics, physics, social science, or Spanish.

For the candidate who desires the degree in two teaching areas, the requirements in professional education are the same. The academic field of study is twenty-four or more semester hours, with at least twelve hours in each of the two teaching fields. All students are required to complete a research project. The thesis is optional.

*MAEd Fellows Program.* Assistantships and fellowships are offered to students who have earned the initial license to teach, have a record of strong teaching, and want to pursue graduate study. Students in this program help supervise student teachers who are seeking the initial license.

*Master of Arts.* Master of arts degree candidates in the academic areas who hold a Class A license may be recommended for a G license in teaching if an additional six semester

hours of education are taken in the Department of Education. Candidates should consult the Department of Education.

## Licensure Only Coursework

Students who wish to enroll in graduate courses to obtain or renew a license may seek admission through the certification officer of the Department of Education. The GRE is not required.

## Counselor Education Program

The master of arts in education degree in counseling is awarded to candidates who successfully complete a minimum of forty-eight 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 community counseling—in which they complete their internships and take courses which assure at least entry-level competence.

*School Counseling Program.* The School Counseling Program is designed to provide 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 twelfth grade. The course of study which leads to a license in school counseling in North Carolina (and through reciprocity agreements leads to licensure in most other states), is based on the requirements of the North Carolina State Board of Education, and is accredited by the National Council for Accreditation of Teacher Education, and the Council on Accreditation of Counseling and Related Educational Programs (CACREP).

*Community Counseling Program.* In the Community Counseling 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.

*Admission to the Program.* Admissions decisions are based on consideration of a combination of criteria: college grade-point average, Graduate Record Examination scores, recommendations, professional commitment, work experience, and suitability for the profession. Qualified applicants for admission are required to have a personal interview with program faculty.

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 North Carolina Licensed Professional Counselor exam and for the National Certified Counselor exam. Those who complete the School Counseling Program are eligible to apply for licensure with the Public Schools of North Carolina.

## For Advanced Undergraduates and Graduate Students

**601. Microcomputer and Audiovisual Literacy.** (3) An 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. *Evans*

**602. Production of Instructional Materials.** (3) Methods of producing instructional materials and other technological techniques. P—Education 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. Theories of Education.** (3) Contemporary proposals for educational theory and practice studies in the context of social issues.

**605. The Sociology of Education.** (3) A study of contemporary educational institutions. This course examines such issues as school desegregation, schooling and social mobility, gender equity, and multiculturalism.

**606. Studies in the History and Philosophy of Education.** (3) A study of selected historical eras, influential thinkers, or crucial problems in education. Topics announced annually.

**607. Technology in Education.** (3) An introduction to the use of computers in education. Includes use of Internet, software, and hardware including multimedia to meet instructional goals.

**611. Educational Psychology.** (3) The theories, processes, and conditions of effective teaching/learning. P—Education 201 or permission of instructor.

**612. Teaching Children with Special Needs.** (3) A survey of the various types of learning problems commonly found in elementary children. Students will observe exemplary programs, tutor children with special needs, and attend seminars on effective instructional techniques. P—Education 221 and 250.

**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. *Staff*

**651. Adolescent Psychology.** (4) An introduction to theories of adolescent psychology as related to teaching and counseling in various settings. The readings emphasize researchers' suggestions for parenting, teaching, and counseling adolescents between the ages of thirteen and nineteen.

**653. Resident Advising.** (1) An exploration of the theoretical and experiential dimensions of residential counseling in an academic institution. P—Permission of instructor. *Roberge*

**654. Methods and Materials.** (5) Methods, materials, and techniques used in teaching particular secondary subjects (English, mathematics, science, second languages, social studies). Includes forty-hour field experience component. P—Permission of instructor.

**661. Foundations of Education.** (3) Philosophical, historical, and sociological foundations of education, including analysis of contemporary issues and problems.

**662. Field Experience One.** (2) Practical experiences in elementary or secondary classrooms. Weekly public school participation and seminar. Pass/fail only.

**663. Field Experience Two.** (2) Further experiences in elementary or secondary classrooms. Weekly public school participation and seminar. Pass/fail only. P—Education 362.  
**664. Secondary Student Teaching.** (6) Supervised teaching experience in grades 6-12. Pass/fail.

**673. Comparative and International Education.** (3) An in-depth study of education in selected countries such as the Soviet Union, Japan, Brazil, and Germany with specific reference to objectives, educational theory, curriculum and administration, and the impact of the education system on social and economic development.

**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 on the application of contemporary instructional methods and materials. Includes prior (intercession) twenty hours field experience requirement.

**681. Special Needs Seminar.** (1.5) 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, diversity, and evaluation. Meets four hours per week the first six weeks of the semester.

**682. Reading and Writing in the Content Areas.** (2) A 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.

**684. Creative Research Methodologies.** (2) An 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. *Staff*

**685. Publishing in America and Professional Authorship.** (2) A survey of the history of publishing and literary authorship in the United States, emphasizing social contexts and the impact of books on American institutions. *Staff*

- 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. (No student allowed credit for both Education 387 and English 387.)
- 690. Methods and Materials for Teaching Foreign Language (K-6).** (3) A survey of the basic materials, methods, and techniques of teaching foreign languages in the elementary and middle grades. Emphasis is placed on issues and problems involved in planning and implementing effective second language programs in grades K-6. (Spring only.) *Redmond*
- 691. Teaching the Gifted.** (3) A general investigation of the theory and practice which have special meaning for the gifted child, including an examination of general curricular matters, such as classroom styles, learning modes, epistemological theories, developmental constructs, and psychosociological patterns which have special pertinence to the teacher of the gifted. *Milner*
- 692. The Psychology of the Gifted Child.** (3) An exploration of giftedness and creativity in children and the relationship of those characteristics to adult superior performance. *Milner*
- 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. *Staff*
- 694. Internship in Education of the Gifted.** (3) An intensive period of observation and instruction of gifted students. Readings and directed reflection upon the classroom experience are used to develop a richer understanding of such a special school setting. *Staff*
- 695. Teaching Exceptional Students.** (3) An introduction to understanding exceptional students and the most effective teaching strategies for their inclusion in the regular classroom.
- 696. Education in Business and Industry.** (3) Educational concepts applied to programs in education and training in business/industrial settings.
- 697. Research and Trends in the Teaching of Foreign Languages.** (3) A study of current trends and issues in foreign language education. Research topics include language and linguistics, culture, and technology. *Redmond*
- 698. Seminar in Secondary Education.** (1) An investigation of the issues that form the context for teaching in secondary schools.

## For Graduate Students

**705. Sociology of Education.** (3) A study of contemporary society and education, including goals and values, institutional culture, and the teaching/learning process.

**706. History and Philosophy of Education.** (3) Philosophical, historical, and sociological foundations of education, including analysis of contemporary issues and problems.  
P— Permission of instructor for all but MTF students.

**707. Philosophy of Education.** (3) Survey of philosophical systems and their influence on education. Philosophical foundations of educational theories. Analysis of educational issues and problems.

**708. School and Society.** (3) A 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) A study of current reading theory and consideration of its application in the teaching of reading, grades K-12. *Cunningham*

**713. Psychology of Learning: Classroom Motivation and Discipline.** (3) Study of the nature and fundamental principles of learning. Major learning theories and their implications for teaching problems. Cognitive processes, concept-formation, problem-solving, transfer of learning, creative thinking, and the learning of attitudes, beliefs, and values. Research in learning. *Staff*

**714. Instructional Strategies and Evaluation.** (3) Application of learning theories to instructional strategies and techniques and evaluation of various assessment techniques. *Litcher*

**715. Descriptive Research.** (3) Individual research project on a specific pedagogical topic developed through descriptive methods in a school setting. Includes definition of research problem, literature review, collection of field data, and reporting of results.

**716. Professional Development.** (3) Reflection and self-evaluation of student teaching experience and definition of professional goals. Includes review of research literature on best practices in teaching, critical examination of personal teaching experiences as related to the research literature, and development of a teaching portfolio.

**721. Educational Research.** (3) Theory, construction, and procedures of empirical research dealing with educational and counseling problems. Analysis and evaluation of research studies; experience in proposal writing, the design and execution of research studies. *McCoy, Anderson*

**723. Educational Statistics.** (3) Descriptive, inferential, and nonparametric statistical procedures involved in educational research. Computer methods for statistical analysis.

*McCoy*

**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. *Staff*

**733. Supervision of Instruction.** (3) An 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. *Staff*

**735. Appraisal Procedures for Teachers.** (3) An overview of the development, interpretation, and application of tests of achievement, aptitude, interest, personality, intelligence, and other inventories commonly employed by teachers. Educational tests and measurement in the classroom. Test construction, validity, and reliability. *Staff*

**751. Adolescent Psychology.** (3) An introduction to theories of adolescent psychology as related to teaching and counseling in various settings. The readings emphasize researchers' suggestions for parenting, teaching, and counseling adolescents between the ages of thirteen and nineteen.

**758. Studies in Educational Leadership.** (3) An examination of contemporary leadership theory and its various applications in education. Students engage in practical leadership exercises, read on a variety of leadership topics, and develop their own philosophy of leadership.

**764. Seminar in Curriculum and Instruction.** (3) Exploration of special topics in the field of curriculum and instruction.

**781. Methodology and Research.** (3-6) Advanced study of the methods and materials of a specific discipline (English, French, social studies, mathematics, science) in the curriculum with special attention directed to the basic research in the discipline. Includes twenty hours field experience/project. *Staff*

**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. *Staff*

**784. Research in Writing.** (3) An investigation of selected topics related to the writing process. *Milner*

**785. The Teaching of Writing.** (3) An examination of the theories and methods of instruction of writing. *Milner*

**787. Teaching Advanced Placement.** (3) An investigation of the content of and the pedagogy appropriate to advanced placement courses in the various disciplines. Summer only. *Staff*

**788. Teaching Foreign Languages in the Elementary Grades.** (3) An 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. *Redmond*

**791, 792. Thesis Research.** (1-9) *Staff*

## Counselor Education Program

**723. Educational Statistics.** (3) Descriptive, inferential, and nonparametric statistical procedures involved in educational research. Computer methods for statistical analysis. *Newsome*

**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. Counseling students only. *Newsome*

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

**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. Counseling students only. P—Education 737. *Henderson, Newsome, Veach*

**740. Professional Orientation to Counseling.** (3) Course covers the history, roles, organizational structures, ethics, standards, specializations, and credentialing in the profession of counseling. Public policy processes and contemporary issues also will be considered. Counseling students only. *Gladding*

**741. Theories and Models of Counseling.** (3) The 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. Counseling students only. *Anderson, Karr*



**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. P—Education 741. Counseling students only. *Anderson, Armentrout, Gladding, Schubert*

**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. P— or C—Education 641. Counseling students only. *Veach*

**744. Counseling Internship I.** (3) Supervised counseling experience in a school, college, or community agency under a regularly employed staff member professionally trained in counseling. Observation of and active participation in direct service work to clients. Monitoring of audio or videotaped interviews. Case review. Counseling students only. P—Education 737, 741. *Henderson, Newsome, Veach*

a. *School*                      b. *Community agency*

**745. Counseling Internship II.** (3) Supervised counseling experience in a school, college, or community agency under a regularly employed staff member professionally trained in counseling. Observation of and active participation in direct service work to clients. Monitoring of audio or videotaped interviews. Case review. Counseling students only. P—Education 744. *Henderson, Newsome, Veach*

a. *School*                      b. *Community agency*

**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. Counseling students only. *Henderson*

**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. Counseling students only. *Henderson*

**748. Lifespan Development: Implications for Counseling.** (3) Examination of major theories and principles of human development across the lifespan, including physical, psychological, intellectual, social, and moral perspectives. Counseling students only. *Henderson*

**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. Counseling students only. *Henderson*

**750. The Vienna Theorists—Freud, Adler, Moreno and Frankl.** (3) An 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 will read and discuss several original writings of each practitioner—Sigmund Freud, Alfred Adler, Jacob Moreno, and Victor Frankl—prior to and during a two-week stay in the Wake Forest University Flow House in Vienna during which they will visit relevant historical sites and institutes. *Gladding, Staff*

**754. Advanced Counseling Internship I.** (3) Extension of basic internship experience for second-year students. In-depth counseling and human services work under supervision of professionally qualified counseling staff. Development of higher level counseling skills through interaction with clients and supervision by agency and University faculty. Counseling students only. P—Education 744, 745. *Staff*

a. *School*

b. *College*

c. *Community agency*

d. *Marriage and family agency*

**755. Advanced Counseling Internship II.** (3) Extension of basic internship experience for second-year counseling students. In-depth counseling and human services work under supervision of professionally qualified counseling staff. Development of higher level counseling skills through interaction with clients and supervision by agency and University faculty. Counseling students only. P—Education 744, 745. *Staff*

a. *School*

b. *College*

c. *Community agency*

d. *Marriage and family agency*

**761. College Student Development Counseling.** (3) History, philosophy, and organization of student affairs practice and services in higher education; student development theory and implementation models; college student counseling; program planning and leadership development. Counseling students only. *Staff*

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

a. *School Guidance  
and Counseling*

g. *Career Counseling*

h. *Rehabilitation*

b. *College Student  
Development Services*

i. *Adult Development/  
Aging Counseling*

c. *Mental Health  
Counseling*

j. *Religious Counseling*

k. *Health Counseling*

d. *Marriage and Family  
Counseling*

l. *Multicultural Counseling*

m. *Addiction Counseling*

e. *Business/Industry  
Counseling*

n. *Holistic Counseling*

f. *Correctional Counseling*

**770. Counseling and Mental Health.** (3) Studies the healthy personality and reviews developmental and situational problems in adjustment. Explores personality and systemic interventions for career, educational, and relationship concerns. P—Advanced graduate standing or permission of instructor. *Veach*

**771. Community Counseling.** (3) History, philosophy, organization, management, and delivery of counseling services in various community agencies. Preventative, developmental, and remedial strategies for use with various populations. Counseling students only. *Veach*

**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 life styles, such as dual career, single parent, and blended are covered. Counseling students only. *Gladding*

**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. Counseling students only. *Gladding*

**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. Counseling students only. *Gladding*

**775. Marital and Family Health and Dysfunctionality.** (3) This course 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. Counseling students only. *Gladding*

**780. Professional, Ethical and Legal Issues in Counseling.** (3) This course 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 permission of instructor. *Anderson, Henderson*

**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. *Staff*

**786. Consultation and Program Development in Counseling.** (3) Consultation theory and process. Consultation with families, schools, colleges, and community agencies. Models for facilitating change in human systems. Counseling students only. *Newsome*

## English

*Reynolda Campus*

Gale Sigal, Chair

Professors Nancy J. Cotton, Mary K. DeShazer,

Andrew V. Ettin, James S. Hans, W. Dillon Johnston,

Philip F. Kuberski, Robert W. Lovett, Barry G. Maine,

Dolly A. McPherson, William M. Moss, Gillian R. Overing,

Gale Sigal, Edwin Graves Wilson

Associate Professors Bashir El-Beshti, Anne Boyle,

Claudia Thomas Kairoff, Scott W. Klein

Assistant Professors Janis Caldwell, Lisa Sternlieb,

Olga Valbuena, Eric G. Wilson

Poet-in-Residence Jane Mead

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.

Candidates for degrees are required to have a reading knowledge of a modern foreign language. After consulting with his or her advisory committee, the student can 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 or the appropriate language department of the University. With approval of the department, a classical language may be substituted.

Students seeking graduate teacher certification are required to take six semester hours of courses in the Department of Education in addition to those for the MA degree in English.

With approval by the departmental graduate committee, students may take one or two related courses in other departments.

## For Advanced Undergraduates and Graduate Students

*Not every course listed in this section is given every year.*

**601. Individual Authors.** (2) Study of selected work 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) A survey of the development of English syntax, morphology, and phonology from Old English to the present, with attention to vocabulary growth. *Overing*

**605. Old English Language and Literature.** (3) An 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. *Overing*

**610. The Medieval World.** (3) Through the reading of primary texts, this course will examine theological, philosophical, and cultural assumptions of the Middle Ages. Topics may 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. *Sigal*

**612. Medieval Romance and Allegory.** (3) The origin and development of poetic genres and lyric forms of Middle English. *Sigal*

**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. *Sigal*

**619. Virgil and His English Legacy.** A 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 sixteenth through the eighteenth centuries, including Spenser, Marlowe, Milton, Dryden, and Pope. Knowledge of Latin not required. *Ettin*

**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. *El-Beshti*

**623. Shakespeare.** (3) Thirteen representative plays illustrating Shakespeare's development as a poet and dramatist. *El-Beshti, Valbuena*

- 625. Sixteenth Century British Literature.** (3) Concentration on the poetry of Spenser, Sidney, Shakespeare, Wyatt, and Drayton, with particular attention to sonnets and *The Faerie Queene*. *Ettin*
- 627. Milton.** (3) The poetry and selected prose of John Milton, with emphasis on *Paradise Lost*. *Ettin*
- 628. Seventeenth Century British Literature.** (3) Poetry of Donne, Herbert, Vaughan, Marvel, Crashaw, prose of Bacon, Burton, Browne, Walton. Consideration of religious, political, and scientific backgrounds. *Ettin*
- 630. British Literature of the Eighteenth Century.** (3) Representative poetry and prose, exclusive of the novel, 1700-1800, drawn from Addison, Steele, Defoe, Swift, Pope, Johnson, and Boswell. Consideration of cultural backgrounds and significant literary trends. *Thomas*
- 635. Eighteenth Century British Fiction.** (3) Primarily the fiction of Defoe, Richardson, Fielding, Smollett, Sterne, and Austen. *Lovett*
- 636. Restoration and Eighteenth Century British Drama.** (3) British drama from 1660 to 1780, including representative plays by Dryden, Etherege, Wycherley, Congreve, Goldsmith, and Sheridan. *Thomas*
- 637. Studies in Eighteenth-Century British Literature.** (3) Selected topics in eighteenth century literature. Consideration of texts and their cultural background. *Lovett*
- 640. Women and Literature.** (3) Selected topics. *DeShazer*
- 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. *Wilson*
- 653. Nineteenth Century British Fiction.** (3) Representative major works by Dickens, Eliot, Thackeray, Hardy, the Brontës, and others. *Sternlieb*
- 654. Victorian Poetry.** (3) A study of the Brownings, Tennyson, Hopkins, and Arnold or another Victorian poet. *Johnston*
- 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. *Johnston*
- 661. Literature and Science.** (3) Literature of and about science. Topics will vary and may include literature and medicine, the two-culture debate, poetry and science, nature in literature, the body in literature. *Caldwell*

- 662. Blake, Yeats, and Thomas.** (3) Reading and critical analysis of the poetry of Blake, Yeats, and Dylan Thomas; study of the plays of Yeats and his contemporaries in the Irish Renaissance, especially Synge and Lady Gregory. *Wilson*
- 663. Studies in Modernism.** Selected issues in Modernism. Interdisciplinary, comparative, and theoretical approaches to works and authors. *Kuberski*
- 664. Studies in Literary Criticism.** (3) Consideration of certain figures and schools of thought significant in the history of literary criticism. *Hans*
- 665. Twentieth Century British Fiction.** (3) Representative major works by Conrad, Ford, Forster, Joyce, Lawrence, Woolf, and others. *Klein*
- 666. James Joyce.** (3) The major works by James Joyce, with an emphasis on *Ulysses*. *Klein*
- 667. Twentieth-Century English Poetry.** (3) A study of twentieth-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. *Kuberski*
- 668. Studies in Irish Literature.** (3) Critical readings of the works of major Irish writers within the context of the political, social, and literary history of Ireland. *Johnston*
- 669. Modern Drama.** (3) Main currents in modern drama from nineteenth 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. *Cotton*
- 672. American Romanticism.** (3) Studies of Romanticism in American literature. Focus will vary by topic and genre, to include such writers as Emerson, Thoreau, Hawthorne, Melville, Whitman, and Dickinson. *Moss*
- 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. *Sternlieb*
- 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. *Cotton*
- 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. *Wilson*

**677. American Jewish Literature.** (3) A survey of writings on Jewish topics or experiences by American Jewish writers. The course 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. *Ettin*

**678. Literature of the American South.** (3) A 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. *Moss*

**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. *McPherson*

**680. American Fiction from 1865 to 1915.** (3) Such writers as Twain, James, Howells, Crane, Dreiser, Wharton, and Cather. *Maine*

**681. Studies in African-American Prose.** (3) Reading and critical analysis of selected fiction, essays, and other prose writings by representative African-Americans. *McPherson*

**682. Modern American Fiction, 1915 to 1965.** (3) To include such writers as Cather, Lewis, Hemingway, Fitzgerald, Faulkner, Dos Passos, Wolfe, Baldwin, Ellison, Agee, O'Connor, Styron, Percy, and Pynchon. *Maine*

**683, 684. Theory and Practice of Poetry Writing.** (3,3) Emphasis on reading and discussing student poems in terms of craftsmanship and general principles. *Mead*

**685. Twentieth-Century American Poetry.** (3) Readings of modern American poetry in relation to the literary and social history of the period. *Kuberski*

**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. *Staff*

**690. Structure of English.** (3) An introduction to the principles and techniques of modern linguistics applied to contemporary American English. *Overing*

**691. Studies in Postmodernism.** (3) Interdisciplinary, comparative, and theoretical approaches to works and authors. *Kuberski*

**694. Contemporary Drama.** (3) The course will consider experiments in form and substance in plays from *Godot* to the present. Readings will cover such playwrights as



Beckett, Osborne, Pinter, Stoppard, Churchill, Wertebaker, Albee, Shepard, Mamet, Wilson, Soyinka, and Fugard. *Cotton*

**695. Contemporary American Literature.** (3) A study of post-World War II American poetry and fiction by such writers as Bellow, Gass, Barth, Pynchon, Morrison, Ashbery, Ammons, Bishop, and Rich. *Hans*

**696. Contemporary British Fiction.** (3) A 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. *Klein*

### For Graduate Students

*Not every course listed in this section is given every year, but at least four are offered in the regular academic year, and normally one in each term of the summer session.*

**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 on interdisciplinary viewpoints (artistic, archaeological, geographic), and on contemporary narrative theory. *Overing*

**711. Studies in the Arthurian Legend.** (3) Emphasis 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. *Sigal*

**712. Studies in Medieval Literature: Romance and Identity.** (3) A diverse corpus of medieval poetry, both lyric and narrative, will be 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 twelfth century. *Sigal*

**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. *Sigal*

**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—will be approached as the products of a dynamic exchange between individual authors and the larger political and social concerns of the period. *El-Beshti*

**721. Studies in Spenser.** (3) Emphasis on *The Faerie Queene*; attention to the minor works; intellectual and critical background. Lectures, discussions, and class papers. *Ettin*

**722. Studies in Sixteenth 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*. *Ettin*

**723. Studies in Shakespeare.** (3) Representative text from all genres, examined in light of critical methodologies in the field of Shakespeare studies. Emphasis 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. *Valbuena, El-Beshiti*

**725. Studies in Seventeenth Century British Literature.** (3) Non-dramatic literature of the seventeenth century, exclusive of Milton. Emphasis on selected major writers. Lectures, discussions, and presentation of studies by members of the class. *Ettin*

**733. Eighteenth Century British Fiction.** (3) A study of two major British novelists of the eighteenth century. Lectures, reports, critical papers. Authors for study chosen from the following: Defoe, Richardson, Fielding, Smollet, and Austen. *Lovett*

**743. Nineteenth Century British Fiction.** (3) A study of one or more major British novelists of the nineteenth century. Lectures, reports, discussions, and a critical paper. Authors for study chosen from the following: Austen, Dickens, Thackeray, Eliot, and Hardy. *Sternlieb*

**745. British Poetry of the Nineteenth and Twentieth Centuries.** (3) A study of several British poets chosen from the major Romantics, Tennyson, Browning, Hardy, and Yeats. *Wilson*

**746. Studies in British Romanticism.** (3) Examination of major writers, topics, and/or theoretical issues from the late eighteenth and early nineteenth centuries.

**757. American Poetry.** (3) Studies of the poetry and poetic theory of three major American writers in the nineteenth and twentieth centuries. Writers chosen from the following: Whitman, Dickinson, Frost, Eliot, Stevens, or Williams. Discussions, reports, and a critical paper. *Staff*

**758. Studies in Modern Poetry.** (3) Theoretical issues and themes in twentieth century poetry. *Kuberski*

**765. Literary Criticism.** (3) A review of historically significant problems in literary criticism, followed by study of the principal schools of twentieth century critical thought. Lectures, reports, discussions, and a paper of criticism. *Hans*

**767. Twentieth Century British Fiction.** (3) A study of one or more of the major British novelists of the twentieth century. Authors chosen from among the following: Conrad, Ford, Forster, Joyce, Lawrence, or Woolf. *Klein*

**768. Irish Literature.** (3) Selected topics. *Johnston*

**772. Studies in American Romanticism.** (3) Writers of the mid-nineteenth century, including Emerson, Thoreau, Hawthorne, and Melville. *Moss*

**779. Autobiographical Voices: Race, Gender, Self-Portraiture.** (3) Using an historical and critical approach, this seminar will examine 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. *McPherson*

**780. Studies in American Fiction from 1865 to 1915.** (3) A study of the principal fiction of one or more major American writers of the late nineteenth and early twentieth centuries. Lectures, seminar reports, and a research paper. Authors for study chosen from the following: Twain, James, Howells, Adams, Crane, Dreiser, Wharton, or Cather. *Maine*

**781. African-American Literature and the American Tradition.** (3) Critical readings of selected works of major African-American writers within the contexts of the African-American and American literary and social traditions. The course will cover such genres as autobiography, fiction, drama, and poetry. Lectures, reports, discussions, and a critical paper. *McPherson*

**782. Studies in American Fiction from 1915 to 1965.** (3) A study of the principal fiction of one or more major American writers of the twentieth century. Writers to be chosen from the following: Cather, Lewis, Hemingway, Fitzgerald, Faulkner, Dos Passos, Wolfe, Baldwin, Ellison, Agee, O'Connor, Percy, or Pynchon. *Maine*

**783. Contemporary American Fiction.** (3) A seminar devoted to the close study of some of the most important novels produced in the United States since World War II. *Hans*

**784. Contemporary American Poetry.** (3) A seminar devoted to the close study of some of the most important poems written in America since World War II. *Hans*

**789. Linguistics in Literature.** (3) Examination of theories of grammar and attitudes toward the English language reflected in the literature of selected periods. *Overing*

**791, 792. Thesis Research.** (1-9) *Staff*

# Health and Exercise Science

*Reynolda Campus*

Paul M. Ribisl, Chair

Professors Michael J. Berry, Stephen P. Messier, W. Jack Rejeski, Paul M. Ribisl

Associate Professors Peter H. Brubaker, Patricia A. Nixon

Assistant Professors Anthony P. Marsh, Shannon L. Mihalko, Gary D. Miller

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 laboratories (exercise physiology, biomechanics, or rehabilitation), and/or direct programs of exercise training or rehabilitation (YMCAs, 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, but with departmental approval some of them may be completed during the regular course of study. 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 course work 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 and students may elect a variety of more specialized courses in areas of particular interest.

The departments of medicine and health and exercise science have joined in a cooperative effort to sponsor a cardiac rehabilitation program for patients in the community with documented coronary disease. As part of the course work in HES 761 and HES 765, graduate students serve an internship in the cardiac rehabilitation program to gain practical experience as exercise specialists. After serving an internship with the cardiac rehabilitation program during the first academic year, each candidate will have the opportunity to participate in the workshop and certification sessions for exercise specialists which are offered through the American College of Sports Medicine (ACSM). These sessions are conducted on campus during the third week of June. Satisfactory completion of the ACSM certification requirement will allow the candidate to assume an appointment with the cardiac rehabilitation program. In the first year, candidates are expected to teach one departmental laboratory course each semester, Exercise for Health, a one-credit course for first-year undergraduate students. This experience fulfills the departmental language skill requirement for graduation.

The Department of Health and Exercise Science began offering graduate study in 1967. Departmental graduate committee: Marsh (chair), Berry, Brubaker, Messier, Mihalko, Miller, Nixon, Rejeski, Ribisl.

## For Advanced Undergraduates and Graduate Students

**650. Human Physiology.** (3) A lecture course which 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. *Berry/Brubaker*

**651. Nutrition and Weight Control.** (3) A lecture/laboratory course which 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. Laboratory experiences are focused on intervention in obesity and coronary heart disease through diet analysis, methods of diet prescription, and behavior modification. *Miller*

**652. Human Gross Anatomy.** (3) A lecture/laboratory course which involves the study of the structure and function of the human body. Laboratory experiences are devoted to the dissection and study of the human musculoskeletal, neuromuscular, and vascular systems. *Marsh/Messier*

**653. Physiology of Exercise.** (3) A lecture course which 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—650 or permission of instructor. *Miller/Nixon*

**660. Epidemiology.** (3) An 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 will be analyzed by formal statistical modeling. *Nixon*

**670. Biomechanics of Human Movement.** (3) Study of the mechanical principles which influence human movement, sport technique, and equipment design. *Marsh/Messier*

**675. Advanced Exercise Physiology.** (3) A lecture course which deals with the study of physiological and biochemical adaptations of the human body to exercise, with special emphasis on substrate metabolism, ventilation and respiration, oxygen transport, and muscle physiology. *Berry*

**680. Physical Activity and Aging.** (3) A lecture course which examines both normal/abnormal aging from a physiological perspective and explores how aging and chronic disease affect performance of activities of daily living, including vocational and recreational activities. The potential of regular physical activity to delay or reverse the deleterious effects of aging and degenerative disease is investigated. P—Permission of instructor. *Ribisl*

**682. Independent Study.** (1-3) Literature reviews and/or laboratory research performed on an individual basis under the supervision of a faculty member. *Staff*

## For Graduate Students

**715. Experimental Design.** (3) A 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. *Rejeski*

**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 co-variance, and non-parametric statistics. *Berry*

**733. Health Psychology.** (3) A seminar on current topics in health psychology with a focus on wellness programs and rehabilitative medicine. *Mihalko*

**761. Cardiopulmonary Disease Management.** (3) A lecture/laboratory class that examines the physiologic, pathologic, and pharmacologic considerations of managing patients with cardiovascular and pulmonary disease. Special emphasis will be placed on learning diagnostic procedures, interventions, and therapies, particularly models for cardiac and pulmonary rehabilitation. *Brubaker*

**763. Advanced Biomechanics.** (3) An in-depth study of the mechanical principles which influence human movement. Topics include the study of kinetics, kinematics, cinematography, sport shoe design, and skeletal biomechanics. P—Anatomy, kinesiology, physics, or permission of instructor. *Messier*

**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. Laboratory experiences include the use of electrocardiographs, ergometers, and metabolic analyzers in the assessment of functional capacity. *Brubaker*

**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 which are not a regular part of required course work. Topics are chosen from the following areas: anatomy, biomechanics, computer analysis, multivariate statistics, and physiology of exercise. Seminar and/or laboratory approach. *Staff*

**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. *Staff*

**783, 784. Seminar in Health and Exercise Science.** (1,1) A 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 will be included as seminar sessions. Graduate students will receive reading and work assignments related to the material presented in the seminar. May be repeated for credit. *Staff*

**791, 792. Thesis Research.** (1-9) *Staff*

## Master of Arts in Liberal Studies

*Reynolda Campus*

Cecilia H. Solano, Director

The Master of Arts in Liberal Studies program (MALS) enables the college-educated adult student to pursue graduate study in the liberal arts. The coursework consists of both courses available in the University curriculum and courses designed specifically for the MALS program. Students are encouraged to use this flexibility to tailor interdisciplinary programs to suit their particular needs and interests.

Liberal studies courses numbered above 700 are specially designed interdisciplinary graduate seminars for students enrolled for the master of arts in liberal studies. The thirty hours required for the MALS degree must include a minimum of four liberal studies courses and Liberal Studies 791: Thesis Project. Students may elect a maximum of five courses from the 600- and 700-level departmental courses that carry three hours of graduate credit; no more than four 600-level courses may count toward the MALS degree.

The MALS program began in 1987. The Director is assisted by a six-member Advisory Committee selected from the faculty of the University.

The following list of courses is representative, rather than a complete list.

**702. The Psychology of Gender.** (3) An exploration of gender differences and similarities in humans, from a psychological and cross-cultural perspective. Some questions to be explored are: Why do women mother? Are men more aggressive and women more passive and/or social? How does one establish his or her sexual identity? What is the influence of culture in relation to biology on all these matters? We will look at some traditional clinical perspectives of thinkers like Sigmund Freud and Helen Deutsch, as well as recent feminist and non-feminist critiques, such as those by Nancy Chodorow, Carol Gilligan, and Richard Isay. In addition, we shall explore some anthropological studies of gender roles across cultures, including the instructor's work on Palestinian and Salvadoran women, and some fictional and poetic works which address these issues by such authors as Ernest Hemingway, Robert Blye, and Sylvia Plath. Students will be expected to participate actively in seminar discussions; no exams shall be given, and a term paper is optional. *Gorkin*

**704. Meaning and Value in Western Thought: The Ancient Foundation.** (3) Due to a widespread need for interdisciplinary synthesis, not only in academia but also in the lives of thoughtful people in society in general, this study was developed. The curriculum of higher education should be centered in the examination and weighing of meaning and discovery and the acceptance of values. This course is one of two covering the history of Western thought. The two courses may be taken independently or consecutively. This first course will cover elements of Mesopotamian and Egyptian cultures up through early Christianity and will stress the thought of Hebrews, Greeks, and Romans. *Helm*

**705. The Art of Biography: Myth, Mystery, Mask, and Meaning.** (3) A literary critic has observed that biography is built on a three-part equation: the life of the subject, the life of the author, and the life of the reader. This course, led by a biographer at work on her fourth book, will explore the art and craft of modern biography. What elements define a meaningful biography? How does the author choose the subject, research the life, and write a compelling biographical portrait? How do the reader and the writer penetrate the myths, the mysteries, and the masks to get to the meaning of a life? Through the reading of biographies, journals, and letters, and a hands-on encounter with original primary sources, participants in the course will explore biography as literature and history. In addition, there will be an examination of the tools and techniques used in researching and writing biography, and experiments in writing biographical and/or autobiographical portraits. *Niven*

**710. Cultural Pluralism and Values.** (3) An exploration of the impact of cultural pluralism on the foundation, implementation, and criticism of values in various historical periods and cultural contexts and in the modern world through the study of representative works of literature, social science, and film. Works and authors may include the Book of Isaiah, Herodotus, Pliny, Maimonides, Montaigne, Soyinka, Forster, and Kurusawa. *J.A. Martin*

**712. Literary Classics of World Religions.** (3) Course participants will read and discuss selected works of literature that reflect the views of several world religions. The approach will be literary-critical, with such attention to religious import as may be needed to understand and appraise the books as classics of world religions. Half the class sessions will be devoted to selections from the Biblical corpus that has played a major role in three religions—Judaism, Christianity, and Islam—and in Western culture; half will be devoted to works that reflect the ideas of Eastern religions and cultures. *J.A. Martin*

**717. Film and the Creative Life.** (3) This seminar focuses on the ways in which modern film represents the lives of artists and other highly creative women and men, and their achievements, failures, and struggles. Special emphasis will be placed on the dynamics of the creative process, the relationship between artists and society, autobiographical writings, the role of spirituality, cultural myths of creativity and innovation, and cross-cultural comparisons. Among the artists discussed are Ludwig van Beethoven, Pablo Picasso, Camille Claudel, Artemisia Gentileschi, Virginia Woolf, Basquiat, Tina Turner, Billie Holiday, Vincent van Gogh, and Wolfgang Amadeus Mozart. The class will include field trips to the Diggs Gallery, the Reynolda House Museum of American Art, and SECCA.



**753. The Concerned Photographer and Society.** (3) It has been said that "a picture is worth a thousand words." Is this truly the case? Perhaps it is an understatement. This course will deal with the effect that photography has on society. We will survey the literature dealing with this subject, and we will critically examine the photographs and photo-essays of a number of "concerned photographers." Issues which will be investigated include whether or not particular essays are propaganda or documentation, the role of art in determining public policy, and the ethical implications surrounding the manipulation of photographs.

**763. The Artist and Intellectual in Nazi Germany and During the Holocaust.** (3) In this course we examine Nazi policies toward the arts and toward academic and intellectual life, and we will consider the works and role of creative artists and intellectuals in responding to Nazism and the concentration camps. Attention will be paid to the nuances of commitments and circumstances affecting the positions of the major figures we will discuss. Topics include: Nazi legislation regulating the arts and universities; Nazi aesthetic ideals and adopted cultural "heroes," and cultural life within the Third Reich; silence, complicity, or active support of the Nazi regime by creative artists and performers, academic intellectuals, and theologians; styles and works ridiculed or banned by the Nazis as decadent; creativity in the camps, especially the musical culture within the Tererzin concentration camp; and the reflective responses of artists and intellectuals to their experience during and after the Holocaust. *Ettin*

**764. Gender, Spirituality, and Art.** (3) This course will introduce students to major themes in the current discussion on the nature of art and spiritual experience. Special emphasis will be placed on definitions of femininity and masculinity in the construction of symbols and religious meaning. Each of the areas under investigation has its own matrix of meaning and historical development, and, in its own way, each promises to access the realm of the transcendent. During the course of the semester, students will acquire a critical vocabulary and road map for the world of art and spirit, and, most importantly, be invited to value more deeply their own creative participation in the world. The class will make ample use of the resources of Wake Forest University, the Reynolda House Museum of American Art, and SECCA. If a schedule can be arranged, there also will be one or more field trips. *Wiethaus*

**786, 787. Directed Study.** (3) Working with a faculty director, the student will complete 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 a written request to the program director. May be repeated for credit with the permission of the program director.

**791. Thesis Research.** (1-9)

# Mathematics

## *Reynolda Campus*

Richard D. Carmichael, Chair

Reynolds Professor Robert J. Plemmons

Wake Forest Professor John V. Baxley

Professors Richard D. Carmichael, Elmer K. Hayashi, Fredric T. Howard,

Ellen E. Kirkman, James Kuzmanovich, J. Gaylord May

Associate Professors Edward E. Allen, James L. Norris III, Stephen B. Robinson

Assistant Professors Hugh N. Howards, Miaohua Jiang

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 thirty-three semester hours of mathematics, of which at least eighteen 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, thirty semester hours of coursework, including Mathematics 791, 792, and at least four additional courses numbered above 700, are required for the MA degree. If a thesis is not written, thirty-six semester hours of coursework, including at least five courses numbered above 700, are required for the MA degree. 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 adviser, graduate courses may be taken in related areas to fulfill requirements; however, no more than six 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 course work 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.

This program began in 1961. Mathematics graduate committee: Allen (chair), Carmichael, Howard, Jiang, Kuzmanovich, Norris, Plemmons. Mathematics graduate adviser: Howard.

## For Advanced Undergraduates and Graduate Students

- 601. Vector Analysis.** (1.5) Vector functions, partial derivatives, line and multiple integrals, Green's theorem, Stokes' theorem, divergence theorem. Not to be counted toward any major offered by the department, except for the major in mathematical business. P—Mathematics 112.
- 602. Matrix Algebra.** (1.5) Matrices, determinants, solutions of linear equations, special matrices, eigenvalues and eigenvectors of matrices. Not to be counted toward any major offered by the department, except for the major in mathematical business. Credit not allowed for both 121 and 602.
- 603. Complex Variables.** (1.5) Topics in analytic function theory, Cauchy's theorem, Taylor and Laurent series, residues. Not to be counted toward any major offered by the department. Credit not allowed for both 603 and 617. P—Mathematics 112.
- 604. Applied Partial Differential Equations.** (1.5) The separation of variables technique for the solution of the wave, heat, Laplace, and other partial differential equations with the related study of special functions and Fourier series. Not to be counted toward any major offered by the department. P—Mathematics 251.
- 610. Advanced Calculus.** (3) A rigorous proof-oriented development of important ideas in calculus. Limits and continuity, sequences and series, pointwise and uniform convergence, derivatives and integrals. (No student allowed credit for both Mathematics 610 and 611. May not be used toward any graduate degree offered by the department.)
- 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. (No student allowed credit for both Mathematics 610 and 611.)
- 617. Complex Analysis I.** (3) Analytic functions. Cauchy's theorem and its consequences, power series, and residue calculus. Credit not allowed for both 603 and 617. P—Mathematics 113.
- 622. Modern Algebra II.** (3) A continuation of modern abstract algebra through the study of additional properties of groups, rings, and fields. P—Mathematics 221.
- 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. P—Mathematics 121 and Mathematics 221.
- 626. Numerical Linear Algebra.** (3) Numerical methods for solving matrix and related problems in science and engineering. Topics will include systems of linear equations, least

squares methods, and eigenvalue computations. Special emphasis given to parallel matrix computations. Beginning knowledge of a programming language such as Pascal, FORTRAN, or C is required. Credit not allowed for both Mathematics 626 and Computer Science 626. P—Mathematics 112 and Mathematics 121.

**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. P—Mathematics 113.

**645, 646. Elementary Theory of Numbers I, II.** (3,3) Properties of integers, including congruences, primitive roots, quadratic residues, perfect numbers, Pythagorean triples, sums of squares, continued fractions, Fermat's Last Theorem, and the Prime Number Theorem.

**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) A 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. P—Mathematics 113 and Mathematics 251.

**653. Mathematical Models.** (3) Development and application of probabilistic and deterministic models. Emphasis given to constructing models which represent systems in the social, behavioral, and management sciences.

**655. Introduction to Numerical Methods.** (3) Numerical computations on modern computer architectures; floating point arithmetic and round-off error. Programming in a scientific/engineering language (C or FORTRAN). Algorithms and computer techniques for the solution of problems such as roots of functions, approximation, integration, systems of linear equations and least squares methods. Credit not allowed for both Mathematics 655 and Computer Science 655. P—Mathematics 112, Mathematics 121, and Computer Science 111.

**656. Statistical Methods.** (3) A study of statistical methods that have proven useful in many different disciplines. These methods include tests of model assumptions, regression,

general linear models, nonparametric alternatives, and analysis of data collected over time. Knowledge of matrix algebra is desirable but not necessary.

**657, 658. Mathematical Statistics I, II.** (3,3) Probability distributions, mathematical expectation, sampling distributions, estimation and testing of hypotheses, regression, correlation, and analysis of variance. C—Mathematics 112 or P—Permission of instructor.

**661. Selected Topics.** (1,1.5,2, or 3) Topics in mathematics which are not considered in regular courses. Content varies.

**681. Individual Study.** (1 or 2) A course of independent study directed by a faculty adviser. By prearrangement.

**682. Reading in Mathematics.** (1,2, or 3) Reading in mathematical topics which is meant to provide a foundational basis for more advanced study in a particular mathematical area. Topics will 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 M.A. degree without thesis. *Staff*

## For Graduate Students

**711, 712. Real Analysis.** (3,3) Measure and integration theory, elementary functional analysis, selected advanced topics in analysis. *Carmichael, Hayashi, Robinson*

**715, 716. Seminar in Analysis.** (1,1) *Baxley*

**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. *Baxley*

**718. Topics in Analysis.** (3) Selected topics from functional analysis or analytic function theory. *Baxley, Robinson*

**721, 722. Abstract Algebra.** (3,3) Groups, rings, fields, extensions, Euclidean domains, polynomials, vector spaces, Galois theory. *Kirkman, Kuzmanovich*

**723, 724. Seminar on Theory of Matrices.** (1,1) *Plemmons*

**725, 726. Seminar in Algebra.** (1,1) *John, Kirkman*

**728. Topics in Algebra.** (3) Topics vary and may include algebraic coding theory, algebraic number theory, matrix theory, representation theory, non-commutative ring theory. *Kirkman, Kuzmanovich*

**731, 732. General Topology.** (3,3) An axiomatic development of topological spaces. Includes continuity, connectedness, compactness, separation axioms, metric spaces, convergence, embedding and metrization, function and quotient spaces, and complete metric spaces. *Staff*

**733. Topics in Topology and Geometry.** (3) Topics will vary and may include knot theory, non-Euclidean geometry, combinatorial topology, differential topology, minimal surfaces and algebraic topology. *Howards*

**735, 736. Seminar on Topology.** (1,1) *May*

**737, 738. Seminar on Geometry.** (1,1) *Staff*

**744. Topics in Number Theory.** (3) Topics will vary and will be 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. *Hayashi, Howard*

**745, 746. Seminar on Number Theory.** (1,1) *Hayashi, Howard*

**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. *Allen, Howard, John*

**748, 749. Seminar on Combinatorial Analysis.** (1,1) *Allen, Howard*

**750. Dynamical Systems.** (3) Introduction to modern theory of dynamical systems. Linear and non-linear 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—Mathematics 121 and Mathematics 611. *Baxley, Jiang*

**752. Topics in Applied Mathematics.** (3) Topics will vary and may include computational methods in differential equations, optimization methods, approximation techniques, eigenvalue problems. *Baxley, Plemmons, Robinson*

**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 will be examined and a comparison made of various techniques for both unconstrained and constrained optimization problems. Credit not allowed for both Mathematics 753 and Computer Science 753. P—Mathematics 113 and Mathematics (or Computer Science) 655. *Plemmons*

**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 Mathematics 754 and Computer Science 754. P—Mathematics 113 and either Computer Science 655 or Mathematics 655. *Baxley, Jiang, Plemmons, Robinson*

**758. Topics in Statistics.** (3) Topics will vary and may include linear models, nonparametric statistics, stochastic processes. *Kirkman, Norris*

**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. *Norris*

**791, 792. Thesis Research.** (1-9) *Staff*

## Medical Engineering

*Bowman Gray Campus*

Peter Santiago, Chair  
Professors Frederick W. Kremkau, Richard L. Webber  
Associate Professors Frederic H. Fahey, Peter Santiago  
Assistant Professors J. Daniel Bourland, H. Donald Gage, Yaorong Ge,  
Craig A. Hamilton, Paul F. Hemler, Yi-Fen Yen  
Instructor Beth A. Harkness  
Adjunct Professor Wesley E. Snyder

The Department of Medical Engineering offers a PhD degree in medical engineering. The program emphasizes medical applications, particularly in image and signal processing and analysis, but also prepares students for nonmedical careers. The program is open to qualified applicants with a BS degree in a technical field, including electrical engineering, computer engineering, computer science, mathematics, and physics. Students are expected to have strength in the basic areas of the program, including mathematics prerequisites in calculus through differential equations, linear algebra, and linear systems theory. Additional training in the life sciences and signal/image processing is desirable, but not essential.

The program consists of traditional classroom instruction, clinical involvement, and independent research. At least forty-eight hours of coursework, including core courses and carefully chosen electives, are required for the degree. The core curriculum consists of

courses in the anatomical basis for medical imaging, physiology for engineers, medical communications or information systems, and two semesters of clinical rotations. Other requirements include signal and image processing and stochastic processes. Selection of elective courses can be individualized to complement the student's background and interests, and offerings include courses in the departments of physics, mathematics, and computer science at Wake Forest University. Courses at participating universities are offered over the North Carolina Information Highway via interactive video at the Teleconference Center.

During clinical rotations, students are exposed to technical equipment with medical applications, to patient care and procedures used in medical centers, and to the reading and interpreting of medical images. During the rotation, guest speakers provide lectures on clinical and health care topics, and students visit various hospital facilities such as the operating suite, the power plant, and the Emergency Department.

Office and laboratory space is provided for students in the MR Imaging Center. The lab is equipped with SUN workstations and servers, personal computers, laser printers, scanners, and a film digitizer. All of the computers are networked and connected to the clinical modalities, the University, and the Internet. Associated labs also provide equipment for student research. The Virtual Endoscopy Center maintains a powerful Silicon Graphics computing environment, and the Cardiology Image Processing Lab uses SUN workstations and sophisticated video capture equipment.

Ongoing research in the group covers a number of applications, most of which focus on the use of medical imaging and computer applications. Current topics include cardiac MR imaging, neuro-functional MRI, ultrasonic tissue characterization, radiation treatment planning, PET image reconstruction, image classification, segmentation and compression, virtual reality, intravascular ultrasonography, tomosynthesis, and flow analysis based on mechanical modeling and imaging techniques.

More information is available on our homepage, <http://www.rad.wfubmc.edu/me>, and prospective students are encouraged to contact individual faculty members or schedule a visit to the department.

**601. Anatomic and Physiologic Basis for Medical Imaging.** (3) A study of human anatomy and physiology as it relates to medical imaging. This course is oriented toward graduate students who have a background in electrical engineering, computer engineering, and computer science. The objectives are 1) to make the student conversant in anatomy and physiology and thus, better able to communicate with physicians, 2) to understand the function and placement of various organ systems, and 3) the relation of structure and function to the use of medical images in the diagnosis of disease. Normal and abnormal anatomy and physiology will be explored using images obtained with conventional x-ray, magnetic resonance imaging, computed tomography, ultrasound, nuclear medicine, and positron emission tomography. *Harkness*

**613. Digital Signal Processing.** (3) The processing of information represented in digital form. Linear systems theory, the z-transform, sampling, Fourier analysis, digital filters, spectrum estimation. *Hamilton*



**614. Probability and Random Processes.** (3) This course covers probabilistic descriptions of signals and noise including joint, marginal, and conditional densities, autocorrelation, and power spectral densities. Also covered are linear and nonlinear transformations, linear least-square estimation, and signal detection. The course will provide the students with the mathematical tools available for analysis of systems involving uncertainties from a theoretical point-of-view and by actual experiments and examples. *Santago*

**632. Structured Computing for Scientists and Engineers.** (3) An intense study of computer systems and programming for graduate level scientists and engineers. A broad overview of computer architecture and design. Following this introduction, the student will learn to write structured programs allowing for easier testing and software reusability. The course will introduce data structures found in common use and students will implement some of these using the structured programming approach. Several common algorithms will be investigated, and tools for analyzing and comparing the running time of an algorithm will be presented. Course topics include: assembly language, processor components, cache memory, main memory, I/O systems, and introduction of C/C++ language, structured design, software testing and validation, linked list, trees, graphs, heaps, top-down design, dynamic programming, recursion, and asymptotic analysis. P—permission of instructor. *Hemler*

**703. Medical Imaging I.** (3) A study of several medical image modalities, including magnetic resonance imaging (MRI), positron emission tomography (PET), single photon emission computed tomography (SPECT), computed tomography (CT), and ultrasound; taught from a 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. 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. Prerequisites include MDEG 758 and MDEG 714. *Fahey, Staff*

**704. Medical Imaging II.** (3) This is a continuation of MDEG 703. A study of several medical image modalities, including magnetic resonance imaging (MRI), positron emission tomography (PET), single photon emission computed tomography (SPECT), computed tomography (CT), and ultrasound; taught from a 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. Prerequisites include MDEG 758 and MDEG 714. *Santago, Staff*

**705. Medical Physics.** (3) A study of the various physical aspects associated with the use of ionizing radiation in medicine. Basic radiobiology will be discussed as it pertains to the risks associated with the medical use of radiation. The fundamental concepts in radiation dosimetry both from external and internal sources will be covered. Radiation shielding also will be studied, particularly as to how it relates to designing a room to be used with ionizing radiation. *Bourland, Fahey*

**707. Topics in Medical Imaging.** (3) This course provides an in-depth study of modern medical imaging modalities including the techniques necessary for image analysis. Topics may vary by student and faculty interest and could include functional MRI, cardiac MRI, intravascular ultrasound, and positron emission tomography. Students will be required to consult and report on current literature. Experience with an appropriate programming tool such as Matlab or IDL is required. P—MDEG 703 and 704. *Hamilton*

**725. Statistical Pattern Recognition.** (3) A study of image pattern recognition techniques and computer-based methods for scene analysis, including discriminant functions, feature extraction, classification strategies, clustering, and discriminant analysis. Applications to medicine and current research results will be covered. Prerequisites include MDEG 614, or a course in statistics. *Santago*

**758. Digital Image Processing.** (3) A study of advanced techniques of image processing including image formation and perception, digitization, Fourier transform domain processing, restoration, enhancement, and tomographic reconstruction. *Hemler, Ge*

**759. Advanced Image Analysis.** (3) The course provides an overview of current trends in image analysis with in-depth studies of topics particularly relevant to medical imaging. Students will be required to analyze and report on current literature. Computer-oriented projects will allow the 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 placed 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—MDEG 614, 725, 758. *Santago*

**761. Medical Communications Systems.** (3) Description and related performance issues of OSI layers two and three for wide area networks, well-known standards for metropolitan area networks such as the asynchronous transmission mode (ATM), and for local area networks such as IEEE 802.5 (ethernet). Computer communications architecture issues such as network performance, topological optimization, and standard organizations. In this course two new protocols are discussed. The first is the Xpress Transfer Protocol (XTP), a high-performance protocol combining the Network and Transport protocols for the Open System Interconnect model and providing mechanisms for multicast/multipeer and multimedia communications. The second is an application medical imaging protocol, Digital Imaging and Communications (DICOM), proposed by the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA). *Staff*

**762. Medical Information Systems.** (3) Description and functional requirements of an image management and communications system (IMACS) and picture archival and communications system (PACS). Image data objects, database management, networking, imaging, and storage in an IMACS environment. Also hospital information systems (HIS). The student will prepare a report on the topic or implement an information subsystem

and make a presentation to the faculty and students. The implementation could be to take an existing implementation and use XTP as the transport protocol. *Staff*

**780, 781. Clinical Rotation I.** (2) The course gives the student 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 will be allowed to see the operation and maintenance of various clinical modalities, systems, and devices under the guidance of a working engineer or technician. The student will participate in clinical rounds and in image reading sessions to gain insight into the actual operation and needs of departments using medical imaging modalities. *Santago*

**782, 783. Clinical Rotation II.** (2) This course builds on Part I of the clinical rotation. For this in-depth portion, the student will investigate an organ system, disease process, or other medical area for which engineering principles are used. The student will work closely with a physician or physical science faculty member during this course. Independent study and written reports as well as an oral presentation describing the in-depth portion are required. *Hemler, Ge*

**792. Topics in Medical Engineering.** (1-3) Topics in medical engineering which are not considered in regular courses. Content varies. *Staff*

**797, 798. Research.** (1-12) *Staff*

## Microbiology and Immunology

*Bowman Gray Campus*

Steven B. Mizel, Chair  
Professors Louis S. Kucera, Douglas S. Lyles, Charles E. McCall,  
Steven B. Mizel, Stephen H. Richardson, Ivo van de Rijn  
Associate Professors Eugene R. Heise, Griffith Parks, Daniel J. Wozniak  
Assistant Professors Martha Alexander-Miller, David Ornelles  
Associates Jon S. Abramson, David A. Bass, Gary M. Kammer

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.

Students complete their formal course work in the first year with a core curriculum consisting of bacteriology, bacterial genetics, immunology, virology, biochemistry, and molecular biology. Also during the first year, students participate in research through three rotations in laboratories studying bacterial and viral pathogenesis, cellular and molecular immunology, and the cell and molecular biology of the microbe-host interaction. At the end of the first year, students select their research area and dissertation adviser. In the second year, Science as a Profession provides training in the art of grant-writing

and the ethical obligations of the scientist. Also in the second and subsequent years, all students and all faculty participate in the interdisciplinary, literature-based course, Advanced Topics in Microbiology, Immunology and Virology.

See the Department of Microbiology and Immunology homepage (<http://wfubmc.edu/microbio>) for further information on the department and detailed descriptions of faculty research interests.

**702. Fundamentals of Virology.** (4) A lecture course which deals with basic aspects of structure, replication, and pathogenesis of animal viruses. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas.  
P—Biochemistry. *Parks, Staff*

**703. Fundamentals of Bacteriology.** (4) A lecture course which deals with basic aspects of bacterial structure, replication, and pathogenesis. Intended for all graduate students in microbiology and immunology to provide in-depth coverage of these areas.  
P—Biochemistry. *van de Rijn, Staff*

**705. Fundamentals of Immunology.** (4) The course deals with the cellular, biochemical, and molecular aspects of cellular and humoral immunity. It is intended for all graduate students in microbiology and immunology, and provides in-depth coverage of these areas.  
P—MICR 731 or current enrollment in 731. *Alexander-Miller, Staff*

**708. Biology of Neoplasia.** (3) A multidisciplinary lecture/conference course dealing with the cell biology, molecular biology, and therapy of neoplasia. Emphasis is on presentation of experimental research models and survey of current literature pertaining to neoplasia.  
P—Biology or microbiology, immunology, biochemistry desirable. Offered in even-numbered years. *Kucera, Staff*

**710. Science as a Profession.** (1) This course includes training in the preparation of a research proposal and a discussion of the ethical conduct of scientific research.  
P—Permission of instructor. *van de Rijn*

**711. Tutorial in Medical Microbiology.** (1-3) Guided reading and discussion of the pathogenesis of infectious diseases. *Staff*

**719, 720. Research in Microbiology.** (Credit to be arranged.)

**S719. Research in Microbiology.** (Credit to be arranged.) Research training offered to graduate students with faculty advisers in a tutorial system. *Summer.*

**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.

**731. Molecular Biology.** (1 or 3) A survey of the fundamentals of molecular biology. Included are fundamentals of microbial genetics and discussions of nucleic acid structure

and multagenesis, DNA replication and recombination, transcription and control of gene expression and protein translation (1 hour). The introduction is followed by an advanced treatment of these topics, and discussions of mammalian genetics and immunogenetics with emphasis on current trends in research. P—BICM 705 or current enrollment in 705. *Bowden, Staff*

**732. Molecular Biology.** (3) Detailed lectures and discussion surveying the analysis of cellular processes, oncology, atherosclerosis and development by the experimental approaches of molecular biology. Emphasis is on eukaryotic systems and review of pertinent research literature. P—MICR 731. *Brewer, Bowden, Staff*

**749, 750. Advanced Topics in Microbiology and Immunology.** (2) A seminar course dedicated to the analysis of current research literature on the fundamental biochemical and molecular processes that are 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—Biochemistry, microbiology, immunology, and virology. *Staff*

## Molecular and Cellular Pathobiology

*Bowman Gray Campus, Friedberg Campus*

### Pathology

A. Julian Garvin, Chair

Professors Michael R. Adams, Bill C. Bullock, Thomas B. Clarkson Jr.,

A. Julian Garvin, Jay R. Kaplan, John S. Parks, Lawrence L. Rudel,

Herman H. Samson, Zakariya K. Shihabi, Carol A. Shively, Richard W. St. Clair,

William D. Wagner, Benedict L. Wasilauskas, Mark C. Willingham

Associate Professors J. Mark Cline, Paul A. Dawson, Iris J. Edwards,

Steven Feldman, Randolph L. Geary, W. Gray Jerome III, John W. Hartz,

Samy S. Iskandar, Jeanne M. Wallace, Dawn C. Schwenke, Gregory S. Shelness,

Mary Sorci-Thomas, Mary Lou Voytko, Janice D. Wagner, J. Koudy Williams

Assistant Professors Robert Brommage, Nancy L. Jones,

Cynthia J. Lees, Thomas C. Register, Richard W. Young

Adjunct Assistant Professor Scott A. Washburn

Research Instructor Madju Gupta

Instructor Jerry W. Reagan

This is an interdisciplinary program offered by the Department of Pathology leading to the PhD degree. The course of study and research is designed for students who wish to prepare for a career of research or research and teaching in pathobiology, the study of the fundamental mechanisms of disease processes. By means of course work and seminars, the student is given a firm background in the basic medical sciences, including pathology, cell biology, molecular biology, biochemistry, physiology, statistics, etc. Advanced course

work is designed to fit the interests of the individual student, and disciplinary strength may be developed in molecular, cellular, biochemical, metabolic, comparative, or morphologic aspects of disease processes. Experimental design, the use of modern techniques and procedures, and interpretation of experimental results are stressed. The student is required to fulfill a special skills requirement, such as statistics, electron microscopy, computational analysis in molecular biology, or a foreign language.

Research opportunities are available in the areas of cell and molecular biology, including gene discovery and translational genetics; macrophage and smooth-muscle cell biology; cancer biology; lipid and lipoprotein metabolism; arteriosclerosis; diabetes; hypertension; osteoporosis; nutrition; reproductive biology; nonhuman primate behavior; comparative genetics; and diseases of laboratory animals. Research is particularly strong in the area of cardiovascular disease, chiefly arteriosclerosis, with emphasis on the use of transgenic animals, pigeons, and nonhuman primates as animal models for this disease.

The program is open to qualified applicants with the BS or BA degree and a strong background in the physical and biological sciences. In addition, the program is open to applicants holding the MD or DVM degree who desire an advanced degree to prepare them for careers in research. The PhD program began in 1969, the MS in 1970.

**\*702. Fundamentals of Pathology.**

**705. Microanatomy-Cells and Tissues.** See Neurobiology and Anatomy.

**\*705. Metabolism and Bioenergetics.** See Biochemistry.

**706. Microanatomy-Organ Systems.** See Neurobiology and Anatomy.

**706. Animal Models in Biomedical Research.** See Comparative Medicine.

**709, 710. Advanced Topics in Comparative Medicine.** See Comparative Medicine.

**710. Pathologic Biochemistry.**

**713. Proteins and Enzymes.** See Biochemistry.

**715, 716. Advanced Topics in Pathology.**

**717. Pathobiology of Atherosclerosis.**

**719. Research Techniques in Electron Microscopy.**

**721, 722. Select Topics in Electron Microscopy.**

**723, 724. Specialized Training in Electron Microscopy.**

**\*725, 726. Fundamentals of Pathophysiology.**

**727, 728. Molecular and Cellular Pathobiology Seminar.**

**729, 730. Research.**

**731, 732. Molecular Biology.** See Biochemistry.

**702. Fundamentals of Pathology.** (3) An introduction to the principles of disease with special emphasis on mechanisms of cellular and tissue responses. The first portion of the course deals with methods of study; cellular pathobiology and mechanisms of inflammatory response; and genetic, immune and infectious disorders. The second portion is concerned with disorders of cellular differentiation and growth, disorders of circulation, metabolic disorders and aging. Exposure to human gross pathology is provided during the course. P—Histology or permission of instructor. *Feldman, Staff*

**704. Advanced Topics in Cardiovascular Science.** (3) A comprehensive review (from the cell to clinical studies) of the cardiovascular research done at Wake Forest University School of Medicine. Topics include: hypertension, atherosclerosis, stroke, heart failure, women and heart disease. *Williams*

**710. Pathologic Biochemistry.** (2) A lecture and student participation course designed to present concepts of biochemical changes associated with disease processes. It is meant to provide the student with examples of various ways in which biochemical changes can cause disease or result from disease. The course is not designed as a survey of all the biochemical disorders that have been described; emphasis is on the intensive discussion of examples of different mechanisms of biochemical alterations associated with disease. Examples of biochemical disorders affecting the following systems are considered: disorders of protein, amino acid, and carbohydrate metabolism; endocrine disorders; lipid storage diseases; disorders of metal, porphyrin, heme metabolism, receptors and hemostasis; diseases of muscle and connective tissue. P—General biochemistry or equivalent. *St. Clair, Staff*

**715, 716. Advanced Topics in Pathology.** (1-5) An advanced lecture and student participation course dealing with areas of new knowledge in pathobiology. Course content may change with recent advances in knowledge. Four semesters may be taken for credit. P—General pathology, Comparative Medicine 703, or permission of instructor. *Staff*

**717. Pathobiology of Atherosclerosis.** (4) A lecture course exploring intensively the pathogenetic mechanisms which underlie this most prevalent human disease. Broad areas studied include human atherosclerosis as a disease process (natural history and factors affecting extent and severity), approaches to the study of pathogenesis of atherosclerosis in man (animal models, homeostasis of serum lipids, lipoproteins, diet, behavioral factors, arterial wall metabolism, cellular and molecular biological aspects of atherosclerosis, clotting mechanisms and thrombosis, genetic factors, experimental myocardial infarction), and the scientific basis for therapy in atherosclerosis (surgery, sterol synthesis inhibitors, etc.). P—General biochemistry, general pathology, or equivalent. *St. Clair, Staff*

**718. Diagnostic Clinical Microbiology.** (2) A didactic course designed to provide the student with an understanding of basic concepts of infectious disease and how they relate to clinical microbiology. Emphasis is on the role of the clinical microbiologist in the proper collection of specimens, interpretation of laboratory results, and selection of appropriate antimicrobial agents. *Wasilauskas*

**719. Microscopy Research Techniques.** (2) An introductory course designed to develop skill in the use of microscopy in biomedical research. The basic laboratory-oriented, hands-on program provides the opportunity to develop proficiency in operation of light, video, confocal, and electron microscopes. Laboratory experience is supplemented with a lecture series introducing major research applications such as histo- and cyto chemistry, digital image processing and analysis, quantitative microscopy, 3-D microscopy, and X-ray microanalysis. *Jerome, Staff*

**721, 722. Select Topics in Microscopy.** (1-3) Laboratory-based independent study course to develop specialized practical knowledge in the use of a select research technique such as autoradiography, histo- or cytochemistry, whole-mount (3-D) microscopy, replica techniques, or morphometry. This student-initiated, individualized study is designed to meet specific research and educational needs and generally requires Microscopy Research Techniques as a prerequisite. P—Permission of instructor. *Jerome, Staff*

**723, 724. Specialized Training in Electron Microscopy.** (5,5) An intensive laboratory skills course designed to provide comprehensive technical training in all phases of electron microscopy. Intended for students wishing to develop full competency in the use of electron microscopy as a major research tool. Encompassed is training in sample processing for both transmission and scanning electron microscopy, routine microscope service, and darkroom skills. Limited enrollment. P—Permission of instructor. *Jerome, Staff*

**725, 726. Fundamentals of Pathophysiology.** (2) A lecture course which discusses the principles of normal and pathologic mammalian physiology. The first portion of the course covers homeostatic mechanism and general endocrinology. The second part of the course is organized around an organ system approach. *M. Jayo, Staff*

**727, 728. Molecular and Cellular Pathobiology Seminar.** (1,1) Seminars on topics of current interest are offered weekly by graduate students, staff, and visiting lecturers. *Sorci-Thomas, Staff*

**729, 730. Research.** Research opportunities are available in molecular and cellular pathology projects conducted in the Department of Pathology.



# Molecular Genetics

*Bowman Gray Campus*

Mark O. Lively, Director  
Professors Steven Akman, Donald W. Bowden, H. Alexander Claiborne,  
Carol C. Cunningham, Susan Hutson, Mark O. Lively, Douglas S. Lyles,  
Charles E. McCall, Steven B. Mizel, Ronald W. Oppenheim, John Parks, Peter B. Smith,  
William E. Sonntag, Ivo J. van de Rijn  
Associate Professors Paul A. Dawson, Barry Freeman,  
Roy R. Hantgan, Ross Holmes, Fred W. Perrino, Mark J. Pettenati,  
Leslie B. Poole, David Sane, Greg S. Shelness, William Sonntag,  
Mary Sorci-Thomas, Alan Townsend, Kent E. Vrana  
Assistant Professors Martha Alexander-Miller, Scott Cramer, Zheng Cui,  
James A. Hammarback, Jamal Ibdah, Constantinos Koumenis  
Mark S. Miller, Carolanne Milligan, Charles S. Morrow, David Ornelles, Griffith Parks,  
Derek Parsonage, Thomas C. Register, Paul A. Savage,  
Greg S. Shelness, Suzy Torti, Daniel J. Wozniak  
Research Assistant Professor Barb Yoza

Faculty representing eight basic science and clinical departments are brought together to form an interdisciplinary curriculum that emphasizes detailed analyses of the molecular and biological mechanisms of a wide variety of biomedical problems. The major goal of the program is to train students for independent research and teaching in the fields of molecular and cellular biology. The curriculum provides a broad treatment of the fundamental techniques of molecular biology as well as specialization which is developed through the application of the approaches of molecular biology to the research areas investigated by the Molecular Genetics faculty members. These areas include: control of gene expression; molecular pathogenesis; protein biosynthesis and compartmentalization; cell development and differentiation; carcinogenesis; development of cellular resistance to cancer; genetic linkage analysis; major histocompatibility genes; clinical cytogenetics; molecular mechanisms of mutagenesis; lymphokine function; and others. Individualized programs of study leading to the PhD degree in molecular genetics are offered.

During the first year, students participate in courses that build a strong foundation upon which to add the specialization developed later in laboratory research. The first-year courses include Molecular Biology, Proteins and Enzymes, Metabolism and Energetics, Research in Molecular Genetics and Fundamentals of Virology. Additionally, first-year students participate in laboratory rotations designed to help them choose a thesis adviser. During the second year, students begin research in their thesis laboratory and take specialty courses relevant to the research. Second-year courses include Tutorials in Molecular Biology, an advanced seminar-style course, Scientific Writing, and Computational Analysis in Molecular Biology. Thesis research is performed under the supervision of a program faculty member and is tailored to meet the interests of the individual student.

## For Graduate Students

**701, 702. Research in Molecular Genetics.** (To be arranged) Research investigations in molecular genetics are conducted in the laboratories of program members studying a wide range of disciplines. *Staff*

**702. Fundamentals of Virology.** See Microbiology and Immunology.

**705. Metabolism and Bioenergetics.** See Biochemistry.

**710. Scientific Writing.** (1) A course 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—Permission of instructor. *Staff*

**713. Proteins and Enzymes.** See Biochemistry.

**721. Computational Analysis in Molecular Biology.** (2) Lecture and laboratory. An introduction to the use of computers in analysis of gene sequences and molecular modeling. Students will learn to use a variety of computer software important to research in molecular biology, with emphasis on use of the Wisconsin Sequence Analysis Package. *Lively*

**731. Molecular Biology.** (3) A lecture course that surveys the fundamentals of molecular biology. Topics include nucleic acid structure, DNA replication and repair, transcription and translational control, microbial and human genetics. These topics are discussed with emphasis on the use of molecular approaches to research in these areas. *Perrino*

**732. Molecular Biology.** (3) Detailed lectures and discussion surveying the analysis of cellular processes, oncology, arteriosclerosis and development by the experimental approaches of molecular biology. Emphasis is on eukaryotic systems and review of pertinent research literature. *Staff*

**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 will be placed on the search for genes which 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. P—Molecular Genetics/Biochemistry/Microbiology-Immunology 731 or permission of instructor. *Bowden*

**741, 742. Tutorials in Molecular Biology.** (2,2) A 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. *Staff*

**751. Medical Genetics.** (3) An introduction to the principles and clinical evaluation of human genetic diseases. The course will cover 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 will be presented.

*Pettenati, Staff*

## Molecular Medicine

*Bowman Gray Campus*

Floyd H. Chilton (Ski) , Director

Mary Beth Fasano, Associate Director and Recruiter

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 an unparalleled time of opportunity and excitement for basic and clinical scientists. Both basic and clinical scientists can now test novel and provocative hypotheses using tools such as recombinant DNA, nuclear magnetic resonance, mass spectrometry, and monoclonal antibodies and quickly acquire results that would have seemed only fanciful science fiction 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.

In many major academic medical centers in this country, new advances have largely erased many of the historical divisions between basic and clinical scientists. For modern-day clinicians to understand and to take advantage of new developments, they often spend a great deal of time at both the bedside and the bench. On the other hand, the potential to understand mechanisms of and have an impact on the treatment of human diseases has lured some basic scientists to move closer to their clinical counterparts. This movement into the clinical arena facilitates the challenge of viewing a complex clinical disorder through the eyes of the basic scientist. Moreover, ideas generated in a clinical setting by the basic scientist can often quickly transcend into an understanding of the role of a particular biological process in a human disease and ultimately the development of a treatment for that disease. 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. These developments have created a unique niche for basic (PhD) scientists who are trained on the cutting edge of molecular advances to perform “translational” research in human biology.

To meet the challenge of training basic scientists who function successfully in clinical environments, the new program in molecular medicine will provide training in the use of cellular, molecular, and integrative approaches to investigate mammalian biology with an emphasis on human disease. This is a multidisciplinary program with a faculty consisting of scientists who have major ongoing human research programs. This program offers PhD students a comprehensive knowledge of human biology and disease which will allow them to develop basic research programs with fundamental clinical implications. This program

is designed to train biomedical researchers who fill an important niche in both academia and industry.

A master's degree in molecular medicine is also available for qualified MD candidates. The overall objective of this program is to train individuals who already hold an MD degree at the cellular and molecular level and to integrate this basic training with clinical applications involving human disease. The program is designed to provide physicians with the skills to develop and apply sophisticated biochemical and molecular approaches useful in the understanding, diagnosis, and treatment of human disease. It is hoped that this program will enhance interaction between PhDs and MDs in clinical departments who are engaged in fundamental bench research that is focused on human disease.

More information regarding both the PhD and the master's in molecular medicine are available on our homepage, [http://www.wfubmc.edu/mol\\_med/](http://www.wfubmc.edu/mol_med/), and prospective students are encouraged to contact individual faculty members.

## Required Courses

**702. Fundamentals of Pathology.** (3) See Molecular and Cellular Pathobiology.

**705. Medical Microanatomy—Cells and Tissues.** (2) See Neurobiology and Anatomy.

**705. Metabolism and Bioenergetics.** (3) See Biochemistry.

**707. Introduction to Statistics.** (3) See Health Services Research.

**707. Biochemical Techniques.** (2) See Biochemistry.

**710. Pathologic Biochemistry.** (2) See Molecular and Cellular Pathobiology.

**710. Cell Biology.** (3) See Neurobiology and Anatomy.

**711, 712. Advanced Topics in Molecular Medicine.** (1, 1) A course designed to describe a human disease, first in clinical terms and then to follow the development of the understanding of that disease to the molecular level. This course will introduce students to potential preceptors and allow the students to see experimental strategies used to study human disease by faculty in the program. *Chilton*

**713. Proteins and Enzymes.** (3) See Biochemistry.

**715. Clinical Molecular Medicine.** (3) This course will serve as an introduction to clinical medicine. Students will be required to round with medicine and pediatric teams both on the wards and in the intensive care units. Students will observe and interface with medical decision-making and therapy as it applies to patient care and serve as a source of basic science information to the healthcare team. The opportunity to rotate through many of the specialty and subspecialty clinics, as well as the specialty labs, will be provided. At the

completion of the rotation, students should demonstrate the ability to obtain and write up a medical history from patients. *Fasano*

**717. Pathobiology of Atherosclerosis.** (4) See Molecular and Cellular Pathobiology.

**721. Introduction to Molecular Medicine I.** (3) This course is designed to provide the graduate students with a command of the basic principles and language underlying the scientific basis of medicine today. This course differs substantially from the medical school curriculum in that it emphasizes the cellular and molecular mechanisms of health and disease, and will point out the important issues and research questions in each field. It differs from a standard graduate program in that it integrates medicine into a basic science foundation to teach the student how to understand and address basic questions in human disease. At the end of this course, the graduate students should have a working knowledge of the basis of common human diseases and treatment and be able to confidently navigate through the evolution of a disease and its medical literature. *Payne*

**722. Introduction to Molecular Medicine II.** (3) Winter semester. Continuation of Molecular Medicine 721. This course is designed to provide the graduate students with a command of the basic principles and language underlying the scientific basis of medicine today. This course differs substantially from the medical school curriculum in that it emphasizes the cellular and molecular mechanisms of health and disease, and will point out the important issues and research questions in each field. It differs from a standard graduate program in that it integrates medicine into a basic science foundation to teach the student how to understand and address basic questions in human disease. At the end of this course, the graduate students should have a working knowledge of the basis of common human diseases and treatment and be able to confidently navigate through the evolution of a disease and its medical literature. *Payne*

**731. Molecular Biology.** (3) See Biochemistry.

**732. Molecular Biology.** (3) See Biochemistry.

**734. Human Molecular Genetics.** (2) See Molecular Genetics.

**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.

# Neurobiology and Anatomy

*Bowman Gray Campus*

Barry E. Stein, Chair

Professors Walter J. Bo, M. Gene Bond, Judy K. Brunso-Bechtold, Craig K. Henkel, Ronald W. Oppenheim, Barry E. Stein, Michael Tytell

Professors Emeritus David M. Biddulph, Charles E. McCreight, W. Keith O'Steen

Associate Professors James E. Johnson, John G. McHaffie, Mary Lou Voytko

Associate Professor Emeritus Inglis J. Miller Jr.

Assistant Professors Robert C. Coghill, Dwayne W. Godwin,

James A. Hammarback, Lucien Houenou, Huai Jiang, Wan Jiang,

James E. Johnson, Daeyeol Lee, Carolanne E. Milligan, Jian Mu,

David R. Riddle, Terrence R. Stanford, Andrew J. Sweatt,

Rong Tang, J. William Vaughan, Mark T. Wallace

The Department of Neurobiology and Anatomy offers a graduate program leading to the PhD degree for students interested in research and teaching in areas of contemporary neuroscience and anatomy.

The department offers a flexible and highly individualized curriculum designed to fit the needs and interest of the student. The first year core has been developed to provide the student with a solid foundation in the areas of Neuroscience, Biochemistry/Physiology and Cell and Structural Biology. In addition, during this time, students gain practical laboratory experience by participating in a series of research rotations. In their second year, many students opt to specialize in one of the two core academic and research areas within the department—Systems Neurobiology or Developmental Neurobiology. During the second year, students typically choose a research area and begin thesis work. Throughout the course of graduate training in the department, an emphasis is placed on the development of such important issues as mentoring, networking, career options, presentation skills and grant writing. The department is home to a federally sponsored training program in Sensory Systems that funds both pre- and postdoctoral fellowships.

There is a wide diversity of research interests within the department. These include such topics as sensory, multisensory and sensorimotor integration, naturally occurring cell death and the role of neurotrophins, regeneration and repair of nervous system damage, aging and its impact on the nervous system, cellular differentiation and migration, heat shock and cytoskeletal proteins, and the pathogenesis of atherosclerosis.

The department is home to a number of state-of-the-art research facilities, including core laboratories for molecular biology, electron microscopy, video microscopy, electrophysiology and behavior/psychophysics. In addition, numerous institutional cores and laboratories are readily accessible to students in the department program.

Applicants applying for the graduate program should have demonstrated undergraduate proficiency in biology, chemistry, physics and mathematics, and should also have satisfactory scores on the Graduate Record Examination. The PhD was first offered in 1961.

**701. Gross Anatomy.** (10) This course is designed for graduate students. It consists of in-depth dissection of the human body and cross-sectional anatomy. Students are given special reading assignments which are designed to bring together fundamental concepts of gross anatomy and microscopic anatomy. In addition, students are required to read additional articles concerned with some of the major concepts of gross anatomy. Evaluation will be based on performance in the laboratory, conferences, and oral and written examinations. P—Chordate Anatomy. *Bo, Staff*

**703. Embryology.** (2) An in-depth course designed for graduate students consisting of an introduction to the morphological development of the human embryo and fetus, including developmental anomalies. The development of the major tissues and organ systems will be examined. Principles and concepts of early development also will be explored by focusing on several fundamental phenomena in development. These include induction, cell and tissue interactions, gastrulation, progressive determination and differentiation, differential gene expression, and molecular aspects of development, pattern formation, hormones, and related growth factors. Both classical and modern techniques in developmental biology will be included, and descriptive and experimental approaches will be discussed. *Oppenheim, Staff*

**704. Molecular Neuroscience.** (3) This course will introduce graduate and advanced undergraduate students to the basic principles of neurobiology as studied by cell and molecular biologists. Lectures will introduce invertebrate and vertebrate model neuronal systems and the cellular and molecular methods to study them. P—Permission of instructor. (Also listed as Neuroscience 704.) *Hammarback, Staff*

**705. Microanatomy-Cells and Tissues.** (3) This course, designed for graduate students, includes lectures and laboratories, plus a weekly conference to discuss lecture material in-depth and integrate it with current research where applicable. *Tytell, Staff*

**706. Microanatomy-Organ Systems.** (3) In-depth lecture and laboratory course, designed for graduate students, which deals with the microscopic structure of the major organ systems of the body. Weekly conferences provide for an evaluation of the current literature and research methods in selected areas in addition to full participation of the lectures and laboratories. P—705. *Staff*

**710. Cell Biology.** (3) An interdisciplinary course utilizing faculty from several departments. Historical and current concepts relating to cell theory, experimental approaches to the study of cells, and knowledge of cellular components are discussed in detail. The cell surface, nucleus, and cellular organelles are presented in relation to membrane turnover, cell division, cellular growth, and energetics, as well as cell motility and regulation. Several features of cellular metabolism also are covered. P—705 and Biochemistry 705 or equivalent and permission of instructor. *Tytell, Staff*

**712. Introduction to Neuroscience I.** See Neuroscience.

**712. Developmental Neurobiology.** (3) The development of the central and peripheral nervous system will be examined from its earliest stages in the embryo to the onset of neuronal function and behavior. A major focus will be on developmental principles of neuronal organization. Some of the major topics to be discussed include neural tube induction, pattern formation, proliferation, migration, phenotypic determination and differentiation, cell death, hormones and related growth factors, axonal outgrowth, pathway formation, synaptogenesis, plasticity (regeneration and sprouting), neuronal physiology, and the initiation of behavior. A previous course in embryology or developmental biology is strongly recommended. *Oppenheim, Staff*

**713. Introduction to Neuroscience II.** See Neuroscience.

**717, 718. Special Topics in Gross Anatomy.** (1 or 2, 1 or 2) Special dissection of selected areas of the body, as well as discussions and reading assignments in those areas. P—701.

**719, 720. Special Topics in Microanatomy.** (1 or 2, 1 or 2) Special preparations and discussions, seminars, and reading assignments in selected areas of histology. P—*Permission of instructor.*

**720, 721. Developmental Biology of the Neuromuscular System.** (See Interdisciplinary Program in Neuroscience.)

**721, 722. Special Topics in Developmental Biology.** (1 or 2) This course deals with selected current topics in the field of developmental biology. The course includes seminars, discussions, and reading assignments in the areas of interest. P—*Permission of instructor.*

**735. The Development and Anatomy of Sensory Systems.** (3) This course is designed as an introduction to the structure and ontogeny of the sensory pathways. The aim of the course is to provide a foundation for the subsequent advanced course work in sensory systems, which provides one of the most fertile experimental areas in developmental biology. Topics will 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. *Brunso-Bechtold, Riddle*

**741. Sensory Neuroscience I: Audition and Vision.** (6) This course is designed to introduce students to auditory and visual sensory neurobiology from the cellular to systems level. The first segment of this course will emphasize the auditory system and will include the following topics: signal transduction and sensory coding in the cochlea; the perception of pitch, derivation of position through interaural phase differences; auditory processing in the ascending pathways and cortical processing of sound; electroreception in fish as a specialization of the auditory pathway; prey localization by barn owls and echolocation in bats. Coverage of the visual system will include: signal transduction, sensory coding and pattern perception in the retina; receptive field analysis at the retina, lateral geniculate



nucleus, superior colliculus and cortex; Fourier theorem applied to sensory systems; multiple visual areas of cortex; higher order processing in parietal cortex and inferotemporal cortex; color and motion. Separate laboratory exercises will present techniques used in the study of these systems. *Godwin*

**742. Sensory Neuroscience II: Somatosensation, Taste and Olfaction.** (6) This course will emphasize the somatosensory system as well as the chemical senses of taste and olfaction. The following topics will be covered: peripheral sensory receptors in the skin and joints, and signal transduction; texture encoding and receptive field structure of somatosensory neurons; perception of pain and phantom limb phenomena; localization of somatosensory stimuli on the body surface; somatosensory processing in the ventrobasal thalamic complex and primary somatosensory cortex; encoding of taste; hypotheses of taste perception; higher level olfactory processing. Separate laboratory exercises will present techniques used in the study of these systems. *McHaffie*

**743. Sensory Neuroscience III: Higher Order Interactions and Integration.** (3) This course is designed to integrate the information presented in I and II into a unified view of sensory systems. Comparison and contrasts will be made between sensory systems at key points along the ascending pathways including the cellular basis of response properties as well as neurochemical transmission and interactions with voltage-dependent membrane conductances. Higher order phenomena, including attention, sensory neglect and the merging and interaction of the senses in the cerebrum and midbrain will be emphasized, as well as neuropathologies associated with deficits in one or more sensory systems. In addition, this course will include a detailed consideration of clinical neuroscience and neuropathology. The Department of Otolaryngology will participate in this aspect of the course. Separate laboratory exercises will present techniques used in the study of these systems. *Stanford*

**745. Special Topics: Thalamus.** (1-2) The thalamus is often considered a simple gateway to the cerebral cortex, but it has a variety of complex functions—such as interactions with other thalamic nuclei and the cerebral cortex—that affect our perceptions and actions. This course considers the thalamus from a multidisciplinary perspective, with directed readings on the detailed neuroanatomy, neurophysiology and neuropharmacology of the thalamus designed to portray a unified view of its many functions in health and disease. P—Permission of instructor. *Godwin*

**747, 748. Directed Journal Club in Sensory Neuroscience.** (2) This course is designed to correlate with topics in journal club readings the formal lecture courses in Sensory Neuroscience I-III. In this course, students will be required to read and critique papers chosen to complement the classroom lectures. Both seminal papers and current research will be reviewed. The aims of this course are two fold. First, the directed nature of the readings will enhance the student's appreciation and understanding of the formal lectures. Second, students will lead the in-class presentation of the journal articles, thus providing opportunities for teaching in the area of sensory systems. *Wallace*

**751. Developmental Neurobiology I: Molecular Control of Neural Lineages and Differentiation.** (6) This course is 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 will 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 will introduce 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). *Johnson*

**752. Developmental Neurobiology II: Progressive and Regressive Events in Neural Development.**

(6) This course will emphasize 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 in the course will be topics concerning the development, specificity and pruning of synaptic connections in neural networks. The role of cell adhesion and extracellular matrix in the formation of neural networks will be included. Students will examine both historical and current molecular models of cell death, neurotrophism, neurotrophic factors and their receptors. A weekly hands-on tutorial will introduce 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 TUNNEL labeling of cell death, methods of axonal and dendritic labeling and EM ultrastructural analysis of synaptic changes). *Oppenheim*

**753. Developmental Neurobiology III: Neural Plasticity and Regeneration.** (4) This course will focus on the capacity of neural networks to be modified by experience or to be reconstructed after injury. The course will examine 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. The course will also review current attempts to utilize neural transplantation to enhance the recovery of function in models of neurological diseases and trauma. Students will examine both historical and current models of neural plasticity and regeneration through prescribed readings, tutorials and interactive discussion sessions. *Riddle*

**757, 758. Directed Journal Club in Developmental and Molecular Neurobiology.** (2) This course is designed to correlate with topics in journal club readings, the formal lecture courses in Cellular, Molecular and Developmental Neurobiology I-III. In this course, students will be required to read and critique papers chosen to complement the classroom

lectures. Both seminal papers and current research will be reviewed. The aims of this course are two fold. First, the directed nature of the readings will enhance the student's appreciation and understanding of the formal lectures. Second, students will lead the in-class presentation of the journal articles, thus providing opportunities for teaching in these areas. *Milligan*

**761, 762. Research Design in Neurobiology.** (2-3) This course sequence emphasizes training in the essential elements of biomedical research design. The class sequence will begin in the summer prior to other course work, in a two-hour course emphasizing the articulation, definition and prioritization of neurobiological research problems as well as formulation of strategies to address these problems. Statistical design focused on special requirements of sensory neurobiological inquiry will also be covered. In the following semesters, the concepts introduced in the first course will be applied to student preparation (under the guidance of faculty mentors) of grant proposals styled after National Research Service Awards, that could be submitted to the appropriate agencies at the end of this course. The culmination of this series of courses will be a NIH-styled Study Section wherein students will take part in the critique and evaluation of research proposals. *Staff*

**771, 772. Career Development in Neurobiology.** (1) This course is structured to address practical issues related to establishing and maintaining a career in Neurobiology. Students will be trained in the necessary skills to create employment opportunities, either in a traditional tenure-track academic environment, or in the rapidly growing areas of biotechnology in industry and government. As part of this course, students will be exposed to neurobiology-oriented biotechnology research in the local area of the Research Triangle Park. Other major topics to be covered in this course include: managing and supervising a research laboratory, preparation for job interviews, biomedical ethics and animal welfare issues. *Staff*

**790. Marine Models in Cell Biological Research.** (6) An eight-week course with an emphasis on independent research that is taught during the summer at the Marine Biological Laboratory in Woods Hole, MA. Students attend lectures and seminars in areas of cell and developmental biology and neurobiology. Each student will be guided in a research project selected from the area of expertise of participating faculty. Research projects will be designed to take advantage of the special facilities of the Marine Biological Laboratory, such as confocal microscopy and intracellular Ca<sup>++</sup> imaging, and the availability of a wide variety of marine organisms. Students will write up their results in the standard format used for scientific journal publication. They will have the option of presenting their work orally at the annual MBL scientific meetings. This course is a companion to the undergraduate biology course (395S). P—Permission of the instructors. *Tytell, Browne*

**791, 792. Research.** (1-9) Closely supervised research in various topics in biological structure, developmental and cell biology, and neuroscience, including research in preparation for the doctoral dissertation. *Staff*

# Neuroscience

*Bowman Gray and Reynolda Campuses*

Ronald W. Oppenheim, Director

Samuel A. Deadwyler, Associate Director

The faculty is composed of over 100 members 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 composed of courses in: Introduction to Neuroscience I & II, Behavioral Neuroscience, Neuropharmacology, Molecular Neuroscience, and Clinical Neuroscience. Students also are required to take course work 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 course work 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 the cellular and molecular biology of neurons and with specialized skills in a specific sub-area of neurobiology.

Areas of research expertise of the faculty include: developmental neurobiology; neurobiology of aging; neurobiology of drug abuse; neural basis of memory; learning and plasticity; nerve growth and regeneration; visual sciences; sensory neurobiology; neuropsychology; epilepsy; cellular and molecular neurobiology; repair of the injured nervous system; and neurodegenerative diseases.

As a major center of neuroscience research, the University, including the medical school, has modern research facilities that cover all areas of contemporary neurobiological investigation, from gene cloning and molecular genetics to electrophysiology, cell biology, and behavioral analysis. The PhD program began in 1989.

For more information, please visit our homepage at <http://www.wfubmc.edu/nba/neurosci>. Prospective students are encouraged to contact individual neuroscience faculty members.

## Core Courses

**701. 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 aspects of behavior. A broad overview of the field and its relationship to these individual disciplines will be presented. The course will provide a survey of the field from the cellular level to the complexity of molar aspects of behavior including learning and memory. An introduction to laboratory models of human neurobiological disorders will also be included. *Roberts, Staff*

**702. Neuroscience Animal Behavior.** (3) Seminar-style course including discussion, research projects, presentations, and trips to observe animals in the field. This survey of laboratory and field research will consider current issues in the context of classic animal behavior. P—Permission of instructor. *Shively*

**703. Introduction to Clinical Neuroscience.** (3) A series of lectures and discussion of topics dealing with the pathophysiology of patients with neurological problems. This course is an introduction to major concepts of patient care with utilization of up-to-date methodology in clinical neuroscience. Students have the opportunity to participate in patient evaluation and diagnostic testing in the clinical setting. *Vogt*

**704. Molecular Neuroscience.** (3) This course will introduce graduate and advanced undergraduate students to the basic principles of neurobiology as studied by cell and molecular biologists. Lectures will introduce invertebrate and vertebrate model neuronal systems and the cellular and molecular methods to study them. P—Permission of instructor. (Also listed as Neurobiology and Anatomy 704.) *Hammarback, Staff*

**707. Neuropharmacology.** (3) General survey of neuropharmacology, emphasizing neurotransmitters, receptors and their interactions. The course will discuss general principles of drug action, including receptor binding, second messengers, and neurotransmitter metabolism. It also will survey neurotransmitter function, including acetylcholine, biogenic amines, excitatory and other amino acids, and neuropeptides. *Delbono, Staff*

**712. Introduction to Neuroscience I.** (5) Neuroscience I is the first in a required two-course series for first-year neuroscience students covering basic topics in the neurosciences. Neuroscience I is offered only in the fall semester and deals with neuroanatomy (six weeks), cellular and molecular neuroscience (six weeks), and developmental neuroscience (three weeks). Approximately one third of the course will include laboratory work in neuroanatomy. *Oppenheim, Staff*

**713. Introduction to Neuroscience II.** (4) Neuroscience II is the second in the series of required courses for first-year neuroscience graduate students covering basic topics in the neurosciences. Neuroscience I is a prerequisite for Neuroscience II. Topics covered include: developmental neuroscience (3 weeks), sensory systems (six weeks) and motor systems (six weeks). Lectures will be given by faculty in the neuroscience program. There will be additional participation required outside of lecture in the form of a presentation at the end of the semester. Neuroscience 712 is a prerequisite for Neuroscience 713. *Oppenheim, Staff*

#### Advanced Courses and Seminars

**626. Learning Theory and Research.** See Psychology.

**629. Perception.** See Psychology.

**633. Motivation of Behavior.** See Psychology.

**661. Operant Conditioning and Behavior Modification.** See Psychology.

**700. Behavioral Pharmacology.** (3) This course will focus on behavioral factors that influence the effects of drugs. Material presented will provide a detailed review of the rate-dependent, reinforcing, and stimulus effects of drugs. Additional topics will include rate dependency, behavioral factors related to tolerance and sensitization and a review of animal models of drug action. *Staff*

**701. Neuropsychology and Learning Disorders.** See courses in Clinical Sciences, Psychology 767.

**702. Neuroscience Animal Behavior.** Seminar-style course including discussion, research projects, presentations, and trips to observe animals in the field. This survey of laboratory and field research will consider current issues in the context of classic animal behavior. P—Permission of instructor. *Shively*

**706. Neuropeptides, Neurotransmitters and Receptors.** (2) Topics course dealing with specialized areas of neuropharmacology. Topics will include molecular biology of neurotransmitter receptors, second messenger systems, and regulation of neuropeptides and neurotransmitters. *Childers*

**708. Neurobehavioral Pharmacology.** (3) Topics course dealing with specialized areas in behavioral pharmacology, to include the neurobiological components of the behavioral effects of drugs, the neurobiology of drug abuse, and the neurotoxic effects of drugs. Additionally, there will be discussions on research design and evaluation in this area and the development of laboratory models for the pharmacological treatment of behavioral disorders. *Staff*

**709. Seminars in Neuroscience.** (0) A series of research presentations by invited speakers from other institutions that will discuss modern concepts, methods, and approaches used in understanding nervous system structure, function, and pathology. This is a required two-semester course for first-year neuroscience students. *Oppenheim, Staff*

**710. Cell Biology.** See Neurobiology and Anatomy.

**710. Autonomic Pharmacology.** See Physiology and Pharmacology.

**710. Special Topics in the History of Neuroscience.** (2) Discussions of important historical milestones and individual contributions to the present day conception of nervous system structure, function and pathology. *Oppenheim*

**711. Special Topics in Developmental Neurobiology.** (2) A course 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, neuron-glia interactions, and neurotrophic agents. *Oppenheim, Brunso-Bechtold, Johnson*

**712. Pharmacology of Aging.** See Physiology and Pharmacology.

**712. Developmental Neurobiology.** See Neurobiology and Anatomy.

**713. Morphogenesis.** See Neurobiology and Anatomy.

**714. The Development of the Synapse and Synaptic Function.** (3) An examination of the morphological and physiological differentiation of vertebrate synapses in the peripheral and central nervous system. P—Neuroscience 701, 709, 710. *Staff*

**715. Neuroscience Tutorial.** (0) A tutorial format course required in the fall and spring semesters of all PhD students in the neuroscience program. A one-hour presentation by faculty and students of current research topics being conducted in the neuroscience program followed by a one-hour discussion of the topic and of recent research or review articles in the same area of research. *Oppenheim, Staff*

**715. Sensory Neurobiology.** See Neurobiology and Anatomy, Physiology and Pharmacology.

**715. Research Design and Analysis in Psychology.** See Psychology.

**716. Neurotrophic Factors.** (2) Objectives: 1) Review the history of the neurotrophic hypothesis; 2) Current review of neurotrophic molecules; 3) Analysis of the current status of the neurotrophic hypothesis; 4) Develop student skills in analysis and criticism of original literature (including discussion of experimental design and written expression of hypothesis testing). *Johnson, Oppenheim*

**717. Summer Neuroscience Tutorial.** (1) A summer session tutorial format course required of all PhD students in the neuroscience program. A one-hour presentation by students on their current research area. Students will be evaluated by faculty and peers on their presentation and given overall assessment of their introduction, methods, graphics, explanation of data, conclusions, and speaking style and rapport with the audience. *Oppenheim, Staff*

**718. Readings in Cellular Neurophysiology.** See Physiology and Pharmacology.

**720. Biological Psychology.** See Psychology.

**720, 721. Developmental Biology of the Neuromuscular System.** (2) This course will emphasize the neural control of skeletal muscle development at both cellular and molecular levels. Mechanisms of muscle innervation and the trophic effect of muscle on motor neurons will also be examined. Finally, the course will provide some discussion of known neuromuscular diseases. P—Permission of instructor.

**723, 724. Special Topics in Neuroanatomy.** See Neurobiology and Anatomy.

**725, 726. Neuroscience Research.** (1-12) Laboratory 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. *Staff*

**727. Basic Retinal Cell Biology.** See Neurobiology and Anatomy.

**727. Theories of Learning.** See Psychology.

**728. Advanced Retinal Cell Biology.** See Neurobiology and Anatomy.

**729, 730. Retinal Research Techniques.** See Neurobiology and Anatomy.

**731. Molecular Biology.** See Biochemistry.

**731, 732. Tutorials in Visual Science.** See Neurobiology and Anatomy.

**743. Neuroendocrinology.** See Physiology and Pharmacology.

**746. Neurobiology.** See Biology.

**753. Psychophysiology of Disease Processes.** See courses in Clinical Sciences.

**763. Nerve Cell Physiology and Plasticity.** See Physiology and Pharmacology.

**764. Sensory Biology.** See Biology.

**767. Physiology of Aging.** See Physiology and Pharmacology.



# Physics

*Reynolda Campus*

G. Eric Matthews, Chair  
Reynolds Professor Richard T. Williams  
Professors Keith D. Bonin, George M. Holzwarth,  
Natalie A. W. Holzwarth, William C. Kerr, G. Eric Matthews,  
Howard W. Shields, George P. Williams Jr.  
Associate Professors Paul R. Anderson, Eric D. Carlson  
Assistant Professors Gregory B. Cook, Daniel Kim-Shapiro  
Adjunct Professor George Cvijanovich  
Adjunct Associate Professors Fred Fahey, Peter Santago  
Adjunct Assistant Professor John D. Bourland

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 a knowledge of 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.

For the MS degree, the student's course of study must include Physics 711, 712, and 741, as well as participation in departmental seminars. These seminars, in fields of special interest, are regularly scheduled and usually feature outside speakers. 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.

For the PhD degree, students will normally take Physics 711 (Classical Mechanics), 712 (Electromagnetism), 741, 742 (Quantum Mechanics), 731 (Particle Physics), and 770 (Statistical Mechanics) unless satisfactorily completed elsewhere. A Research Advisory Committee, appointed after completion of the general examination, determines the additional courses needed for the PhD, such as Advanced Quantum Mechanics, Solid State Physics, General Relativity, Nonlinear Optics, Math or Computer Science, Medical Engineering, etc. The University's preliminary examination requirement is satisfied by passing a written preliminary examination at the end of the first year of graduate study. The examination may be retaken once, at the end of the second year. Within twelve months of completing the preliminary examination, the student submits to his or her individual Advisory Committee, and defends orally a dissertation research plan. 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 research interests of the graduate faculty are in experimental solid state physics, atomic physics, experimental biophysics, and in theoretical condensed matter physics, particle physics, and relativity. Well-equipped laboratories are available for subpicosecond pulsed laser studies, surface physics, excimer laser interaction with materials, time-resolved spectroscopy of defects in insulators, A.C. susceptibility, thermally stimulated depolarization measurements of defects in ionic solids, electron spin resonance studies of irradiation damage in solids and biological materials, time-resolved biospectroscopy, and video microscopy. Theoretical research is supported by a networked set of six DEC Alpha computers.

For more details on the PhD program, check our Web pages (<http://www.wfu.edu/physics>) or write to the chair of the graduate committee. Departmental graduate committee: G. Holzwarth (chair), Carlson, Kerr, Kim-Shapiro, Matthews, R. Williams.

## For Advanced Undergraduates and Graduate Students

**601, 602. Physics Seminar.** (0,0) Discussion of contemporary research, usually with visiting scientists. Attendance required of junior and senior physics majors.

**603. Biophysics.** (3) An 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 will be emphasized. P—Physics 113, 114 as well as Biology 112 or 214 or permission of instructor.

**604. Physics of Medical Imaging.** (3) Physical principles of x-ray computed tomography (CT), positron emission tomography (PET), single-photon emission computed tomography (SPECT), magnetic resonance imaging (MRI), and ultrasonic imaging. P—Physics 113, 114 as well as Mathematics 111-112 or permission of instructor.

**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. P—Physics 114, 141.

**612. Introduction to Stellar Astronomy.** (3) The physics of stellar atmospheres and interiors. Topics covered will include radiation transfer, absorption and emission of radiation, formation of spectra, models for stellar interiors, nuclear fusion reactions and stellar evolution. Methods of measuring distances to stars and interpretation of stellar spectra will also be included. P—Physics 114, 141, Mathematics 601.

**620. Physics of Macromolecules.** (3) The physics of large molecules, especially proteins and nucleic acids, including the structural basis for secondary and tertiary structure; polymer solution thermodynamics; experimental methods for determining molecular weight and conformation; polyelectrolyte theory and binding; statistical thermodynamics and

kinetics of molecular motion and configurational change. P—Physics 651 or Chemistry 641 or Biology 671.

**630. Data Acquisition and Analysis.** (3) Advanced treatment of computer interfacing, signal processing methods, non-ideal integrated circuit behavior (offset voltage, bias current, fan-out, fan-in) and data reduction and fitting procedures. P—Physics 130, 230.

**637. Analytical Mechanics.** (1.5) The Lagrangian and Hamiltonian formulations of mechanics with applications. This course is taught in the first half of the fall semester. P—162, Mathematics 251.

**639, 640, 642. Electricity and Magnetism.** (1.5,1.5,1.5) 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 Physics 637. The other two are taught in the first and second halves of the spring semester. These should be taken in sequence. P—Physics 114, Mathematics 251 and 601.

**643, 644. Quantum Physics.** (3,3) Application of the elementary principles of quantum mechanics to atomic, molecular, solid state, and nuclear physics. P—Physics 141.

**645. Advanced Physics Laboratory.** (1) The laboratory associated with Physics 643, 644.

**651. Thermodynamics and Statistical Mechanics.** (3) Introduction to classical and statistical thermodynamics and distribution functions.

**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) A survey of the structure, composition, physical properties, and technological applications of condensed matter. P—Physics 643.

**681, 682. Research.** (1-3,1-3) Library, conference, and laboratory work performed on an individual basis.

## For Graduate Students

**711. Classical Mechanics.** (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. *Kerr; N. Holzwarth*

**712. Electromagnetism.** (3) A study of Maxwell's equations, boundary value problems for the electromagnetic field, and radiation; the ponderomotive equation for the charged particle. *N. Holzwarth*

**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—three hours. *R. Williams*

**731. Elementary Particle Physics.** (3) Fundamentals of contemporary elementary particle physics. *Carlson*

**741, 742. Quantum Mechanics.** (3,3) The 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. *Anderson, N. Holzwarth, Kerr, Carlson*

**743. Advanced Quantum Mechanics.** (3) Advanced topics in quantum mechanics, including an introduction to relativistic quantum theory, quantum electrodynamics, and many particle treatments. *Anderson, N. Holzwarth, Kerr, Carlson*

**744. Introduction to Quantum Field Theory.** (3) An introduction to relativistic quantum field theory, including canonical quantization, path integral techniques, perturbation theory, and renormalization. *Anderson, Carlson*

**745. Group Theory.** (3) Group theory and its applications to the quantum mechanics of atoms, molecules, and solids. *Carlson*

**752. Solid State Physics.** (3) An 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. *Kerr, N. Holzwarth, Matthews, R. Williams*

**754. Surface Science.** (3) Experimental and theoretical methods for the study of surfaces and interfaces. Lab—1.5 hours. *N. Holzwarth, R. Williams*

**755. Magnetic Properties of Solids.** (2) Diamagnetism, paramagnetism, and ferromagnetism treated, with special emphasis on application of nuclear and spin resonance techniques. *Shields*

**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. *Matthews, R. Williams*

**770. Statistical Mechanics.** (3) An 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. *Kerr*

**780. Theory of General Relativity.** (3) A study of the covariant formulation of physical laws in mechanics and electromagnetism. *Anderson, Cook*

**785. Topics in Theoretical Physics.** (1-3) Selected topics of current interest in theoretical physics not included in other courses. *Carlson, N. Holzwarth, Kerr, Anderson, Cook*

**791, 792. Thesis Research.** (1-9) *Staff*

**793. Summer Research.** This is a course for summer research by continuing graduate students working with their adviser. *Staff*

**891, 892. Dissertation Research.** (Hours open) *Staff*

## Physiology and Pharmacology

*Bowman Gray Campus*

James E. Smith, Chair  
Professors Michael Aschner, David W. Busija, Steven R. Childers,  
Samuel A. Deadwyler, Allyn Howlett, Kathleen A. Grant, Linda Porrino,  
David C.S. Roberts, James C. Rose, Herman H. Samson, James E. Smith,  
William E. Sonntag, Jack W. Strandhoy, Donald J. Woodward  
Associate Professors Osvaldo Delbono, J. Charles Eldridge,  
David R. Friedman, Robert Hampson, Michael A. Nader,  
Brent A. Vogt, Kent E. Vrana  
Assistant Professors Michael Callahan, Jing-Yu Chang, Anthony Liguori,  
David Lyons, T. Jeff Martin, Jian Mu, Jeff Weiner, Shou Y. Zhuang  
Associates David B. Averill, Martin Bitzen, K. Bridget Brosnihan,  
Vardaman M. Buckalew Jr., John Butterworth, Mark C. Chappell,  
Che-Ping Cheng, Floyd Chilton, Robert A. Cordell, Carol Cunningham,  
Debra I. Diz, Carlos Ferrario, Jorge Figueroa, Patricia Gallagher,  
Gregory L. Kucera, Robert H. Mach, Henry S. Miller,  
Mark Miller, Thomas E. Nelson, R. Mark Payne, Tim Pons,  
Bruce Rubin, David Sane, Thomas L. Smith, E. Ann Tallant, Sheila Vrana  
Adjunct Professor Hermes Yeh  
Adjunct Associate Professors J. Donald deBethizy, Huw Davies,  
David J. Doolittle, Ronald A. Fleming, Walter S. Pritchard, John Robinson,  
James T. Stevens, Jakob Vinten-Johansen  
Adjunct Assistant Professors Merouane Bencherif, Wes Byerly,  
William S. Caldwell, Michelle Chenault, Claud E. Dunlap III,  
Patrick Lipiello, Carr Smith  
Instructors Alexey Azarov, Howard Cromwell, Cristine Czachowski,  
Jim Daunais, Robert McPhail, Keith Shelton, Darrell Sumner, Jeffrey Vivian

The Department of Physiology and Pharmacology offers separate degree programs in both disciplines. The graduate programs provide advanced courses and seminars in physiology and pharmacology for students who hold a BA, BS, or higher degree and who seek a PhD degree with intent to pursue an academic or research career.

The program is individualized to meet student needs. Students are expected to obtain a broad background in physiology and pharmacology and in related sciences by taking introductory courses. Through selected advanced courses and seminars, the student is offered the opportunity of exploring topics intensively.

After acquiring basic knowledge of physiology and pharmacology and developing fundamental skills and techniques of investigation, a student embarks on an area of research which is the basis of a dissertation. The research program is guided by the adviser and a departmental dissertation committee.

Research interests of the department are focused in the areas of aging, substance abuse, cardiovascular control, renal function, the endocrine system, toxicology, and neuroscience. Collaborative research in the department provides a multifaceted approach resulting in a molecular, cellular, and systems level of analysis.

The PhD degree has been offered since 1941.

## Core Courses in Physiology and Pharmacology

**781, 782. Advanced Topics.** (1-6) An advanced lecture and conference course which 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.

*Cardiovascular:* Topics under current investigation or recent advances in areas not covered in the regular seminar schedule or in the regularly planned elective courses. Students give reviews and discussions of papers presented at scientific meetings which they have attended. *Staff*

*Renal, Endocrine, Neural, Cardiovascular:* Rotating topic coverage on physiologic and pharmacologic topics supplemented with lectures by visiting scientists. Permission of instructor. *Staff*

**783, 784. Directed Research.** (1-3) First-year students will undertake a substantial research project under the direction of their adviser. *Staff*

**785, 786. Introduction to Research.** (1-2) First- and second-year students will read and discuss recent research publications from selected members of the faculty. *Staff*

**795, 796. Seminar.** (1) Departmental seminars are presented by graduate students and staff. They provide coverage of subjects not included in the other graduate courses and serve as a research forum for presentation of research proposals, work in progress, and completed work by staff and by post- and pre-doctoral trainees. Visiting scientists are scheduled at regular intervals. *Nader*

## Advanced Courses in Physiology

**695. Pathophysiology of Hypertension.** (1) A lecture course presenting the basic pathophysiological mechanisms of hypertension. A portion is devoted to intensive analysis of topics of current interest in hypertension research. P—Permission of instructor. *Staff*

**700. Advanced Physiology.** (5) Advanced graduate level instruction in specialty areas in physiology, including: pathophysiology of hypertension, sensory neurobiology, cellular neurophysiology, cardiac physiology and pathophysiology, vascular physiology and pathophysiology, perinatal physiology, endocrinology, nerve cell physiology and plasticity, physiology of aging, renal function and electrolyte balance. *Delbono, Staff*

**715. Sensory Neurobiology.** (3) Audition, olfaction, somatic, senses, taste, and vision; anatomy, physiology, and behavior involved in the sensory neurobiology of these systems, including central nervous system plasticity. P—Anatomy 712 or equivalent course and permission of instructors. Offered in odd-numbered years. *Deadwyler, Henkel, Oppenheim*

**718. Readings in Cellular Neurophysiology.** (2) Advanced readings and discussions in the physiology of nerve conduction, transmitter release, ionic mechanism and membrane currents in the regulation of neuronal function and plasticity. *Staff*

**731. Cardiac Physiology and Pathophysiology.** (3) Lectures and discussions of normal and abnormal cardiac physiology at the cellular, isolated muscle, and organ levels. *Staff*

**732. Vascular Physiology and Pathophysiology.** (3) Lectures and discussions of normal and abnormal vascular physiology in the macro- and micro-circulation. *Ferrario, Staff*

**740. Perinatal Physiology I.** (2) Discussion of literature in physiology and pharmacology concerning developmental aspects of mammalian organ systems. Particular emphasis is placed on the endocrine and cardiovascular systems. *Rose*

**741. Perinatal Physiology II.** (2) Discussion of literature in physiology and pharmacology concerning developmental aspects of mammalian organ systems. Particular emphasis is placed on endocrinology and developmental pharmacology. *Rose*

**742. Endocrinology.** (2) Recent advances in endocrinology, with emphasis on endocrine regulatory and controlling mechanisms, hormonal interrelationships, and mechanisms of hormonal action at the cellular level. *Staff*

**743. Neuroendocrinology.** (2) Recent advances in neuroendocrinology, with emphasis on receptor-linked functions, hormonally-active drugs and influences of pharmacologic agents on neuroendocrine function. In a tutorial setting, students will study principles of structure and function, examine current technology and published literature, and design and critique experimental approaches. *Eldridge*

**763. Nerve Cell Physiology and Plasticity.** (2 or 3) Consideration of basic neurobiological events related to neuron function. Emphasis will be given to topics dealing with morphological, chemical, and physiological plasticity at the synaptic level in various mammalian neural systems. Seminar arrangements include student presentation of research papers that can serve as a background for continued graduate work in these areas. *Deadwyler*

**767. Physiology of Aging.** (2) Seminar on the physiology of aging. Presentations on current topics relevant to age-dependent changes in various organ systems and theories of aging. *Sonntag*

**771. Renal Function and Electrolyte Balance.** (2) Recent advances and experimental approaches to the study of renal physiology, with emphasis on the research literature. *Strandhoy*

**791. Research Methods: Medical Electronics.** (2) Discussions and demonstrations covering the basic principles of electrical circuits, semi-conductor devices, computers, and electronic equipment commonly used in physiological research. *Staff*

**797, 798. Research.** Opportunities are available for collaborative or independent research on physiological problems, including research in preparation for the thesis. *Staff*

### Advanced Courses in Pharmacology

**700. Advanced Pharmacology.** (5) Advanced graduate-level instruction in specialty areas in pharmacology, including: cardiovascular pharmacology, toxicology, neuropharmacology, biochemical pharmacology, autonomic pharmacology, behavioral pharmacology, pharmacology of aging, pharmacology of electrolyte balance and renal function. *Childers, Staff*

**702. Cardiovascular Pharmacology.** (2) Readings and discussions center around recent developments in drug groups affecting the heart and circulation, with particular emphasis on the experimental approach. *Staff*

**704. Behavioral Pharmacology.** (3) This course will focus on behavioral factors that influence the effects of drugs. Material presented will provide a detailed review of the rate-dependent, reinforcing, and stimulus effects of drugs. Additional topics will include behavioral factors related to tolerance and sensitization and a review of animal models of drug action. *Nader, Staff*

**705. Neurobehavioral Pharmacology.** (3) Topics course dealing with specialized areas in behavioral pharmacology, to include the neurobiological components of the behavioral effects of drugs, the neurobiology of drug abuse and the neurotoxic effects of drugs. Included will be discussions on research design and evaluation in this area, and the development of laboratory models for the pharmacological treatment of behavioral disorders. *Nader, Grant, Staff*

**707. Neuropharmacology.** (3) General survey of neuropharmacology, emphasizing neurotransmitters, receptors and their interactions. The course will discuss general principles of drug action, including receptor binding, second messengers, and neurotransmitter metabolism. It also will survey neurotransmitter function, including acetylcholine, biogenic amines, excitatory and other amino acids, and neuropeptides. *Childers, Staff*



**708. Biochemical Pharmacology.** (3) A series of lectures and discussions exploring the pharmacodynamics of drugs and endogenous ligands at the cellular and subcellular level. Designed to give students in pharmacology and other disciplines an in-depth understanding of molecular and biochemical mechanisms operative in translation of drug-receptor interaction into pharmacological response. *Vrana*

**710. Autonomic Pharmacology.** (2) Readings and discussions concerned with the current concepts of the cellular mechanisms in the control of cholinergic and adrenergic receptors. Integrative emphasis will be placed on cardiovascular/renal, endocrine and gastrointestinal systems. *Vrana, Staff*

**711. Pharmacology of Electrolyte Balance and Renal Function.** (2) Reading of original papers, monographs, reviews, and discussions acquaint the student with the use of drugs and hormonal substances which affect the renal control of electrolyte and water balance. Emphasis on the experimental approach and the mechanism of action. *Strandhoy*

**712. Pharmacology of Aging.** (2) A series of lectures, readings, and discussions centered on the study of drugs and the aging process. The topics of age-related alterations in drug absorption, kinetics, and metabolism will be examined. Emphasis on degenerative diseases and mechanisms of action. *Staff*

**714. General Toxicology.** (2) A lecture course designed to provide the student with the basic concepts and mechanisms underlying toxic responses to xenobiotics. Emphasis will be placed 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. In addition, experimental models and methodologies of risk assessment will be explored. *Aschner, Staff*

**715. Neurotoxicology.** (2) This course identifies damage that is specific to the central nervous system that occurs after exposure to neurotoxic compounds. Emphasis will be placed on cellular mechanisms that are altered and the classes of neurotoxic agents that induce cell damage. Experimental models and risk assessment will also be explored. *Aschner, Staff*

**720. Current Topics in Drug Abuse.** (2) This course is intended to provide students with perspective in the problem of drug abuse. It will define 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. The course will describe how current research in drug abuse contributes to the design of rational treatment and prevention programs. *Childers*

**723, 724. Research.** (Credit to be arranged) Current areas of investigation available are cardiovascular and renal pharmacology, endocrinology, chemical pharmacology, drug metabolism, and neuropharmacology. *Staff*

**726, 727. Biology of Alcohol Abuse—Alcoholism.** (2) This course is designed to instruct graduate and postdoctoral students on the pharmacological, physiological, and behavioral effects of alcohol. The 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 will provide the basis for an exploration of the conditions leading to tolerance and dependence, and how the brain adapts to prolonged exposure to alcohol. *Grant*

**743. Neuroendocrinology.** (2) Recent advances in neuroendocrinology, with emphasis on receptor-linked functions, hormonally-active drugs, and influences of pharmacologic agents on neuroendocrine function. In a tutorial setting, students will study principles of structure and function, examine current technology and published literature, and design and critique experimental approaches. *Eldridge*

**797, 798. Drug Discovery and Development.** (2) This course is designed to introduce students to the intricacies of the pharmaceutical industry. Emphasis will be placed on providing an overview of drug discovery from both the pharmacologic and business perspective. Students will receive an overview of drug metabolism and pharmacokinetics, drug discovery, pre-clinical and clinical testing, and bioinformatics. P—Pharmacology 782 or Physiology 782 or permission of course director. *Vrana*

## Psychology

*Reynolda Campus*

Deborah L. Best, Chair

Wake Forest Professors Deborah L. Best, Mark R. Leary

Professors Robert C. Beck, Charles L. Richman

Adjunct Professors Jay Kaplan, Jack Rejeski

Associate Professors Terry D. Blumenthal, Christy M. Buchanan,

Dale Dagenbach, Catherine E. Seta, Cecilia H. Solano

Adjunct Associate Professors C. Drew Edwards, Carol A. Shively, Frank B. Wood

Assistant Professors William W. Fleeson, Janine M. Jennings, Batja Mesquita,

Karen L. Roper, James A. Schirillo, Eric R. Stone, Julie H. Wayne

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 and exposes students to a variety of both basic

science (e.g., learning, social, motivation, cognition, personality, developmental, statistics) and applied science (e.g., testing, clinical psychology) content areas.

The program is designed for capable students who (1) 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, (2) do not have adequate background for direct entrance into a PhD program, or (3) wish to terminate graduate work with the master's degree.

The applicant is expected to have an undergraduate major in psychology at an accredited institution. Such a major includes courses in experimental psychology, statistics, and history and systems of psychology, with a well-rounded selection of other psychology courses. Students who are judged to be deficient in these aspects are required to remedy such deficiencies after entering the Graduate School.

The department has unusually good facilities and library materials for research. The areas in which research is currently being conducted include learning, motivation, perception, emotion, cognitive processes, neuropsychology, clinical counseling, child development, aging, personality, social, psychological testing, cross-cultural, and primate behavior. In addition to the departmental micro- and mini-computer facilities, the University has a computer center for teaching and research.

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 pass a departmental qualifying examination.

The MA degree has been offered since 1964. Departmental graduate committee: Seta (chair), Beck, Dagenbach, Fleeson, Schirillo, Best (ex officio).

## For Advanced Undergraduates and Graduate Students

**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) A 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) A survey of laboratory and field research on animal behavior.

**626. Learning Theory and Research.** (3) Theoretical and experimental issues in the psychology of learning.

**629. Perception.** (3) Survey of theory and research findings on various sensory systems (vision, hearing, touch, taste).

**631. Cognition.** (3) Current theory and research in cognitive processes. Emphasis on memory, attention, visual and auditory information processing, concept identification/formation, and language.

**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.

**641. Research in Child Development.** (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. Psychological Disorders of Childhood.** (3) Survey of problems including conduct disorders, attention deficit disorders, depression, and autism. Emphasis on causes, prevention, treatment, and the relationships of disorders to normal child development and family life.

**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) An examination of differences in psychological processes (e.g., attitudes, perception, mental health, organizational behavior) associated with cultural variation.

**659. Psychology of Gender.** (3) An 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) An overview of the field of clinical and other selected areas of applied psychology.

**664. Prejudice, Discrimination, and Racism.** (3) A comparison of cross-cultural similarities and differences in the initiation, maintenance, and treatment of prejudice, discrimination, and racism, with an emphasis on past and current trends in the United States.

**667. Effectiveness in Parent/Child Relations.** (3) A survey of popular approaches to child-rearing, with examination of the research literature on parent/child interaction and actual training in parental skills.

**669. Contemporary Applications of Psychology.** (3) Supervised field experience in applied psychology.

**674. Judgment and Decision Making.** (3) A 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 Problems in Psychology.** (3) Seminar treatment of current theory and research in several frontier areas of psychology. Principally for senior majors planning to attend graduate school.

## For Graduate Students

**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. These courses cover conventional methods, including univariate and multivariate analysis of variance, multiple regression, and factor analysis. Requires previous or concurrent course work in basic statistics. Written permission of instructor required. *Leary, Stone, Wayne*

**720. Biological Psychology.** (3) The 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. *Blumenthal*

**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. *Dagenbach*

**738. Learning and Motivation.** (3) Basic learning principles and concepts and related motivational concepts. *Beck*

**742. Seminar in Developmental Psychology.** (3) A critical examination of the major findings, principles, and theories of development, with attention to both human and lower-animal research. *Best, Buchanan*

**752. Seminar in Social Psychology.** (3) Content and methodology of social psychology examined through a critical and comparative analysis of contemporary theory and literature. *Seta*

**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. *Fleeson, Leary*

**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. *Edwards*

**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—Permission of instructor. Same course as Neuropsychology 701. Summer only. *Wood*

**770, 771, 772, 773. Psychology Practicum.** (1-3) Work experience in an applied psychology setting (such as clinical or industrial) under a qualified supervisor. *Staff*

**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. Same course as Neuropsychology 782. Fall and spring. *Staff*

**785, 786. Directed Thesis Research.** (3,3) First-year students will undertake a substantial research project under the direction of their adviser. *Staff*

**791, 792. Thesis Research.** (1-3,1-3) *Staff*

## Religion

*Reynolda Campus*

Charles A. Kimball, Chair  
John T. Albritton Professor Fred L. Horton Jr.  
University Professor James A. Martin Jr.  
Professors Stephen B. Boyd, John E. Collins, Charles A. Kimball  
Adjunct Professor Bill Leonard  
Associate Professors Kenneth G. Hoglund, Simeon O. Ilesanmi  
Assistant Professors James Ford, Mary F. Foskett  
Adjunct Associate Professor Mark Jensen  
Visiting Professor Carol LaHurd

The Department of Religion offers the MA in either religion or pastoral care and counseling. Both programs offer a rigorous learning environment enriched by extended personal interaction with departmental faculty. The degrees serve as either terminal degrees or as preparation for further graduate study.

Ordinarily, applicants for admission into the MA in religion program have majored in religion or religious studies during their undergraduate coursework. Admission is based on the degree of success in previous courses in religion, the clarity of the applicant's educational goals, and the general potential for successfully engaging in graduate level work within the program. Applicants will not be admitted if it is likely that they cannot fulfill any of the program requirements, including the foreign language requirement. Any student admitted into the program without what the Graduate Committee considers to be a well-rounded undergraduate course of study in religion will be required to take remedial coursework without graduate credit.

In addition to the University's requirements for the master of arts degree, the Department of Religion requires proficiency in a modern foreign language, normally German. Another modern foreign language may be substituted only if the student, with the consent of their adviser, can show that it is more relevant to their thesis research. For theses written in the areas of Old Testament, New Testament, or Patristics, the primary ancient languages are required in addition to the modern foreign language requirement. Among the twenty-four required credit hours for the degree, a student must successfully complete Religion 705 and 706 for admission to candidacy.

The MA in pastoral care and counseling is offered as a clinically oriented program for the professional minister who has completed basic theological training (MDiv or equivalent) and who desires further training in this specialty. It requires conjoint enrollment in a North Carolina Baptist Hospital residency through the Department of Pastoral Care. Ministers pursuing careers in chaplaincy, pastoral supervision, or pastoral counseling will find particular relevance in this program. Two units of clinical pastoral education are accepted as a specialized skill requirement in place of a required modern foreign language. Successful completion of Religion 705 and 706 as well as a thesis are required, in this program as in the general MA in religion program. Ordinarily, a student is in residence for two years in order to complete the requirements for this degree.

In the list of courses offered with graduate credit, not every course is scheduled every year, but usually two courses at the 700-level are offered in each semester. 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.

The general MA in religion program began in 1967. The MA in pastoral care and counseling was added in 1972. Departmental graduate committee: Høglund (chair), Ford.

## For Advanced Undergraduates and Graduate Students

**600. Meaning 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. Myth.** (3) A study of the interpretation of myth, with a focus on the meaning and values implicit in the myths of contemporary culture.

**602. Mysticism.** (3) A study of mysticism from a multi-religious perspective with emphasis on the psychological and sociological aspects of this phenomenon.

**603. Religion and Science.** (3) An examination of the ways in which religion and science have conflicted with, criticized, and complemented one another in the history of Western thought from Galileo to the present.

**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. *Kimball*

**610. The Prophetic Literature of the Old Testament.** (3) An examination of the development and theological contents of the literary products of Israel's prophetic movement.

**611. The Psalms.** (3) A study of the Psalter with particular emphasis on the setting of the Psalms in Israel's worship.

**612. The Critical Study of the Pentateuch.** (3) A 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) A survey of twentieth century archeology in the Near East with attention to its importance for Biblical studies.

**614. Ancient Israel and Her Neighbors.** (1.5) A study of ancient Near Eastern archeology with special emphasis on Israel's relationships with surrounding peoples.



- 615, 616. Field Research in Biblical Archeology.** (3,3) A study of the religion and culture of the ancient Near East through the excavation and interpretation of an ancient site.
- 617. The Wisdom Literature.** (3) An 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) A 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. *Foskett, Hoglund, Horton*
- 619. Visions of the End: Jewish and Christian Apocalyptic.** (3) Reading and study of Daniel, Revelation, and certain non-Biblical apocalyptic texts.
- 620. The Search For Jesus.** (3) An introduction to the issues, assumptions, evidence, and debate that shapes the continuing quest for the historical Jesus, the historical and theological implications of such study, and the spectrum of responses that the search for Jesus has generated.
- 621. Introduction to the New Testament.** (3) An intensive introduction to the literature of the canonical New Testament along with methodologies for its study. *Foskett*
- 622. The General Epistles.** (3) An exegetical study of two or more of the General Epistles with emphasis on the setting of the epistles in the life of the early church.
- 623. The Parables of Jesus.** (3) An examination of the historical, social, cultural, and theological significance of the parables of Jesus as recorded in the synoptic gospels. *Foskett*
- 624. Early Christian Literature.** (3) An examination of various literature and perspectives of the first three centuries of the Christian movement. *Foskett*
- 626. Early Christian Theologians: Paul.** (3) An introduction to the Pauline interpretation of Christianity and its place in the life of the early church.
- 627. Early Christian Theologians: The Fourth Evangelist.** (3) An examination of the Johannine interpretation of Jesus and Christian faith.
- 628. The New Testament and Ethics.** (3) A study of selected ethical issues in the New Testament within the context of Mediterranean culture.
- 630. Comparative Religious Ethics.** (3) A 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. *Ilesanmi*
- 631. Christian Ethics and Social Justice.** (3) An inquiry from a Christian perspective into different theoretical and practical responses to the issue of justice in society. *Ilesanmi*

**633. Christian Ethics and the Professions.** (1.5) A study of the nature of the professions in contemporary society, their fundamental ethical suppositions, and the significance of being Christian for professional conduct.

**635. Christian Ethics and the Problem of War.** (3) An examination of the causes and characteristics of war, various Christian response to it, and approaches to peacemaking, with attention to selected contemporary issues. *Ilesanmi*

**636. Religious Traditions and Human Rights.** (3) A study of the relationships and tensions between religious traditions and human rights, with illustrations from historical and contemporary issues and movements. *Ilesanmi*

**638. Religion, Ethics, and Politics.** (3) An examination of ethical issues in religion and politics using materials from a variety of sources and historical periods. *Ilesanmi*

**639. Religions of Africa.** (3) An interdisciplinary study of the growth and 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) An 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 will be given to the ways in which race, class, and sexual orientation affect those dynamics.

**641. 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. (Same as History 376.)

**642. Religion, Culture, and Modernity.** (3) An inquiry into the origins and development of modernity as idea and ideology, with special emphasis on its significance for non-Western social and religious movements.

**643. The City as Symbol.** (3) A study of the city, past and present, as a unique repository and symbol of religious values and human aspirations.

**645. The African-American Religious Experience.** (3) An exploration of the religious dimensions of African-American life from its African antecedents to contemporary figures and movements.

**647. The Emerging Church in the Two-Thirds World.** (3) An investigation of contemporary Christian communities in Africa, Asia, the Caribbean, and Latin America with special attention to theological, political, and economic activities.

- 648. Struggles for Freedom in South Africa and the United States.** (3) Comparison of the liberatory movements in Southern Africa and the United States during the twentieth century (Also listed as History 678.)
- 650. Psychology of Religion.** (3) An examination of the psychological elements in the origin, development, and expression of religious experience.
- 651. Religion and Society.** (3) A study of religion as a social phenomenon and its relationship to the structure of society—political, economic, and others, with special focus on the contemporary United States. *Roniger*
- 654. Religious Development of the Individual.** (3) A study of growth and development from infancy through adulthood, with emphasis on the influences of spirituality and mature religion.
- 655. Theology of Pastoral Care and Counseling.** (3) A study of the relationship between theology and the purpose, theories, and methods of pastoral care and counseling.
- 660. World Religions.** (3) An examination of the ideas and practices of major religious traditions in their historical and cultural context. Focus varies with instructor. *Kimball*
- 661. The Buddhist World of Thought and Practice.** (3) A survey of the development of Buddhism from India to Southeast Asia, China, Tibet, Japan, and the West, focusing on the transformation of Buddhist teachings and practices in these different social and cultural contexts.
- 662. Islam.** (3) An examination of the origins and development of Islam, the world's second largest religious tradition. Particular attention is given to the formation of Islamic faith and practice as well as contemporary manifestations of Islam in Asia, Africa, and North America.
- 663. Religions of Japan.** (3) A study of the central religious traditions of Japan from pre-history to the present, including Shinto, Buddhism, Zen Buddhism, Christianity, and Confucianism.
- 664. Conceptions of the Afterlife.** (3) An examination of the variety of answers given to the question, "What happens in death?" Particular attention is given to the views of Jews, Christians, Muslims, Hindus, and Buddhists and the ways their views relate to life in this world.
- 665. History of Religions in America.** (3) A study of American religions from Colonial times until the present.
- 666. Gender and Religion.** (3) An examination of the historical and contemporary interaction between religion and sex roles, sexism, and sexuality.

**667. The Mystics of the Church.** (3) An historical study of the lives and thought of selected Christian mystics with special attention to their religious experience.

**668. The Protestant and Catholic Reformations.** (3) A study of the origin and development of Reformation theology and ecclesiology.

**669. Radical Christian Movements.** (3) A study of selected radical movements in the Christian tradition and their relation to contemporary issues.

**670. Women and Christianity.** (3) A study of the roles and contributions of women within the Christian tradition throughout history, and an analysis of the mechanisms of their oppression.

**671. Theology and Sexual Embodiment.** (3) A survey of theological responses to human sexuality, with special emphasis on contemporary issues.

**672. History of Christian Thought.** (1.5,3) A study of the history of Christian thought, beginning with its Hebraic and Greek backgrounds and tracing its rise and development to modern times. The course may be divided into halves for 1.5 credits each:

(a) *Patristic Thought*

(b) *Medieval and Reformation Thought*

**674. Contemporary Christian Thought.** (3) An examination of the major issues and personalities in twentieth century theology, both Western and non-Western.

**675. Major Themes in Catholic Theology.** (3) A detailed examination of the central themes of Christian theology through the study of major Roman Catholic theologians. Topics may vary.

**676. Twentieth Century Christian Theologians.** (3) A study of the major exponents of the Catholic, Protestant, and Orthodox traditions.

**677. The Problem of Evil from Job to Shakespeare.** (3) A comparative analysis of the source and remedy of evil in Job, Aeschylus, Sophocles, Plato, Dante, and Shakespeare.

**678. Aesthetics and Religion.** (3) An examination of aesthetic and religious theories of selected thinkers, noting what the arts and religion have in common as modes of perception and expression.

**680. The Main Streams of Chinese Philosophy and Religion.** (3) An introduction to the most important traditions in Chinese philosophy and religion: Confucianism, Daoism (Taoism), and Chinese Buddhism or Chinese Chan (Zen) Buddhism. (Same as Philosophy 226.)

**682. Religion and Culture in China.** (3) A thematic study of Chinese religious traditions and culture focusing on history, ritual, scripture, and popular practice. Additional topics will include cosmology, ancestor veneration, shamanism, divination, and the role of women. *Ford*

*Near Eastern Languages and Literature*

**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) An 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—111, 112, or equivalent.

**211, 212. Hebrew Literature.** (3,3) The reading and discussion of significant Biblical texts. P—153.

**601. Introduction to Semitic Linguistics.** (3) A study of the history and structure of four languages from the Hamito-Semitic family of languages is studied.

**602. Akkadian I.** (3) An 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 Hebrew 302 with further emphasis on building expertise in vocabulary and syntax through the reading of texts from the Middle Babylonian period.

For Graduate Students

**701, 702. Directed Reading.** (1-3,1-3) *Staff*

**705, 706. Research in Religion.** (1.5,1.5) An examination of the major research tools and methodologies in religion, discussion and critique of research currently in progress, and the development of a research model in the student's area of specialization. *Staff*

**716. Old Testament Theology.** (3) Major motifs of revelation in the Old Testament; analysis of recent attempts to write an Old Testament theology. *Horton*

**718, 719. Old Testament Exegesis.** (3,3) Detailed analysis and exegesis of selected portions of the Hebrew Bible. P—Biblical Hebrew. *Staff*

**721. New Testament Theology.** (3) A 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. *Horton*

**722. The Quest for the Historical Jesus.** (3) An investigation of the possibility and relevance of historical knowledge about Jesus through a consideration of the seminal Lives of Jesus since the eighteenth century. *Horton*

**723, 724. New Testament Exegesis.** (3,3) An examination of selected portions of the Greek New Testament, with attention to the tools necessary for exegesis. P—Koine Greek. *Horton*

**738. Seminar in Christian Social Ethics.** (3) A critical study of classic texts and figures in the history of Christian ethics and social thought. *Ilesanmi*

**740. Seminar in the Sociology of Religion.** (3) An examination of selected classical and contemporary texts illustrative of the theories, methods, and purposes of the sociological study of religion. *Staff*

**751. Theory and Practice of Pastoral Counseling.** (3) A study of counseling methodologies, psychotherapeutic techniques, personal development, and human behavior in terms of the implications for pastoral counseling. *Jensen*

**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.) *Staff*

**761. Seminar in Eastern Religion.** (3) Directed study in selected areas of the religious traditions of the East. *Collins*

**762. The Literature of Ancient Judaism.** (3) An 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). *Horton, Hogle*

**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. *Horton*

**766. Seminar in Christian History.** (3) Directed study of selected areas in the history of Christianity, including Baptist history. *Boyd*

**768. The Protestant and Catholic Reformations.** (3) A study of the origin and development of Reformation theology and ecclesiology. *Boyd*

**775. Seminar in the History of Christian Thought.** (3) An intensive study of a selected period or movement in Christian theological history, with special reference to seminal persons and writings. *Boyd*

**780. Seminar in Theology and Literature.** (3) An 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.

**791, 792. Thesis Research.** (1-9) *Staff*

## Courses in Clinical Sciences

*Bowman Gray Campus*

### Neuropsychology

**701. Neuropsychology and Learning Disabilities.** (3) Language, perceptual/motor, memory, attentional, and emotional deficits arising from neuropsychological 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—Permission of instructor. (Same course as Psychology 767.) *F. Wood*

**753. Psychophysiology of Disease Processes.** (3) Physiological responsivity to behavioral events is reviewed in the current research literature. Disease states—especially those involving the cardiovascular, muscle, and central nervous systems—and biofeedback and other therapeutic technologies are especially emphasized. P—Permission of instructor and student's major department. *F. Wood*

**782. Readings and Research in Psychology.** (1,2, or 3) Allows the graduate student, working under the supervision of a faculty member, to pursue and receive credit for a special reading 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 hours credit for which enrolled determined by graduate committee prior to registration. Fall and Spring. (Same course as Psychology 782.) *F. Wood*

### Family and Community Medicine

**794. Directed Study in Educational Research.** (3) A review, discussion and application of educational research literature related to experiential teaching/learning in clinical situations. Performance evaluation will be via one-on-one interactions in seminars, determination of facility in application of concepts from literature and an end of course compendium of bibliographic references with annotated bibliography of selected key references.

# Courses in General Studies

*Reynolda Campus*

As a mechanism for enrichment of graduate studies at Wake Forest University, additional courses in the 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

**600. Museum Practicum.** (3) Designed to give the student practical experience while working at the Museum of Anthropology in six basic areas of museum operation: administration, research, curatorial duties, conservation, exhibition design, and education.

**610. Museum Design and Operation.** (3) The principles of museum design and operation. Lectures, readings, workshops with visiting experts in the field, and field trips to neighboring museums (possibly to Washington, DC). Students have an opportunity to put some of the principles in practice by planning and designing exhibits in the Museum of Anthropology.

**615. Material Culture Studies.** (3) Explores the social and cultural roles of objects through the study of materials, technology, economy, context, and meaning.

**620. The Anthropology of Art.** (3) The arts (primarily visual) in folk and tribal cultures from comparative, structural, and functional points of view.

**630. The Ethnographic Documentary.** (3) Through the use of ethnographic documentary films and videos from different historical periods and by filmmakers from different cultural backgrounds, this course will present a historical and cross-cultural perspective on cultural systems. The course will analyze the technological and aesthetic aspects of film and video production and assess the effectiveness of visual communication in conveying ideas about culture and society.

**640. Anthropological Theory.** (3) A study and evaluation of the major anthropological theories of humans and society, including cultural evolutionism, historical particularism, functionalism, structuralism, cultural ecology, and cultural materialism. The relevance and significance of these theories to modern anthropology are discussed.

**642. Applied Anthropology.** (3) Seminar exploring the ways anthropological concepts and data contribute to understanding and solving contemporary problems facing human populations everywhere. Emphasis will be on change and conflict situations in developing areas, but problems encountered by urban and industrialized cultures also are considered.



**649. Introduction to Political Anthropology.** (3) Comprehensive overview of political anthropology including cross-cultural perspectives on law, political organization, the early state, political succession and power. P—Anthropology 152 or permission of instructor.

**652. Peoples and Cultures of Africa.** (3) The ethnology and prehistory of Africa south of the Sahara.

**658. The American Indian.** (3) Ethnology and prehistory of the American Indian.

**660. Human Ecology.** (3) The relations between man and the inorganic and organic environments as mediated by culture; laboratory experience with aerial photography and other remote sensing techniques.

**662. Medical Anthropology.** (3) The impact of Western medical practices and theory on non-Western cultures and anthropological contributions to the solution of world health problems.

**664. Physical Anthropology.** (3) Introduction to biological anthropology, human biology, evolution, and variability.

**666. Human and Non-Human Evolution.** (3) Investigation of primate and human evolution, both in anatomy and behavior.

**668. Human Osteology.** (3) A survey of human skeletal anatomy and analysis, emphasizing archeological and anthropological applications.

**670. Old World Prehistory.** (3) Survey of Old World prehistory, with particular attention to geological and climatological events affecting culture change.

**672. Archeology of Early Complex Societies.** (3) Comparison of the archeology of early complex societies, with special attention to Maya, Aztec, and Teotihuacan cultures in Mesoamerica; the Huari and Inca in South America; the Anasazi of North America; and Egyptian and Mesopotamian groups of the Old World. An emphasis will be given to theories of origins and change in complex societies.

**674. Prehistory of North America.** (3) The development of culture in North America as outlined by archeological research, with an emphasis on paleoecology and sociocultural processes.

**676. Archeology of the Southeastern United States.** (3) A study of human adaptation in the Southeast from the Pleistocene to the present, emphasizing the role of ecological factors in determining the formal aspects of culture.

**678. Conservation Archeology.** (3) A 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) The recovery of anthropological data through the use of archeology, taught in the excavation and interpretation of a prehistoric site.

**683, 684. Field Research in Cultural Anthropology.** (3,3) Training in techniques for the study of foreign cultures, 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.

**698, 699. Independent Study.** (3,3) A reading, research, or internship course designed to meet the needs and interests of selected students, to be carried out under the supervision of a departmental faculty member.

**758. Values, Symbols, and World-views.** (3) A seminar on the identification and analysis of values, symbols, and other aspects of the world-views of tribal and folk cultures. The use of ethnographic data on visual art, myth, and ritual is emphasized.

**760. Human Ecology: Cultural Anthropology.** (3) This course is designed to integrate theory and methodology in the study of the interaction between human culture and the non-cultural environment. An ecological approach allows participants to develop specific research skills in the designing, conducting, analysis, and presentation of the results of several research projects. *Evans, Tefft*

**770. Human Ecology: Archeology.** (3) A review of the theories and methods relating the statics of the archeological record to the dynamics of past cultural systems, emphasizing the role of human ecology in systemic change through time and space. Readings and discussions focus on the historical development of archeological thought, current theoretical issues and a broad range of individual case studies. *Berman, Woodall*

**780. Human Ecology: Physical Anthropology.** (3) A survey of the physiological, genetic, and evolutionary bases of human biocultural adjustments in case studies of prehistoric and modern human ecology. *Weaver*

**785, 786. Directed Reading and Research.** (3,3) Provides graduate students with opportunities for reading in areas not covered by other courses or research not directly related to the thesis project. *Staff*

**791, 792. Thesis Research.** (1-9) *Staff*

## Art

**675. History of Landscape Architecture.** (3) A study of garden design, beginning with Roman gardens and continuing through the creation of public parks in the nineteenth century. *Titus*

## 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—Permission of instructor.

## History

**601. The Beginnings of the Modern World-view.** (3) A study of the transition from ancient views of the world to the perspective of modern science, with focus on the works of the Presocratic philosophers, Plato and Aristotle. *Shapere*

**602. The Mechanistic View of Nature.** (3) An examination of the philosophical and scientific roots, in Descartes, Newton, and Leibniz, of the belief that the universe and human beings are “machines” subject to deterministic natural laws, and the relevance to this issue of modern scientific ideas. *Shapere*

**603. Revolutions in Modern Science.** (3) An analysis of the ways in which radically new ideas are introduced and accepted in science. Cases studied are space and time in relativity theory, the nature of reality in quantum mechanics, evolution of species, and continental drift. P—At least one course in one of the relevant areas of science or permission of instructor. *Shapere*

**605. Modern Science and Human Values.** (3) Four revolutionary developments in science and technology are studied with a focus on their potential to affect human values: biotechnology, cognitive science, recent primate research, and the search for extraterrestrial life. *Shapere*

**606. The Early Middle Ages.** (3) European history from the end of the Ancient World to the mid-twelfth century, stressing social and cultural developments. *Barefield*

**607. The High Middle Ages Through the Renaissance.** (3) European history from the mid-twelfth through the early sixteenth century, stressing social and cultural developments. *Barefield*

**609. Europe: From Renaissance to Revolution.** (3) A survey of European history from the fifteenth to the eighteenth century. Topics include the voyages of discovery, the military revolution, the formation of the modern state, religious reformation, witchcraft and the

rise of modern science, pre-industrial economic and social structures, including women and the family. *Williams, Schen*

**610. Seminar.** (3) Offered by members of the staff on topics of their choice. A paper is required. *Staff*

**613, 614. European Economic and Social History, 1300-1990.** (3,3) Changes in Europe's economic structures and how they affected Europeans' lives, emphasizing how economic forces interacted with social and institutional factors. 613: 1300-1750; 614: 1750-1990. *Hughes*

**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. *Lerner*

**617. The French Revolution and Napoleonic Empire.** (3) The revolution and wars that constitute one of the pivotal points in modern history. *Williams*

**618. Weimar Germany.** (3) Art, literature, music, and film of Weimar Germany, 1919-1933, in historical context. German or history credit determined at registration. *Hughes*

**619. Germany to 1871.** (3) Social, economic, and political forces leading to the creation of a single German nation-state out of over 1700 sovereign and semi-sovereign German states. *Hughes*

**620. Germany: Unification to Unification, 1871-1990.** (3) The Germans' search for stability and unity in a society riven by conflict and on a continent riven by nationalism. *Hughes*

**621. France to 1774.** (3) The history of France from the paleolithic period to the accession of Louis XVI with particular attention to the early modern period. *Williams*

**622. France since 1815.** (3) The history of France from the restoration of the monarchy to the Fifth Republic. *Williams*

**623, 624. Great Britain.** (3,3) A survey of British history. Topics include religion, revolution and reform, war, poverty and poor relief, women, social and economic change, and empire. 623, to eighteenth century; 624, eighteenth century to present. *Schen*

**628. History of the English Common Law.** (3) A study of the origins and development of the English common law and its legacy to modern legal processes and principles. *Zick*

- 631. Russia: Origins to 1917.** (3) A political, social, economic, and cultural history of Russia. *Rupp*
- 632. History of the Soviet Union.** (3) A political, social, economic, and cultural history of the Soviet Union since 1917. *Rupp*
- 633. European Diplomatic History, 1848-1914.** (3) Research/discussion seminar with emphasis on topics from the Bismarck era.
- 637. Gender in Early America.** (3) The history of gender roles from the colonial period to the mid-nineteenth century. Examines the social constructions of femininity and masculinity and their political and cultural significance. *Gillespie*
- 638. Gender in Modern America.** (3) The history of gender relations from the late nineteenth century to the present. Analyzes the varying 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. *Caron*
- 639. The History of American Medicine.** (3) Analysis of the changing approaches to healing in American history. Examines indigenous systems, the introduction of European methods, the attempts to professionalize in the nineteenth century, the incorporation of modern techniques, and the reemergence of natural approaches in the twentieth century. *Caron*
- 640. African-American History.** (3) The role of African-Americans in the development of the United States, with particular attention to African heritage, forced migration, Americanization, and influence. *Parent*
- 642. Middle East Before 1500.** (4) A survey of Middle Eastern history from the rise of Islam to the emergence of the last great Muslim unitary states. The course provides an overview of political history with more in-depth emphasis on the development of Islamic culture and society in the pre-modern era. *Villagomez*
- 643. Imperial China.** (3) A study of traditional China to 1850, with emphasis on social, cultural, and political institutions. *Sinclair*
- 644. Modern China.** (3) A study of China from 1644 to present. *Sinclair*
- 645. Middle East Since 1500.** (4) A survey of modern Middle Eastern history from the collapse of the last great Muslim unitary states to the present day. Topics include the rise and demise of the Ottoman and Safvid empires, socio-political reform, the impact of colonialism, Islamic reform, the development of nationalism, and contemporary social and economic challenges. *Villagomez*

**646. Japan before 1600.** (3) A survey of Japanese history from early origins to the beginning of the Tokugawa shogunate. Covers the rise of the Yamato state, the age of the Court, the ascendancy of the samurai and shoguns, the period of the warring states, and the rule of Hideyoshi. *Lockyer*

**647. Japan since World War II.** (3) A 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. *Lockyer*

**648. Japan since 1600.** (3) Tokugawa era: Meiji Restoration; industrialization and urbanization; relations with the West; World War II; occupation; Japan in the contemporary world. *Izbicki*

**650. Global Economic History.** (3) An overview of the growth and development of the world economy from precapitalist organizations to the present system of developed and under-developed states. *Watts*

**651. United States Social History I.** (3) Examines various aspects of American social history from the colonial period to the mid-nineteenth century with emphasis on immigration, ethnicity, race, gender, sexuality, the family, religion, and life and culture. *Gillespie*

**652. United States Social History II.** (3) Examines various aspects of American social history from the late nineteenth century to the present with emphasis on immigration, ethnicity, race, gender, sexuality, the family, religion, and life and culture. *Caron*

**653. Colonial English America, 1582-1774.** (3) Determinative episodes, figures, allegiances, apperceptions, and results of the period, organically considered. *Staff*

**654. Revolutionary and Early National America, 1763-1820.** (3) The American Revolution, its causes and effects, the Confederation, the Constitution, and the new nation. *Hendricks*

**655. The Westward Movement.** (3) The role of the frontier in United States history, 1763-1890. *Staff*

**656. Jacksonian America, 1820-1850.** (3) The United States in the age of Jackson, Clay, Calhoun, and Webster. A biographical approach. *Hendricks*

**657. The Civil War and Reconstruction.** (3) The political and military events of the war and the economic, social, and political readjustments which followed. *Escott*

**658. The United States from Reconstruction to World War I.** (3) National progress and problems during an era of rapid industrialization. *Watts*

- 659. The United States from World War I through World War II.** (3) The transition of America from World War I to 1945, with special emphasis on the New Deal and World War II. *Smith*
- 660. The United States since World War II.** (3) Trends and changes in the nation from World War II to the present. *Smith*
- 661. Economic History of the United States.** (3) The economic development of the United States from colonial beginnings to the present. *Watts*
- 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. *Zick*
- 663, 664. The South.** (3,3) Geography, population elements, basic institutions, and selected events. *Gillespie*
- 666. Studies in Historic Preservation.** (3) An analysis of history museums and agencies and the techniques of preserving and interpreting history through artifacts, restorations, and reconstructions. P—Permission of instructor. *Hendricks*
- 667, 668. North Carolina.** (3,3) Selected phases of the development of North Carolina from the colonial period to the present. 667: to 1850; 668: since 1850. *Escott*
- 669. Modern Military History.** (3) Making war in the modern era, with special attention to the social context of military activity. *Hughes*
- 670. Topics in North Carolina History.** (3) A general chronological survey of North Carolina with emphasis on selected topics. Lectures, readings, and class reports. *Hendricks*
- 671. Winston-Salem/Forsyth County.** (3) A 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. *Hendricks*
- 672. Introduction to African History.** (3) An introduction to African history from the perspective of the continent as a whole. The historical unity of the African continent and its relation to other continents will be stressed. *Parent*
- 673. History of Mexico.** (3) An examination of the history of Mexico from the colonial period to the present. *Meyers*

**674. Protest and Rebellion in Latin America.** (3) A study of the history of protest movements and rebellions in Latin America from primitive and agrarian revolts to mass working class and socialist organizations. *Meyers*

**675. Modern Latin America.** (3) A survey of Latin American history since Independence, with emphasis on the twentieth century. The course will concentrate chiefly on economics, politics, and race. *Meyers*

**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. *Parent*

**677. American Diplomatic History.** (3) An introduction to the history of American diplomacy since 1776, emphasizing the effects of public opinion on fundamental policies. *Sinclair*

**678. Struggles for Freedom in South Africa and the United States.** (3) Comparison of the liberatory movements in Southern Africa and the United States during the twentieth century. (Also listed as Religion 648.) *Parent* (history)

**680. America at Work.** (3) This course will examine the people who built America from 1750 to 1945. Themes will 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. *Gillespie*

**681, 682. Preservation Practicum I, II.** (3,3) Training in the techniques and skills of historic preservation. Emphasis will vary according to the specific site(s) involved. P—Permission of the instructor. *Hendricks*

**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 763-764 or 693-694.) *Staff*

**694. American Foundations II.** (3) A continuation of History 693. *Staff*

**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. *Staff*



**699. Directed Reading.** (1-3) Concentrated reading in an area of study not otherwise available. P—Permission of instructor. *Staff*

**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 763-764 or 793-794.) *Staff*

**764. American Foundations II.** (3) A continuation of History 763. *Staff*

**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. *Staff*

**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. *Staff*

**781, 782. Directed Reading.** (3,3) A program of extensive reading arranged with a specialist in the department in an area chosen by the student. The reading may range from a broad survey of a field not previously covered by the student to an intensive investigation of a specific topic, but it may not be directly related to the student's thesis material. *Staff*

**791, 792. Thesis Research.** (1-9) *Staff*

**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. *Staff*

## Humanities

**655. Forms and Expressions of Love.** (3) In this course we will explore some philosophical, religious, and psychological delineations of forms of love, and some literary, dramatic, and visual portrayals of love in selected works. *Martin*

**661. Dante I.** (1.5) A study of the Divine Comedy as epic, prophecy, autobiography, and poetic innovation, relating it to antiquity, Christianity, Dante's European present (the birth of the modern languages and new intellectual and poetic forms), and Dante's own afterlife in the West. *Mandelbaum*

**662. Dante II.** (1.5) The completion of the course on the Divine Comedy as epic, prophecy, autobiography, and poetic innovation, relating it to antiquity, Christianity, Dante's European present (the birth of the modern languages and new intellectual and poetic forms), and Dante's own afterlife in the West. P—Humanities 561 or permission of instructor.

## Natural Sciences

**601. The Beginnings of the Modern World-view.** (3) A study of the transition from ancient views of the world to the perspective of modern science, with focus on the works of the Presocratic philosophers, Plato and Aristotle. *Shapere*

**602. The Mechanistic View of Nature.** (3) An examination of the philosophical and scientific roots, in Descartes, Newton, and Leibniz, of the belief that the universe and human beings are "machines" subject to deterministic natural laws, and the relevance to this issue of modern scientific ideas. *Shapere*

**620. The Universe of Modern Science.** (3) A survey of the contemporary scientific picture of the universe and its evolution, and of the major evidence for that picture. *Shapere*

**651. Philosophy of Science.** (3) A systematic and critical examination of major views concerning the methods of scientific inquiry, and the bases, goals, and implications of the scientific conclusions which result from such inquiry. *Shapere*

## Philosophy

**631. Plato.** (3) A detailed analysis of selected dialogues, covering Plato's most important contributions to moral and political philosophy, theory of knowledge, metaphysics, and theology. P—Permission of instructor.

**632. Aristotle.** (3) A study of the major texts, with emphasis on metaphysics, ethics, and theory of knowledge. P—Permission of instructor.

**641. Kant.** (3) A detailed study of selected works covering Kant's most important contributions to theory of knowledge, metaphysics, ethics, religion, and aesthetics. P—Permission of instructor.

**642. Studies in Modern Philosophy.** (3) Treatment of selected figures and/or themes in seventeenth- and eighteenth-century European philosophy. P—Permission of instructor.

**651. Early German Idealism.** (3) An examination of the development of post-Kantian idealism through the works of Fichte, Schelling, and Schleiermacher, with particular emphasis on their efforts to address the challenge of critical philosophy. P—Permission of instructor.

**652. Hegel, Kierkegaard, and Nietzsche.** (3) An 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—Permission of instructor.

**653. Heidegger.** (3) An examination of the structure and development of Heidegger's philosophy from the ontological analysis in *Being and Time* to his later work in the philosophy of language and poetry. P—Permission of instructor.

**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—Permission of instructor.

**661. Topics in Ethics.** (3) P—Permission of instructor.

**662. Social and Political Philosophy.** (3) A 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—Permission of instructor.

**671. Philosophy of Art.** (3) A critical examination of several philosophies of art, with emphasis upon the application of these theories to particular works of art. P—Permission of instructor.

**672. Philosophy of Religion.** (3) An 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—Permission of instructor.

**673. Philosophy of Science.** (3) A 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—Permission of instructor.

**674. Philosophy of Mind.** (3) A 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—Permission of instructor.

**675. Philosophy of Language.** (3) A 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—Permission of instructor.

**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—Permission of instructor.

**682. Topics in Metaphysics.** (3) P—Permission of instructor.

**685. Seminar.** (2-3) Offered by members of the faculty on specialized topics of their choice. With permission, may be repeated for credit. P—Permission of instructor.

## Politics

*Undergraduate students are given preference in enrollment for courses in the Department of Politics.*

**611. Political Parties, Voters, and Elections.** (3) An 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 will be the regulation of the mass media and the impact of media on political processes and events.

**618. Congress and Policymaking.** (3) An examination of the composition, authority structures, external influences, and procedures of Congress with emphasis on their implications for policymaking in the United States.

**620. The American Presidency.** (3) Emphasis on the office and the role; contributions by contemporary presidents considered in perspective.

**629. Women and Politics.** (3) The course will examine classical and contemporary arguments regarding the participation of women in politics as well as current policy issues and changes in women's political participation.

**631. Western European Politics.** (3) Analysis of the political systems of Great Britain, France, and Italy, focusing primarily on the problems of stable democracy.

**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) A survey of major issues relevant to politics and policy in India, Pakistan, Bangladesh, and Sri Lanka.

**647. Islam and Politics.** (3) The course 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.

**653. International Political Economy.** (3) An introduction to major current issues of international political economy, such as monetary policy, trade policy, and ideologies in international relations.

**654. American Foreign Policy: Contemporary Problems.** (3) A critical examination of different methods of studying American foreign policy and of selected policies followed by the United States since the early 1960s.

**659. The Arab-Israeli Conflict.** (3) An analysis of factors influencing the relationship between Israel and its neighbors relative to fundamental aspects of United States, Israeli, Palestinian, and Arab states policies.

**667. America in Vietnam: Myth and Reality.** (3) An analysis of American policy toward Vietnam with special emphasis on the period of 1954-1975. The focus will be on the relationship between American policies and the problems posed by Vietnamese and American cultures.

**671. Plato, Aristotle, and Classical Political Philosophy.** (3) An examination of the nature and goals of the classical position, with attention to its origins in ancient Athens and its diffusion through Rome. Representative writers are Plato, Aristotle, and Cicero.

**678. Modern Political Philosophy.** (3) Political thought in the period from Machiavelli to the present, including such topics as democracy, equality, liberty, radical theories, and/or the rise of "scientific" political theory. Representative writers include Hobbes, Locke, Rousseau, Kant, Marx, and Heidegger.

**692. Seminar in Comparative Politics.** (3) Readings, research, and independent study on selected topics. P—Permission of instructor.

**693. Seminar in International Politics.** (3) Readings, research, and independent study on selected topics. P—Permission of instructor.

**694. Seminar in Political Philosophy.** (3) Readings, research, and independent study on selected topics. P—Permission of instructor.

## Romance Languages

### *French*

**619. Advanced Grammar and Stylistics.** (3) Review and application of grammatical structures for the refinement of writing techniques. Emphasis placed on the use of French in a variety of discourse types. Attention given to accuracy and fluency of usage in the written language. P—French 219 or equivalent or permission of instructor.

**664. French Prose Fiction.** (3) A broad survey of French prose fiction, with critical study of several masterpieces in the field. P—French 215 or permission of instructor.

**660. Cinema and Society.** (3) A study of French and Francophone cultures through cinema. Readings and films may include film as artifact, film theory, and film history. P—French 215 or permission of instructor.

**663. Trends in French Poetry.** (3) A study of the development of the poetic genre with analysis and interpretation of works from each period. P—French 215 or permission of instructor.

**664. French Prose Fiction.** (3) A broad survey of French prose fiction, with critical study of several masterpieces in the field. P—French 215 or permission of instructor.

**665. French Drama.** (3) A 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. P—French 215 or permission of instructor.

**670. Seminar in French 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. Required for the major. Can be repeated for credit. P—French 215 or permission of instructor.

**674. The Black Experience in Francophone Literature.** (3) A study of poetry, prose, and drama by writers from French-speaking Africa and the Caribbean. Emphasis will be placed on the negritude movement, the African oral tradition, colonial and post-colonial works, and women's voices. P—French 215 or permission of instructor.

**675. Special Topics.** (3) Selected themes and approaches to French literature transcending boundaries of time and genre. Topics to be chosen by staff in consultation with majors prior to the term the course is offered. May be repeated once for credit. P—French 215 or permission of instructor.

**681. Individual Study.** (3) P—Permission of the department.

*Spanish*

**621. History and Structure of the Spanish Language.** (3) Study of the historical development of Spanish in a cultural and linguistic context from its earliest stages to the present. Analysis of its current and internal changes. P—Spanish 219 and 220 or permission of instructor.

**622. Phonology.** (3) Description of, and practice with, the sound system of Spanish. Systematic analysis of the phonemes, allophones, and stress and intonation patterns of the language, and discussion of dialectal and stylistic variation. Lab required. P—Spanish 219 and 220 or permission of instructor.

**631. Medieval Spain: A Cultural and Literary Perspective.** (3) An 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. P—Spanish 219 and 220 or permission of instructor.

**643. Cervantes: The Birth of the Novel.** (3) A study of “Don Quixote,” the first modern novel, and several exemplary novels, and contemporary theoretical approaches to them. Also considers related art, music, and film. Includes discussion of themes such as the development of prose fiction, the novel on self-conscious genre, women and society, religion and humanism, nationalism, and imperialism. P—Spanish 217 or 218 or permission of instructor.

**648. Transatlantic Renaissance.** (3) A 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. P—Spanish 217 or 218 or permission of instructor.

**649. Contemporary Women Novelists and their Female Characters.** (3) A study of representative novels by women writers from Spain and Latin America, with special emphasis on the representation of the female protagonist within her cultural context. P—Spanish 217 or 218 or permission of instructor.

**651. Transgressing Borders: Identity in the Literature of Latin American and U.S. Latino Literatures.** (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. P—Spanish 217 or 218 or permission of instructor.

**653. Indigenous Myth in Spanish American Literary Art.** (3) A study of Spanish American writers' incorporation of Amerindian myths in twentieth century narrative art. Includes works by Miguel Angel Asturias, Mario Vargas Llosa, and José Donoso. P—Spanish 217 or 218 or permission of instructor.

**654. The Social Canvas of Gabriel García Márquez and Pablo Neruda.** (3) An 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. P—Spanish 217 or 218 or permission of instructor.

**661. Latin American Cinema and Ideology.** (3) An examination of major Latin American films as cinematographic expressions of social and political issues. P—Spanish 217 or 218 or permission of instructor.

**663. Contemporary Spanish-American Theater.** (3) A study of the Spanish-American dramatic production from the end of the nineteenth century to the present. The course focuses on some of the main dramatic movements of the twentieth century: realism, absurdism, avant garde, and collective theater. P—Spanish 217 or 218 or permission of instructor.

**664. Spanish-American Short Story.** (3) Intensive study of the twentieth-century Spanish-American short story with emphasis on major trends and representative authors, such as Quiroga, Rulfo, Borges, Cortazar, Donoso, Garcia Marquez. P—Spanish 217 or 218 or permission of instructor.



# Governing and Advisory Boards



## The Board of Trustees

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Kyle Allen Young, Greensboro, NC

### 1998-2002

L. M. Baker Jr., Winston-Salem, NC  
Carlyn J. Bowden, Greensboro, NC  
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L. Glenn Orr Jr., Winston-Salem, NC  
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Roy J. Smith, Raleigh, NC  
John C. Whitaker Jr., Winston-Salem, NC

### 1999-2003

Diana Moon Adams, Bartlesville, OK  
J. Donald Cowan Jr., Greensboro, NC  
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William B. Greene Jr., Elizabethton, TN  
Deborah D. Lambert, Arlington, VA

William L. Marks, New Orleans, LA  
Louis B. Meyer\*  
J. Donald Nichols, Nashville, TN  
Celeste Mason Pittman, Rocky Mount, NC  
Charles Jeffrey Young, Winston-Salem, NC

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James L. Becton, August, GA  
Graham W. Denton Jr., Charlotte, NC  
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Lisbeth C. Evans, Winston-Salem, NC  
Murray C. Greason Jr., Winston-Salem, NC

Sandra R. Kahle, Vero Beach, FL  
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Charles W. Cheek, Greensboro, NC  
Egbert L. Davis Jr., Winston-Salem, NC  
Thomas H. Davis\*  
Floyd Fletcher, Durham, NC  
Jean H. Gaskin, Charlotte, NC  
Weston P. Hatfield, Winston-Salem, NC  
James E. Johnson Jr., Charlotte, NC

Petro Kulynych, Wilkesboro, NC  
James W. Mason, Southern Pines, NC  
W. Boyd Owen, Waynesville, NC  
Arnold D. Palmer, Youngstown, PA  
Zachary T. Smith, Winston-Salem, NC  
D. E. Ward Jr., Lumberton, NC  
Lonnie B. Williams, Wilmington, NC  
J. Tylee Wilson, Ponte Vedra Beach, FL  
T. Eugene Worrell, Charlottesville, VA  
J. Smith Young Sr., Lexington, NC

\* Deceased

*Officers - 1999-2000*

Hubert Humphrey, Greensboro, NC, Chair  
Murray C. Greason Jr., Winston-Salem, NC, Vice Chair  
Adelaide A. Sink, Tampa, FL, Vice Chair  
Louis R. Morrell, Winston-Salem, NC, Treasurer  
Leon H. Corbett Jr., Winston-Salem, NC, Secretary  
J. Reid Morgan, Winston-Salem, NC, Assistant Secretary  
Irene A. Comito, Clemmons, NC, Assistant Treasurer

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*Dale R. Walker, Chair, Board of Visitors*

***Wake Forest College and Graduate School***

*Terms Expiring June 30, 2001*

F. Hudnall Christopher Jr., Winston-Salem, NC  
Robert M. Frehse Jr., New York, NY  
Beverly B. Lambert, Roanoke, VA  
William L. Salter, Hoffman Estates, IL  
William W. Webb, Chapel Hill, NC

*Terms Expiring June 30, 2002*

Peter J. Bondy, Ft. Lauderdale, FL  
Stewart Taylor Butler, Winston-Salem, NC  
Jane F. Crosthwaite, South Hadley, MA  
Evelyn P. Foote, Accokeek, MD  
Shirley T. Frye, Greensboro, NC  
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Albert D. McCulloch, Bryn Mawr, PA  
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Patricia V. Rogers, Natural Bridge, VA  
Dale R. Walker, New York, NY  
Douglas C. Waller, Washington, DC  
Jeanne P. Whitman, Dallas, TX

*Terms Expiring June 30, 2003*

Bruce M. Babcock, Winston-Salem, NC  
Frank Bragg, Charlotte, NC  
Homer Brookshire, Bridgewater, VA  
Callie Anne Clark, Hinsdale, IL  
Graham Denton, Charlotte, NC  
Brenda E. B. Dunson, Washington, DC  
Karen L. Elkins, Silver Spring, MD  
Kathleen B. French, Fairfax, VA  
Lucy Gordon, New York, NY  
Charlotte Hanes, Winston-Salem, NC  
Sandra R. Kahle, Vero Beach, FL  
Thomas W. Lambeth, Winston-Salem, NC  
Martin Mayer, Washington, DC  
James A. Perdue, Salisbury, MD  
Michael G. Riley, Roanoke, VA  
Janice K. Story, Atlanta, GA  
Rick Lee Tarleton, Athens, GA  
John W. Wagster, Nashville, TN

*Ex-Officio Members*

Sammy Rothrock, President, Alumni Council, Winston-Salem, NC  
Celeste M. Pittman, Board of Trustees Liaison, Rocky Mount, NC

## The Graduate Council

*2000-2001*

Gordon A. Melson, Dean of the Graduate School, Chair  
Cecilia H. Solano, Associate Dean of the Graduate School  
Michael Aschner (2003)  
Michael J. Berry (2003)  
Keigh D. Bonin (2002)  
Donald W. Bowden (2002)  
Ronald V. Dimock Jr. (2003)  
Nancy L. Jones (2001)  
Leah P. McCoy (2002)  
Michelle J. Naughton (2003)  
Ronald W. Oppenheim (2002)  
Stephen H. Richardson (2001)  
Catherine E. Seta (2001)  
Alan J. Williams (2001)

## Graduate Faculty Representatives to the University Senate

Dale Dagenbach (2001)  
Gregory S. Shelness (2002)  
Mary Sorci-Thomas (2004)

# The Administration



Date following name indicates year of appointment

## University

Thomas K. Hearn Jr. (1983) BA, Birmingham-Southern; BD, Southern Baptist Theo. Seminary; PhD, Vanderbilt	President
John P. Anderson (1984) BS, MS, PhD, Georgia Tech.; MBA, Alabama (Birmingham)	Vice President for Finance and Administration
Russell E. Armistead Jr. (1976) BS, Virginia Poly. Inst. and SU; MBA, Wake Forest	Vice President for Health Services Administration
Sandra Combs Boyette (1981) BA, UNC-Charlotte; MEd, Converse; MBA, Wake Forest	Vice President for University Advancement
Leon H. Corbett Jr. (1968) BA, JD, Wake Forest	Vice President and Senior Counsel
Richard H. Dean (1986) BA, Virginia Military Institute; MD, Medical College of Virginia	Senior Vice President for Health Affairs
Samuel T. Gladding (1990) BA, MAEd, Wake Forest; MAR, Yale; PhD, UNC-Greensboro	Associate Provost
Louis R. Morrell (1995) BS, Babson College; MBA, Massachusetts	Vice President for Investments and Treasurer
Edwin G. Wilson (1946, 1951) BA, Wake Forest; AM, PhD, Harvard	Senior Vice President
Kenneth A. Zick (1975) BA, Albion; JD, Wayne State; MLS, Michigan	Vice President for Student Life and Instructional Resources

## *Graduate School*

Gordon A. Melson (1991) BA, PhD, Sheffield (England)	Dean of the Graduate School
Cecilia H. Solano (1999) BA, Harvard; MA, PhD, Johns Hopkins	Associate Dean of the Graduate School

## *Wake Forest University School of Medicine*

Richard H. Dean (1986) BA, Virginia Military Institute; MD, Medical College of Virginia	Senior Vice President for Health Affairs
James N. Thompson (1979) BA, DePauw; MD, Ohio State	Vice President and Dean
Russell E. Armistead Jr. (1976) BS, Virginia Poly. Inst. and SU; MBA, Wake Forest	Vice President for Health Services Administration and Senior Associate Dean, Administrative Services
Cam E. Enarson (1990) BA, Concordia; BMS, MD, Alberta; MBA, Pennsylvania	Associate Dean for Medical Education
J. Scott Gibson (1991) BS, UNC-Chapel Hill; MBA, Duke	Assistant Dean for Financial Planning and Outreach
Ronald L. Hoth (1992) BS, Loyola College	Assistant Dean for Human Resources
Jay Moskowitz (1995) BS, Queens College (CUNY); PhD, Brown	Senior Associate Dean for Science and Technology
Lewis H. Nelson III (1976) BS, North Carolina State; MD, Wake Forest	Associate Dean for Student Services and Admissions
Joanne Ruhland (1988) BS, Gardner Webb; MBA, Appalachian	Assistant Dean for Governmental Relations
Elizabeth F. Sherertz (1988) BS, Wake Forest; MD, Virginia	Associate Dean for Faculty Services
Lawrence D. Smith (1983) BS, MS, Illinois	Associate Dean for Research Development

## *College*

Paul D. Escott (1988) BA, Harvard; MA, PhD, Duke	Dean of the College
Toby A. Hale (1970) BA, Wake Forest; MDiv, Duke; EdD, Indiana	Associate Dean
William S. Hamilton (1983) BA, MA, PhD, Yale	Associate Dean
Claudia Thomas Kairoff (1986) BA, College of Notre Dame of Maryland; MA, Virginia; PhD, Brandeis	Associate Dean

Paul N. Orser (1989) BS, Wake Forest; MS, PhD, Emory	Associate Dean and Dean of Freshmen
Jeryl Prescott (1994) BS, Clemson; MA, NCA&T; PhD, South Florida	Associate Dean

### *Wayne Calloway School of Business and Accountancy*

Jack E. Wilkerson Jr. (1989) BS, Bob Jones University; PhD, Texas	Dean of the Wayne Calloway School of Business and Accountancy
Katherine S. Hoppe (1993) BA, Duke; MBA, Texas Christian	Assistant Dean and Director of Information Technology
Terry A. Baker (1998) BA, Miami University; MS, University of Illinois; MBA, University of Chicago; PhD, University of Kentucky	Assistant Professor of Accountancy Director of MS Program in Accountancy

### *Summer Session*

Toby A. Hale (1970) BA, Wake Forest; MDiv, Duke; EdD, Indiana	Dean of Summer Sessions Associate Dean of the College
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### *Legal Department*

Leon H. Corbett Jr. (1968) BA, JD, Wake Forest	Senior Counsel Secretary of the Board of Trustees
J. Reid Morgan (1980) BA, JD, Wake Forest	University Counsel
Donna H. Hamilton (1988) AB, Drury; JD, Wake Forest	Counsel
Anita M. Conrad (1999) BA, University of Akron; JD, Wake Forest	Counsel

### *Chaplain's Office*

Edgar D. Christman (1954, 1961) BA, JD, Wake Forest; MDiv, Southeastern Baptist Theo. Seminary; STM, Union Theo. Seminary	Chaplain
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### *Institutional Research*

Ross A. Griffith (1966) BS, Wake Forest; MEd, UNC-Greensboro	Director of Institutional Research and Academic Administration
Ursula G. Singh (1997) BS, Lynchburg College; MS, Wake Forest	Assistant Director of Institutional Research

### *Information Systems*

Jay L. Dominick (1991) BS, UNC-Chapel Hill; MA, Georgetown; MBA, Wake Forest	Assistant Vice President for Information Systems and Chief Information Officer
C. Lee Norris (1995) BA, MA, South Carolina	Director of Systems Support

Nancy R. Crouch (1992) BA, Virginia Tech; MAEd, Wake Forest	Director of Technology Outreach and Special Assistant to the Vice President
Ronald W. Rimmer Jr. (1995) BS, Appalachian State	Director of Business Computing
Tim Covey (1988) BA, MBA, Wake Forest	Technology Manager
Lynda Goff (1991) BA, Southern California (Fullerton)	Director of Information Systems Support Services
Thomas F. Jackson (1998) BA, Wake Forest	Director of Telecommunications
John D. Henderson (1998) BBA, Campbell	Director of Administration
Anne Yandell Bishop (1981) BA, MA, UNC-Greensboro; MBA, Wake Forest	Director of Intranet Development

### *Career Services*

William C. Currin (1988) BA, Wake Forest; BD, Southeastern Baptist Theo. Seminary	Director of Career Services
Carolyn A. Couch (1997) BS, Meredith College; MA, Appalachian State	Assistant Director of Career Services

### *Libraries*

Rhoda K. Channing (1989) BA, Brooklyn; MS in LS, Columbia; MBA, Boston College	Director of the Z. Smith Reynolds Library
Deborah N. Lambert (1997) BA, Wittenberg; MLS, Pittsburgh	Assistant Director of the Z. Smith Reynolds Library
Marian F. Parker (1999) BA, UNC-Greensboro, MSLS, UNC-Chapel Hill; JD, Wake Forest	Director of the Professional Center Library and Professor of Law

### *Other Administrative Offices*

Julie Cole (1988) BS, MA, Appalachian	Executive Director, Research Programs and Partnerships
George Franck (1993) BS, MD, Indiana; MPH, Michigan	Medical Director Employee Health and Wellness Services (Bowman Gray Campus)
Cecil D. Price (1991) BS, MD, Wake Forest	Director of Student Health Service (Reynolda Campus)

# The Graduate Faculty



Date following name indicates year of appointment.

Jon S. Abramson (1981) BA, Boston University; MD, Wake Forest	Professor of Pediatrics Associate in Microbiology and Immunology
John R. Absher (1994) BS, Radford; MD, Virginia Commonwealth	Assistant Professor of Neurology Associate in Psychiatry and Biobehavioral Medicine
Michael R. Adams (1980), BS, DVM, Illinois (Champaign-Urbana)	Professor of Comparative Medicine
Steven A. Akman (1996) AB, Cornell; MD, Albert Einstein College of Medicine	Professor of Cancer Biology Professor of Internal Medicine
Martha Alexander-Miller (1997) BS, Butler University; PhD, Washington University	Assistant Professor of Microbiology and Immunology
Edward E. Allen (1991) BS, Brigham Young; MA, PhD, California (San Diego)	Associate Professor of Mathematics
David G. Altman (1995) BA, California (Santa Barbara); MA, PhD, California (Irvine)	Professor of Public Health Sciences
David J. Anderson (1992) BA, Denison; MS, Michigan; PhD, Pennsylvania	Associate Professor of Biology
John P. Anderson (1984) BS, MS, PhD, Georgia Institute of Technology; MBA, Alabama (Birmingham)	Professor of Education
Paul R. Anderson (1990) BS, Wisconsin (Madison); MA, PhD, California (Santa Barbara)	Associate Professor of Physics
Roger T. Anderson (1996) BA, Michigan State; PhD, Johns Hopkins	Associate Professor of Public Health Sciences (Social Sciences and Health Policy)
John A. Anstrom (1986) BS, Pennsylvania State; PhD, SUNY (Buffalo)	Assistant Professor of Neurobiology and Anatomy
Robert J. Applegate (1987) BA, California; BS, San Jose State; MD, Virginia	Associate Professor of Medicine
Michael Aschner (1994) BS, MS, PhD, Rochester	Professor of Physiology and Pharmacology



- Miriam A. Ashley-Ross (1997) Assistant Professor of Biology  
BS, Northern Arizona University;  
PhD, California (Irvine)
- David B. Averill (1993) Assistant Professor of Physiology and  
BS, Kent State; PhD, Washington Pharmacology
- Terry Baker (1998) Assistant Professor of Accountancy  
BA, Miami University; MS, University of Illinois;  
MBA, University of Chicago; PhD, University of Kentucky
- James P. Barefield (1963) Wake Forest Professor of History  
BA, MA, Rice; PhD, Johns Hopkins
- David A. Bass (1976) Professor of Medicine  
BA, Yale; MD, Johns Hopkins; PhD, Oxford (Infectious Disease and Immunology)  
Associate in Biochemistry, Microbiology  
and Immunology
- John V. Baxley (1968) Wake Forest Professor of Mathematics  
BS, MS, Georgia Institute of Technology;  
PhD, Wisconsin
- Robert C. Beck (1959) Professor of Psychology  
BA, PhD, Illinois
- S. Douglas Beets (1987) Associate Professor of Accounting  
BS, Tennessee; MAcc, PhD, Virginia Poly. Inst. and SU
- Ronny A. Bell (1998) Assistant Professor of Epidemiology  
BS, UNC-Chapel Hill; MS, Wake Forest;  
MEd, PhD, UNC-Greensboro
- Mary Jane Berman (1986) Director/Curator  
BA, Harpur; MA, PhD, SUNY (Binghamton) Museum of Anthropology  
Associate Professor of Anthropology
- Michael J. Berry (1985) Professor of Health and Exercise Science  
BS, Jacksonville State; MA, Southeastern  
Louisiana; PhD, Texas A&M
- Deborah L. Best (1972) Wake Forest Professor of Psychology  
BA, MA, Wake Forest; PhD, UNC-Chapel Hill
- David M. Biddulph (1970) Professor Emeritus of Neurobiology  
BS, Utah; MS, PhD, Illinois and Anatomy
- Ulrich Bierbach (2000) Assistant Professor of Chemistry  
MS, PhD, University of Oldenburg
- Martin Bitzan (1999) Assistant Professor of Physiology and Pharmacology  
MD, University of Bonn

Terry D. Blumenthal (1987) BSc, Alberta; MS, PhD, Florida	Associate Professor of Psychology
Walter J. Bo (1960) BS, MS, Marquette; PhD, Cincinnati	Professor of Neurobiology and Anatomy
M. Gene Bond (1974) BS, MS, PhD, Ohio State	Professor of Neurobiology and Anatomy Associate in Neurology
Keith D. Bonin (1992) BS, Loyola (New Orleans); PhD, Maryland (College Park)	Associate Professor of Physics
Susan Harden Borwick (1982) BM, BME, Baylor; PhD, UNC-Chapel Hill	Professor of Music
J. Daniel Bourland (1995) BS, MSPH, PhD, UNC-Chapel Hill	Assistant Professor of Radiation Oncology
Donald W. Bowden (1989) BA, Vanderbilt; PhD, California (Berkeley)	Professor of Biochemistry
Stephen B. Boyd (1986) BA, Tennessee; MDiv, ThD, Harvard Divinity School	Professor of Religion
Anne M. Boyle (1997) BA, Wilkes College; MA, PhD, University of Rochester.	Associate Professor of English
Robert Brommage (1997) BS, Manhattan College; MS, PhD, University of Rochester	Assistant Professor of Comparative Medicine
K. Bridget Brosnihan (1993) BS, College of St. Mary; MS, Creighton University; PhD, Case Western Reserve	Professor of Physiology and Pharmacology
David G. Brown (1990) AB, Denison; MA, PhD, Princeton	Professor of Economics
Carole L. Browne (1980) BS, Hartford; PhD, Syracuse	Professor of Biology
Robert A. Browne (1980) BS, MS, Dayton; PhD, Syracuse	Professor of Biology
Peter H. Brubaker (1991) BS, East Stroudsburg; MA, Wake Forest; PhD, Temple	Associate Professor of Health and Exercise Science Director of the Cardiac Rehabilitation Program
Judy Karen Brunso-Bechtold (1983) BS, Duke; MS, PhD, Florida State	Professor of Neurobiology and Anatomy
Christy M. Buchanan (1992) BA, Seattle Pacific; PhD, Michigan	Associate Professor of Psychology

Vardaman M. Buckalew Jr. (1973) BA, UNC-Chapel Hill; MD, Pennsylvania	Professor of Medicine (Nephrology) Associate in Physiology
Bill C. Bullock (1965) DVM, Texas A&M	Associate Professor of Comparative Medicine
Jennifer J. Burg (1993) BA, Elizabethtown College; MA (French), MA (English), Florida; PhD, Central Florida	Associate Professor of Computer Science
Gregory L. Burke (1991) BA, Northern Iowa; MS, MD, Iowa	Professor of Public Health Sciences
David W. Busija (1991) BS, Pittsburgh; MA, PhD, Kansas	Professor of Physiology and Pharmacology
Robert P. Byington (1987) BS, Loyola; MPH, PhD, Texas (School of Public Health)	Professor of Public Health Sciences
Janis Caldwell (1999) BS, Whitworth College; MD, Northwestern University; MA, PhD, Washington	Assistant Professor of English
William S. Caldwell (1994) BS, University of the South; PhD, Wisconsin	Adjunct Assistant Professor of Physiology and Pharmacology Adjunct Assistant Professor of Chemistry
Michael F. Callahan (1993) BA, Southern Mississippi; PhD, University of Health Sciences	Assistant Professor of Physiology and Pharmacology
Daniel A. Cañas (1987) BS, Tecnológico de Monterrey (Mexico); MS, Georgia Tech; PhD, Texas (Austin)	Associate Professor of Computer Science
Eric D. Carlson (1995) BS, Michigan State; PhD, Harvard	Associate Professor of Physics
Richard D. Carmichael (1971) BS, Wake Forest; MA, PhD, Duke	Professor of Mathematics
Simone M. Caron (1991) BA, Bridgewater State; MA, Northeastern; PhD, Clark	Associate Professor of History
J.L. Douglas Case (1986) BS, MSPH, PhD, UNC-Chapel Hill	Associate Professor of Public Health Sciences
Jingyu Chang (1993) Bachelor of Medicine, Beijing Medical University (China); PhD, University of Lund (Sweden)	Assistant Professor of Physiology and Pharmacology
Mark Chappell (1997) BA, American University; PhD, Cleveland State	Assistant Professor of Physiology and Pharmacology

- Si-Yi Chen (1996) Assistant Professor of Cancer Biology  
 MD, Second Medical College (Shanghai, China);  
 PhD, National Academy of Medical Sciences of China (Beijing)
- Che-Ping Cheng (1993) Associate Professor of Internal Medicine-Cardiology  
 MD, Nanjing Railway Medical University (China); PhD, Wayne State  
 Associate in Physiology and Pharmacology
- Steven R. Childers (1990) Professor of Physiology and Pharmacology  
 BS, Texas (Austin); PhD, Wisconsin (Madison)
- Floyd H. Chilton (1998) Professor of Internal Medicine  
 BS, Western Carolina; PhD, Wake Forest
- H. Alexander Claiborne Jr. (1983) Professor of Biochemistry  
 BA, Vanderbilt; PhD, Duke
- Thomas B. Clarkson Jr. (1957) Professor of Comparative Medicine  
 DVM, Georgia
- J. Mark Cline (1993) Associate Professor of Comparative Medicine  
 BS, DVM, PhD, North Carolina State
- Robert C. Coghill (1999) Assistant Professor of Neurobiology and Anatomy  
 BS, College of William and Mary;  
 PhD, Virginia Commonwealth University
- John E. Collins (1970) Professor of Religion  
 BS, MS, Tennessee; MDiv, Southeastern Baptist  
 Theological Seminary; MA, PhD, Princeton
- Christa Colyer (1997) Assistant Professor of Chemistry  
 BSc, Trent University; MSc, University of Guelph;  
 PhD, Queen's University
- William E. Conner (1988) Professor of Biology  
 BA, Notre Dame; MS, PhD, Cornell
- Gregory Cook (2000) Assistant Professor of Physics  
 BS, PhD, UNC-Chapel Hill
- Nancy Cotton (1977) Professor of English  
 BA, Texas; MA, Wisconsin; PhD, Columbia
- Scott D. Cramer (1996) Professor of Cancer Biology  
 BA, PhD, California (Santa Cruz)  
 Professor of Internal Medicine  
 Assistant Professor of Molecular Genetics
- John R. Crouse III (1980) Professor of Medicine  
 BA, Michigan; (Endocrinology and Metabolism)  
 MD, SUNY (Downstate Medical Center)

- Zheng Cui (1996) Assistant Professor of Biochemistry  
 Degree in Medicine, Tsuenyi Medical College (China); MS, Shanghai Institute of Entomology, Chinese Academy of Sciences (China); PhD, Massachusetts (Amherst)  
 Assistant Professor of Molecular Genetics
- Carol C. Cunningham (1970) Professor of Biochemistry  
 BS, MS, Oklahoma State; PhD, Illinois
- Patricia M. Cunningham (1978) Wake Forest Professor of Education  
 BA, Rhode Island; MS, Florida State; EdS, Indiana State; PhD, Georgia
- Walton W. Curl (1988) Associate Professor of Surgical Sciences  
 BS, West Point; MD, Duke  
 (Orthopedic Surgery)
- James F. Curran (1988) Professor of Biology  
 BAAS, Delaware; MA, PhD, Rice
- Dale Dagenbach (1990) Associate Professor of Psychology  
 BA, New College; MA, PhD, Michigan State
- Ralph B. D'Agostino Jr. (1996) Associate Professor of Public Health Sciences  
 AB, Bowdoin College; AM, PhD, Harvard
- Mary M. Dalton (1996) Visiting Assistant Professor of Communication  
 BA, Wake Forest; MA, PhD, UNC-Greensboro
- Larry W. Daniel (1982) Professor of Biochemistry  
 BS, MS, Western Kentucky; PhD, Tennessee (Memphis)
- James B. Daunais (1999) Instructor of Physiology and Pharmacology  
 BS, East Carolina University; PhD, East Carolina University School of Medicine
- Paul A. Dawson (1991) Associate Professor of Comparative Medicine  
 BS, Florida; PhD, SUNY (Stony Brook)  
 Associate Professor of Medicine
- Samuel A. Deadwyler (1977) Professor of Physiology  
 BA, San Diego State; PhD, SUNY (Stony Brook)
- Sumitra Deb (1998) Adjunct Professor of Cancer Biology  
 BSc, MS, PhD, University of Calcutta (India)
- J. Donald deBethizy (1994) Adjunct Associate Professor of  
 BS, Biology; MS, PhD, Utah State  
 Physiology and Pharmacology
- Osvaldo Delbono (1994) Associate Professor of Physiology  
 MD, University of Buenos Aires School of Medicine  
 and Pharmacology  
 Associate Professor of Internal  
 Medicine/Gerontology

Mary K. DeShazer (1988) BA, Western Kentucky; MA, Louisville; PhD, Oregon	Professor of English
Ronald V. Dimock Jr. (1970) BA, New Hampshire; MS, Florida State; PhD, California (Santa Barbara)	Professor of Biology
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