

COLLEGE OF SCIENCE AND TECHNOLOGY

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MISSION

The College of Science and Technology prepares students with skills and expertise essential to the Commonwealth and the nation. The college emphasizes the theory and applications of science, mathematics, and technology. The college develops students' creative and critical thinking skills and teaches students to analyze problems and implement solutions to a vast array of challenges in the arts, sciences and every aspect of business. Students will be prepared to bring creative and socially responsible innovations to the workplace.

UNDERGRADUATE DEGREES

Students in the college earn a Bachelors degree in:

- Anthropology (The Anthropology degree program is undergoing restructuring.)
- Biology with concentrations in Biotechnology, Environmental Biology, General Biology and Medical Technology

- Chemistry with an Environmental Science Option and Professional Chemist and Pre-health Professional advising
- Computer Science and Technology with concentrations in Computer Science, Database, Software Engineering and Networks
- Geography with concentrations in Environmental Studies, Planning and Technical (The Geography degree program is undergoing restructuring.)
- Geology with concentrations in General Geology, Environmental and Engineering Geosciences and Earth Sciences. (The Geology degree program is undergoing restructuring.)
- Information Science and Systems with concentrations in Information Systems and Web Development
- Mathematics with concentrations in Applied Math, Statistics, and Teaching
- Physics with concentrations in Physics and Physical Science

Students can also enroll in interdisciplinary concentrations outside the college, just as minors and concentrations are available for majors of RU's other five colleges (Business and Economics, Education and Human Development, Humanities and Behavioral Sciences, Waldron College of Health Sciences and Visual and Performing Arts). Agreements with local community colleges provide four-year degree opportunities for community college students receiving associate degrees in technology and business management. For example, students who have earned an Associates of Applied Science (AAS) in information systems technology may continue in any of RU's IT concentrations.

GRADUATION REQUIREMENTS

Students must have a grade point average (GPA) of at least 2.0 in all courses taken at Radford to graduate with the Bachelor of Science or Bachelor of Arts degree. In addition, students must have at least a 2.0 GPA in all courses required by the major and all courses required by the concentration. For the purpose of computing the major GPA, please see the requirements specified by each major and concentration in their respective sections of this catalog.

CORE CURRICULUM

The Core Curriculum program introduces students to the varied modes of inquiry in the arts, humanities, social sciences and natural sciences. The College offers a broad introduction to ethics, social consequences, organizational impacts, public policy, and personal responses to issues in the sciences, mathematics and technology.

BIOLOGY AND CHEMISTRY

Joel B. Hagen, Chairperson
Reed Hall 308, (540) 831-5146

Biology: www.radford.edu/~biol-web/BioIndex.html

Chemistry: www.radford.edu/~chem-web/Chemistry/Chemistry.html

UNDERGRADUATE PROGRAM

The Biology and Chemistry Department offers two majors, one in Biology and one in Chemistry. The department provides students with the opportunity to select, in consultation with a faculty adviser, courses

of study suitable for a wide variety of educational and career goals. There are also numerous opportunities for students to participate in undergraduate research with faculty in the Department. The department offers a Bachelor of Arts degree or Bachelor of Science degree in Biology and a Bachelor of Science degree in Chemistry. Students in the Bachelor of Science program may prepare for state licensure to teach biology or chemistry at the secondary level by completing courses in professional education in addition to Core Curriculum courses and requirements in their major. The Department offers a departmental honors program for students in either major. For specific requirements of this program, contact the department chairperson or the director of the Honors Academy.

PREPROFESSIONAL DEGREE PROGRAMS

Students interested in a career in medicine, dentistry, pharmacy, physical therapy or veterinary medicine may obtain either the Bachelor of Science (Chemistry or Biology) or Bachelor of Arts (Biology) degree. Students who plan to pursue graduate study in these areas are urged to work closely with the Pre-health Advisory Committee in choosing elective courses appropriate to their career objectives.

TRANSFER PROGRAMS

Courses are available which meet the requirements for admission to schools of physical therapy, medical technology, and other allied health sciences. Students interested in such programs should consult with an adviser in the Biology and Chemistry Department.

B.A. OR B.S. DEGREE BIOLOGY PROGRAM

All requirements for a biology major are outlined below. All majors must complete the same Required Core courses in Biology, Chemistry and Statistics, and must also complete additional requirements and/or electives in one of four concentrations.

Core Curriculum Requirements

(see p. 81)

43-45

All Biology majors are required to take the following courses and are advised to take them as part of the Core Curriculum requirements:

CHEM 101. General Chemistry.	4
STAT 200. Introduction to Statistics.	3
MATH 137. College Algebra.	-or-
MATH 138. Precalculus Function Analysis.	-or-
MATH 151. Calculus and Analytic Geometry I.	-or-
MATH 152. Calculus and Analytic Geometry II.	3

Required Biology Courses

20*

*BIOL 131. Ecology and Adaptation.	4
*BIOL 132. Biology of Cells and Microorganisms.	4
*BIOL 231. Genetics, Evolution and Development.	4
*BIOL 232. Organismal Biology.	4
BIOL 160. Introductory Seminar in Biology.	2
BIOL 460. Advanced Seminar in Biology.	2
<i>*Declared biology majors must earn a grade of "C" or better in BIOL 131, 132, 231, or 232 before admission to biology electives requiring these courses as prerequisites. They must also earn a grade of "C" or better in BIOL 160 before admission to any biology electives.</i>	

Other Courses Required for the Major

22

CHEM 101:102. General Chemistry.	4:4
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CHEM 301:302. Organic Chemistry.	4:4
STAT 200. Introduction to Statistics.	3
Mathematics requirement.*	3

**Biology majors must take MATH 137, MATH 138, MATH 151, or MATH 152, whichever they are qualified to enroll in.*

(Students concentrating in Medical Technology take a modification of the above requirements; see below.)

Concentration

22-30

All majors must choose one of the three concentrations described below and fulfill all additional requirements for their chosen concentration.

B.A./B.S. REQUIREMENTS

B.A. Requirements

6-12

The Bachelor of Arts degree requires completion of the B.A. language requirements described on p. 87 of this catalog.

B.S. Requirements

8

All Biology majors are expected to complete CHEM 301:302 (8 hrs) to fulfill their Bachelor of Science degree requirement.

Electives

Students should consult with their academic advisers in selecting elective courses to complete the 120 semester hours required for graduation.

Total Credits Needed for Degree

120

CONCENTRATIONS

GENERAL BIOLOGY CONCENTRATION

This concentration is appropriate for students desiring a broad foundation in biology, including those students planning to

enter graduate, medical, dental, or veterinary schools and those students planning to seek teacher licensure. Students planning to enter graduate school programs specifically in Biotechnology or Environmental Biology should consider those concentrations rather than the General Biology Concentration.

Electives 26-30

Students must select either 26 credits of Biology courses or 22 credits of Biology courses and 8 hours of Physics courses. The additional Biology electives may be chosen from any of the Biology courses numbered 200 or higher. Students are advised to consider all the Department's electives and to choose those most appropriate to their goals.

TEACHING LICENSURE

A biology major in the General Biology Concentration seeking teacher licensure should contact the College of Education and Human Development for information concerning the necessary courses. Students not majoring in biology who desire an endorsement to teach biology in secondary schools must complete 32 semester hours of biology coursework, including BIOL 131:132:231:232. Preparation in chemistry, physics, and mathematics is also recommended. Students should contact the College of Education and Human Development to determine the most appropriate courses for this option.

BIOTECHNOLOGY CONCENTRATION

This concentration is appropriate for students seeking employment in the biotechnology industry. It would also be appropriate for students planning to enter graduate school and to specialize specifically in biotechnology or molecular biology.

Required Courses	23-30
BIOL 301. Bioethics.	2

or	
PHIL 310. Professional Ethics.	3
<i>(Prerequisite: 3 hrs PHIL).</i>	
BIOL 334. Microbiology.	4
BIOL 450. Molecular Biology.	4
BIOL 471:472 (CHEM 471:472)	
Biochemistry.	4:3
BIOL 495. Internship in Biology.	3-6
<i>To count towards the Concentration, BIOL 495 must be an internship with an organization working in the area of biotechnology.</i>	

Recommended Electives

A total of 12-23 additional hours are required to reach the 120 hours needed for graduation. The following electives are recommended for students in the Biotechnology Concentration:

BIOL 337. Immunology.	4
BIOL 430. Genes and Development.	4
PHYS 111:112 or 221:222. Physics.	4:4
BIOL 491 and/or BIOL 492. Research.	1-6

ENVIRONMENTAL BIOLOGY CONCENTRATION

This concentration is recommended for students specifically interested in a career in environmental biology or related fields. It would also be appropriate for students planning to enter graduate school and to specialize specifically in environmental biology.

Required Courses 19-25

BIOL 390. Conservation Biology.	3
BIOL 392. Pollution Biology.	4

GEOG 250. Introduction to GIS.	3
GEOG 241. Environmental Regulation.	3
<i>(Note: GEOG 140 is prerequisite)</i>	

BIOL 495. Internship in Biology.	3-6
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To count towards the Concentration, BIOL 495 must be an internship with an organization working in the area of environmental biology.

Recommended Electives

A total of 18-26 additional hours are required to reach the 120 hours needed for

graduation. The following electives are recommended for students in the Environmental Biology Concentration to choose from in completing these additional hours.

BIOL 215. Plants and Society.	4
BIOL 216. General Zoology.	4
BIOL 217. Flora of Virginia.	4
BIOL 334. Microbiology.	4
BIOL 353. Comparative Behavior.	3
BIOL 361. Parasitology.	4
BIOL 380. Ornithology.	4
BIOL 462. Invertebrate Zoology.	4
BIOL 464. Vertebrate Zoology.	4
BIOL 476. Field Botany.	4
BIOL 481. Special Topics.	1-6
<i>(BIOL 481 is recommended when it focuses on a topic in Environmental Biology.)</i>	
CHEM 215. Environmental Chemistry	3
CHEM 424. Instrumental Methods of Analysis.	4
GEOG 340. International Environmental Problems.	3
GEOG 335. Biogeography.	3
GEOG 492. Land Use.	3
GEOG 493. Planning Techniques.	3
GEOL 100. Earth Resources and Natural Hazards.	4
GEOL 365. Oceanography.	4
GEOL 474. Hydrogeology.	4
PHYS 111:112. General Physics.	4:4
PHYS 221:222. Physics.	4:4

MEDICAL TECHNOLOGY CONCENTRATION

(CLINICAL LABORATORY SCIENCES) CONCENTRATION

Biology majors concentrating in Medical Technology take three years of academic courses at Radford University and spend their senior year (12 months) interning and studying in the clinical facilities of one of the hospitals affiliated with Radford University.

For entrance into the clinical year of study (BIOL 401, 402, 403) students must

apply to the hospital. Because the number of clinical spaces in the hospitals is limited and the number of applicants is large, students should have a GPA of 2.5 or higher to be considered competitive for this clinical internship.

Core Curriculum Requirements

(see p. 81) **43-45**

All Biology majors are required to take the following courses and are advised to take them as part of the Core Curriculum requirements:

CHEM 101. General Chemistry.	4
STAT 200. Introduction to Statistics.	3
MATH 137. College Algebra.	-or-
MATH 138. Precalculus Function Analysis.	-or-
MATH 151. Calculus and Analytic Geometry I.	-or-
MATH 152. Calculus and Analytic Geometry II.	3

Biology Required Science Curriculum **36**

(Students in this concentration complete a modified version of the Biology required curriculum)

BIOL 131. Ecology and Adaptation.	4
BIOL 132. Biology of Cells and Microorganisms.	4
BIOL 160. Introductory Seminar in Biology.	2
BIOL 231. Genetics, Evolution and Development.	4
CHEM 101:102. General Chemistry.	4:4
CHEM 301:302 Organic Chemistry.	4:4
STAT 200. Introduction to Statistics.	3
Mathematics requirement.*	3

*Biology majors must take MATH 137, MATH 138, MATH 151, or MATH 152, whichever they are qualified to enroll in.

Required Courses for concentration **18**

BIOL 322. Human Anatomy and Physiology.	6
BIOL 334. Microbiology.	4
BIOL 337. Immunology.	4
BIOL 450 Molecular Biology.	4

Clinical Courses 33
 BIOL 401, 402, 403. Medical Technology
 Internship
 Clinical Courses to be taken in hospital
 senior year and the preceding summer:
 Blood Banking
 Hematology and Coagulation
 Chemistry (clinical)
 Serology
 Bacteriology
 Parasitology/Clinical Microscopy

Total Credits Needed for Degree 120

**AFFILIATED CLINICAL HOSPITALS
 IN MEDICAL TECHNOLOGY,
 PROGRAM DIRECTORS AND
 ADJUNCT FACULTY**

**Augusta Medical Center School of Clinical
 Laboratory Science-Fishersville, VA**
 Julie A. Plumbley, M.D, Medical Director
 Bernadette Bekken, CLS(NCA),
 MT(ASCP)BB, Program Director
 Kathy Miller, CLS(NCA), MT(ASCP)BB,
 Clinical Coordinator

**Carilion Medical Center School of Clinical
 Laboratory Science-Roanoke, VA**
 Maribeth Greenway, M.Ed., MT(ASCP)
 SH, Program Director
 Melanie Minnix, B.S. MT (ASCP),
 Educator
 Janet Hiler Bowman, M.Ed., MT (ASCP),
 CLS (NCA), Advisory Board
 Randall Vandevander, B.A., MT(ASCP),
 Advisory Board
 Robert White M. D., Advisory Board

**Inova-Fairfax Hospital School of Clinical
 Laboratory Science-Falls Church, VA**
 C. Barrie Cook, M.D., Medical Director
 Amy Shoemaker, MBA, MT(ASCP),
 DLM, Program Director
 Nancy Vandel, MPH MT(ASCP) SM,
 Coordinator of Medical Technology

**Rockingham Memorial Hospital School of
 Medical Technology-Harrisonburg, VA**
 Warren D. Bannister, M.D., Medical
 Advisor
 Sue Lawton, MT (ASCP), M.A., M.S.,
 Program Director
 Cyndee Lowe, MT(ASCP), B.S.,
 Education Coordinator

**ASSOCIATED CLINICAL HOSPITAL
 PROGRAMS IN MEDICAL
 TECHNOLOGY, MEDICAL ADVISOR
 AND ADJUNCT FACULTY**

**Wake Forest University Baptist Medical
 Center-Winston-Salem, NC**
 Marcus B. Simpson, M. D., Program
 Advisor
 Beth Gaither, MBA, MT(ASCP)SM,
 Program Director
 Judi Scaro, MT(ASCP)SC, Instructor
 LuAnn Mascorro, MT(ASCP), SH,
 Instructor
 Bettina Turner, MT(ASCP), SBB,
 Instructor

**AFFILIATED COMMUNITY
 COLLEGES**

**Virginia Western Community College-
 Roanoke, VA**
 Jeffery Gillette, Ph.D., Medical
 Technology Program Advisor

**ARTICULATION AGREEMENT
 BETWEEN RADFORD UNIVERSITY
 AND MEDICAL COLLEGE OF
 VIRGINIA**

The Department of Clinical Laboratory
 Sciences, School of Allied Health Profes-
 sions, Medical College of Virginia Campus/
 Virginia Commonwealth University agrees
 to guarantee admission into the Master of
 Science program in clinical laboratory
 sciences for students with the following
 criteria: Baccalaureate degree in Medical
 Technology (Clinical Laboratory Sciences)
 Biology or Chemistry, minimum GPA 3.25

and a minimum science GPA of 3.0. Minimum TOEFL of 570 is required for students whose native language is not English.

GRADUATION REQUIREMENTS

To graduate with a major in biology a student must attain an overall major grade point average of 2.0 or higher. Major GPA is calculated by using BIOL 131, BIOL 132, all biology courses 200 level or higher, all courses outside of biology used as electives (including CHEM 471:472, Physics if used as an elective, Geography or Geology used as an environmental concentration elective), and any course used as an elective by academic petition.

BIOLOGY MINOR (24 semester hours)

A student may earn a minor in biology by completing 24 semester hours selected by the student from the department offerings. Grade point average in the minor is calculated by using all biology courses and courses cross listed with biology courses.

HONORS PROGRAM IN BIOLOGY

This department offers honors courses, honors contracts and BIOL 488. Final Honors Project. For a general description of the Honors Academy at Radford, see p. 91. For specific requirements, contact the Honors Academy or department chair.

CHEMISTRY PROGRAM

COLLABORATIVE PROGRAMS IN ENGINEERING

The Department of Biology and Chemistry at Radford University and the College of Engineering at Virginia Polytechnic Institute and State University (Virginia Tech) offers a joint program in chemistry and chemical engineering. This is a dual degree

program in which the student will receive a B.S. in chemistry from Radford University and a B.S. in engineering from Virginia Tech. The approximate time required for a student to complete these programs is five years. During the first three years, the student completes the major requirements in chemistry, as well as most or all of the Core Curriculum requirements at Radford. Some introductory engineering courses should also be completed while the student is at Radford; some of these may be taken during the summer. The student then transfers to Virginia Tech and, in two additional years, completes the requirements for a degree in engineering. Participants in this program who have a grade point average of 3.0 or above are guaranteed admission to the College of Engineering at Virginia Tech. All degree requirements for both Radford University and Virginia Tech should be satisfied by the end of the fifth year. The student then receives a degree from each institution.

The student should be prepared to take general chemistry (CHEM 101:102) and calculus (MATH 151:152) during the first year. In the second year, organic chemistry (CHEM 301:302), courses in analytical chemistry (CHEM 324, CHEM 424), the calculus-based physics sequence (PHYS 221:222), and additional calculus courses (MATH 251:252) should be completed. In the third year, the student takes physical chemistry (CHEM 401:402), an integrated laboratory course (CHEM 403: 404), additional mathematics courses, and two engineering courses (5 semester hours of credit) at Virginia Tech. Courses in Core Curriculum during these three years will be chosen in consultation with a faculty adviser. After transferring to Virginia Tech, the student will complete any remaining Core Curriculum requirements and the requirements for the chemical engineering degree. Further details about this program can be obtained by contacting the department chairperson.

UNDERGRADUATE PROGRAM

A wide variety of career opportunities are available to persons trained in chemistry. Chemists work in research, industrial production, quality control, sales, management, environmental control, safety engineering, science reporting, teaching, and many other areas. Training in chemistry is also a valuable background for such professions as medicine, pharmacy, dentistry, and environmental and patent law. Many students who enter medical and dental schools do their undergraduate work as chemistry majors. Chemistry majors are required to take courses in general, analytical, organic, and physical chemistry, as well as physics and calculus. Students are encouraged to take elective courses in biochemistry, advanced inorganic chemistry, advanced organic chemistry, polymer chemistry, and other related areas. Premedical and pre-dental students majoring in chemistry should use their elective hours to take general biology and additional biology courses. Students may pursue licensure to teach chemistry in the Bachelor of Science degree program.

B.S. DEGREE CHEMISTRY MAJOR

All requirements for chemistry majors are outlined below. All majors must take the same Required Core Courses and must complete coursework in one of two concentrations.

Core Curriculum Requirements (see p. 81) 43-45

Required Major Core Courses	41
CHEM 101:102. General Chemistry.*	4:4
CHEM 160. Chemistry Seminar.	2
CHEM 216. Inorganic Chemistry	3
CHEM 301:302. Organic Chemistry.	4:4
CHEM 324. Analytical Chemistry.	4
CHEM 401:402. Physical Chemistry.	4:4
CHEM 424. Instrumental Analysis.	4

CHEM 471. Biochemistry. 4
*CHEM 101 and 102 have been approved for Core Curriculum credit in Natural Sciences.

Related Requirements	14
PHYS 111:112. General Physics.	4:4
or	
PHYS 221:222. Physics.	4:4
MATH 151:152. Calculus and Analytic Geometry I and II.*	3:3

*MATH 151:152 have been approved for Core Curriculum credit in Mathematical Sciences.

B.S. REQUIREMENTS

B.S. (Non Teaching) Requirements 8

Bachelor of Science degree without a professional licensure in secondary education requires the following:

BIOL 132. Biology of Cells and Microorganisms.	4
BIOL 231. Genetics, Evolution, and Development.	4

Additional Requirements to Complete the Degree (9-13 hours chosen from the courses below)

Students who plan to become professional chemists or pursue graduate study in chemistry or related fields are advised to take the following courses to complete their major.

Other Courses	9
CHEM 481:482. Undergraduate Research.*	3
CHEM 400-level Elective.	3
MATH 251. Calculus and Analytic Geometry III.	3
*CHEM 474 (Biochemistry Laboratory) may substitute for one hour of undergraduate research.	

Students planning a career in pharmacy, medicine, dentistry, or veterinary medicine are

advised to take the following courses to complete the major.

Other Courses	13
BIOL 322. Human Anatomy and Physiology.	6
BIOL 334. Microbiology.	4
STAT 200. Introduction to Statistics.	3

Total Credits Needed For Degree 120
(Includes Core Curriculum requirements, required courses and electives. Students should consult with their academic advisers in selecting elective courses to complete the 120 semester hours required for graduation.)

GRADUATION REQUIREMENTS

To graduate with a major in chemistry, a student must attain an overall major grade point average of 2.0 or higher. Different courses are considered in the calculation of the major grade point average depending on the student's concentration. All courses required for a given concentration count towards the major grade point average. In cases where additional (beyond those required) electives listed for a given concentration are taken, all count towards the major grade point average calculation.

TEACHING LICENSURE

Students preparing to teach chemistry in the secondary schools are required to take courses in professional education in addition to Core Curriculum courses and courses required by the chemistry major. A complete listing of the courses required for chemistry teachers and suggested semester schedules are available from all faculty advisers in the department.

Students obtaining initial licensure in a science area other than chemistry can obtain licensure to teach chemistry by taking

22 semester hours in chemistry, to include courses in general (inorganic) chemistry, analytical, organic, and physical chemistry. Licensure in chemistry also requires courses in biology, physics, and mathematics, including one semester of calculus.

ENVIRONMENTAL SCIENCE OPTION

The Department of Biology and Chemistry suggests the following Environmental Science Option for its majors who intend to seek employment in the rapidly growing environment field.

CHEM 424. Instrumental Methods of Analysis. 4

Two of the following courses:

CHEM 215. Environmental Chemistry. 3
PHSC 431. Energy and the Environment. 3
PHYS 406 (GEOL 406). Geophysics. 4

One of the following Biology courses:

BIOL 390. Conservation Biology. 3
BIOL 392. Pollution Biology. 4
BIOL 423. General Ecology. 4

And the following Geology courses:

GEOG 241. Environmental Regulation. 3
GEOL 100. Earth Resources and Natural Hazards. 4

Total 23-25

The following course is recommended:

STAT 200. Introduction to Statistics. 3

Note: Most courses listed above are upper-level ones and have prerequisites. Students must consult with their academic advisers to carefully plan their schedules.

CHEMICAL AND PHARMACEUTICAL SALES

Chemistry majors who wish to pursue a career in technical sales are advised to

take a 15-semester-hour minor in Marketing. In order to be competitive for a position in international sales, a second minor in a foreign language is highly recommended. With careful planning, chemistry majors can obtain both of these minors within a 120-hour Bachelor's Degree program.

CHEMISTRY MINOR (20 semester hours)

A chemistry minor requires 20 hours of chemistry, 12 or more of which must be from courses numbered 200 or higher.

PREPHARMACY PROGRAM

Students who wish to enter a pharmacy school should register as chemistry majors; a designated faculty member from the department will be assigned to advise prepharmacy students. For admission to the School of Pharmacy at the Medical College of Virginia, students must have completed two years of college work that includes the following courses: one year each of general biology, general chemistry, organic chemistry, general physics, and English; six semester hours of mathematics including at least three semester hours of calculus; three semester hours of public speaking; three semester hours of ethics/logic; six semester hours of social sciences; twelve semester hours of electives. Other pharmacy schools may have somewhat different entrance requirements and it is the responsibility of the student to fulfill these requirements.

INFORMATION TECHNOLOGY

Arthur Carter, Chairperson
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www.it.radford.edu

UNDERGRADUATE PROGRAM

The Computer Science and Technology and Information Science and Systems programs prepare students for a variety of rewarding careers in industry and government and for graduate study. The Computer Science Concentration of the Computer Science and Technology program is accredited by the Accreditation Board for Engineering and Technology, Inc., 111 Market Place, Suite 1050, Baltimore, MD 21202-4012. Such accreditation is based on an evaluation of the department's faculty, curriculum, computing resources, students and institutional support. There are seven laboratories available for students within the department with hardware ranging from Sun workstations to PCs to Macintosh computers, and software platforms ranging from Linux to Windows XP to Mac OS. Each of the department's laboratories is connected to the campus network and to the Internet. Students in the department are not required to purchase their own computers; instead, all courses can be completed using equipment in the department's laboratories. The department requires its students to use multiple platforms (Windows XP and Linux) and to learn multiple languages (including Java). Many students go on to take coursework in other languages (e.g. C++, Perl, Ada, PHP) and specialized platforms appropriate to their concentration. In this way, graduates of the program have a diverse background and are better able to handle the rapid pace of change in industry.

Department Core Requirements

All students in the department are required to complete the following core requirements:

Information Technology	15
ITEC 110. Principles of Information Technology.*	3
ITEC 120. Principles of Computer Science I.*	4
ITEC 220. Principles of Computer Science II.*	4
ITEC 225. Web Programming.*	3
ITEC 490. Senior Seminar.	1

** a grade of "C" or better is required in these courses for all department majors.*

BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND TECHNOLOGY

Students seeking the Bachelor of Science in Computer Science and Technology must complete the Department Core requirements listed above and the degree core listed below. Students must choose at least one of the four concentrations within the major: Computer Science, Database, Software Engineering, and Networks. The Computer Science concentration prepares students for a variety of technology careers or graduate study by building a broad foundation in the computer science core and developing additional depth in two elective areas. The Database, Software Engineering, and Networks concentrations provide graduates with a breadth of software development experience and a depth of knowledge in a particular application area.

Core Curriculum Requirements

See p. 81

Some major requirements meet Core Curriculum requirements and students are advised to take them as part of their Core Curriculum requirements. All students in the Information Technology Department are

required to take a Natural Science course to fulfill the College Core B Mathematical or Natural Science requirement.

Department Core Requirements	15
See p. 199.	

Major Core Requirements	12
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Information Technology	6
ITEC 324. Principles of Computer Science III.	3
ITEC 122. Discrete Mathematics.	3

Mathematics	3
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*MATH 151. Calculus and Analytical Geometry.	3
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**This course has been approved for Core Curriculum credit in Mathematical Sciences.*

Concentration Requirements

Students must choose one of four concentrations from the following list: Computer Science, Database, Software Engineering, and Networks. See below for specific concentration requirements.

B.S. Requirements	6-8
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Student concentrating in Computer Science must choose two courses from the following list:

ASTR 111:112; any Biology (except BIOL 301:302); any Chemistry; any Geology (except GEOL 110, 205); any Physics (except PHYS 111:112 and PHYS 221:222 or PHYS 231); PHSC 301.

Students concentrating in Database, Software Engineering, or Networks must choose two courses from the following list:

Any 300 level or above ITEC course (except ITEC 301, 304, and ITEC 400); MATH 152; any 200 level or above Math course; ASTR 111, ASTR 112, any Biology (except BIOL 301 and 302); any Chemistry; any Geology (except GEOL 110 and 205), any Physics, or PHSC 301.

Electives

Students should consult with their academic advisers in selecting elective courses to complete the 120 semester hours required for graduation.

Total Credit Hours Needed for Degree **120**

Major GPA Requirement

All majors require a minimum 2.0 GPA in the major in order to be eligible for graduation. The major GPA for all concentrations is calculated using all ITEC, MATH, and STAT courses applied toward the major, excluding courses used to fulfill the B.S. requirements. In addition, students in the computer science concentration must earn a “C” or better in all ITEC courses applied toward the major (see “Graduation Requirements for the Computer Science Concentration” below).

CONCENTRATIONS

COMPUTER SCIENCE CONCENTRATION

In addition to the Core Curriculum, Department Core, Major Core, B.S. requirements, and electives, students in the Computer Science Concentration are required to complete the following:

Information Technology	24
ITEC 320. Procedural Analysis and Design.	3
ITEC 352. Computer Organization.	3
ITEC 360. Data Structures and Analysis of Algorithms.	3
ITEC 370. Software Engineering I.	3
ITEC 371. Operating Systems.	3
ITEC 380. Organization of Programming Languages.	3
ITEC 420. Computability Theory and Formal Languages.	3

One course selected from the following:

ITEC 315. Graphical User Interface Design and Implementation.	3
ITEC 340. Database I.	3
ITEC 350. Introduction to Computer Networking.	3
ITEC 410. Modeling and Simulation.	3
ITEC 430. Computer Graphics.	3
ITEC 460. Translator Design and Construction.	3
ITEC 480. Artificial Intelligence.	3

Physics **8**

*PHYS 221. Physics.	4
*PHYS 222. Physics.	4
<i>*This course has been approved for Core Curriculum credit in Natural Sciences.</i>	

Mathematics **9**

MATH 152. Calculus and Analytical Geometry II.	3
MATH 251. Calculus and Analytical Geometry III.	3
STAT 301 Probability and Statistics I.	3

Graduation Requirements

Each student majoring in the Computer Science Concentration of the Computer Science and Technology degree must take the Graduate Record Achievement Test in Computer Science or an equivalent exam as determined by the department during her or his last semester. Each student majoring in the Computer Science Concentration of the Computer Science and Technology degree must earn a grade of “C” or better in each information technology course required for the major. All majors require a minimum 2.0 GPA in the major in order to be eligible for graduation.

DATABASE CONCENTRATION

In addition to the Core Curriculum, Department Core, Major Core, B.S. requirements, and electives, students in the Database concentration are required to complete the following:

Information Technology	27	ITEC 451. Network Design and Analysis.	3
ITEC 320. Procedural Analysis and Design.	3	ITEC 452. Distributed Computing.	3
ITEC 325. Web Programming II.	3	Plus 6 additional credit hours chosen from any 300 or 400 level ITEC courses (except for ITEC 301, 304, 400, 493, or 498).	6
ITEC 340. Database I.	3		
ITEC 441. Database II.	3		
ITEC 442. Data Warehousing, Mining, and Reporting.	3		
Plus 12 additional credit hours chosen from any 300 or 400 level ITEC courses (except ITEC 301, 304, 400, 493, or 498)	12		

SOFTWARE ENGINEERING CONCENTRATION

In addition to the Core Curriculum, Department Core, Major Core, B.S. requirements, and electives, students in the Software Engineering Concentration are required to complete the following:

Information Technology	27
ITEC 320. Procedural Analysis and Design.	3
ITEC 370. Software Engineering I.	3
ITEC 380. Organization of Programming Languages.	3
ITEC 471. Software Engineering II.	3
ITEC 472. Software Engineering III.	3
Plus 12 additional credit hours chosen from any 300 or 400 level ITEC courses (except ITEC 301, 304, 400, 493, or 498).	12

NETWORKS CONCENTRATION

In addition to the Core Curriculum, Department Core, Major Core, B.S. requirements, and electives, students in the Networks Concentration are required to complete the following:

Information Technology	27
ITEC 310. Programming in C and Unix.	3
ITEC 340. Database I.	3
ITEC 350. Introduction to Computer Networking.	3
ITEC 352. Computer Organization.	3
ITEC 371. Operating Systems I.	3

Mathematics	6
MATH 152. Calculus and Analytical Geometry II.	3
STAT 301. Probability and Statistics I.	3

TEACHER LICENSURE

COMPUTER SCIENCE TEACHING CERTIFICATION ADD-ON ENDORSEMENT

A student may pursue an add-on endorsement in computer science while pursuing another endorsement for licensure in a different area or after receiving initial licensure. The add-on endorsement may not be used for initial licensure. The applicant seeking an add-on endorsement in computer science shall complete a minimum of 15 semester hours of course work according to the guidelines below. Courses may be counted toward multiple categories where appropriate. Each course applied to the endorsement must be passed with a grade of "C" or better. Computer Science: Minimum of 6 hours. Both ITEC 120 and ITEC 220. Data Structures and/or Algorithms Analysis: Minimum of 3 hours. Either ITEC 220 or ITEC 360. Introduction to Computer Systems: Minimum of 3 hours. Either ITEC 100 or ITEC 352. Application of Computer Technology: Minimum of 3 hours. Choose from the following: ITEC 100, ITEC 201, ITEC 122, ITEC 198, ITEC 225, ITEC 324, ITEC 340, ITEC 350, ITEC 370, DSNI 320, DSNI 420, GEOG 360, GEOG 420, GEOL 405, COMS 328, COMS 426, MUSC 127, MUSC 128, MUSC 227, MUSC 428, MATH 330, STAT 430.

BACHELOR OF SCIENCE IN INFORMATION SCIENCE AND SYSTEMS

Students seeking the Bachelor of Science in Information Science and Systems must complete the Department Core requirements listed above. Students must choose from at least one of three concentrations within the major: Information Systems, Web Development and Enterprise Systems Development. The Information Systems concentration is designed to provide graduates with a background in both information technology and business so that graduates can pursue a variety of career opportunities applying, managing, and supporting information technology within profit and non-profit organizations. The Web Development concentration prepares students in all aspects of web site design, development, integration, security, and maintenance.

Core Curriculum Requirements

See p. 81.

Some major requirements meet Core Curriculum requirements and students are advised to take them as part of their Core Curriculum requirements. All students in the Information Technology Department are required to take a Natural Science course to fulfill the College Core B Mathematical or Natural Science requirement.

Department Core Requirements 15
See p. 199.

Major Core Requirements 15

Information Technology:

ITEC 340. Database I. 3
ITEC 370. Software Engineering I. 3

Business:

ACTG 211. Fundamentals of Financial Accounting. 3
MKTG 340. Principles of Marketing. 3

Core Curriculum Courses:

*ECON 106. Principles of Microeconomics. 3
* *This course has been approved for Core Curriculum credit in Social and Behavioral Sciences or U.S. Perspectives.*

Concentration

Students must choose one of two concentrations from the following list: Information Systems and Web Development. See below for specific concentration requirements.

B.S. Requirement 6-7

Three hours chosen from the following:

ITEC 324 or any ITEC 300 level or above ITEC course (except ITEC 301 and ITEC 400). The remaining hours chosen from the following: ITEC 324, any 300 level or above ITEC course (except ITEC 301, 304, and ITEC 400), MATH 152, any 200 level or above Math course, ASTR 111, ASTR 112, any Biology (except BIOL 301 and 302), any Chemistry; any Geology (except GEOL 110 and 205), any Physics, or PHSC 301.

Electives

Students should consult with their academic advisers in selecting elective courses to complete the 120 semester hours required for graduation.

Total Credit Hours Needed for Degree 120

Major GPA Requirement

All majors require a minimum 2.0 GPA in the major in order to be eligible for graduation. The major GPA for all concentrations is calculated using all MATH, STAT, ITEC, MGNT, FINC, BLAW, MKTG, ACTG, and ECON courses applied toward the major, excluding courses used to fulfill the B.S. requirements. Many courses require a "C" or

better in the prerequisite (see “Course Descriptions” section of this catalog below).

CONCENTRATIONS

INFORMATION SYSTEMS CONCENTRATION

In addition to the Core Curriculum, Department Core, Major Core, B.S. requirements, and electives, students in the Information Systems Concentration are required to complete the following:

General Requirements	9
*MATH 126. Business Calculus.	-or-
*MATH 151. Calculus and Analytical Geometry.	3
STAT 200. Introduction to Statistics.	-or-
STAT 301. Probability and Statistics I.	3
**ECON 105. Principles of Macroeconomics.	3
<i>*This course has been approved for Core Curriculum credit in Mathematical Sciences.</i>	
<i>**This course has been approved for Core Curriculum credit in Social and Behavioral Sciences or U.S. Perspectives.</i>	

Information Technology	9
ITEC 100. Introduction to Information Technology.	3
ITEC 485. Decision Support Systems.	3
ITEC 495. Information Systems Capstone.	3

Business	18
BLAW 203. Legal Environment of Business.	3
MGNT 322. Organizational Behavior.	3
MGNT 333. Statistical Decision Support.	3
ACTG 212. Fundamentals of Managerial Accounting.	3
FINC 331. Introduction to Business Finance.	3
MGNT 357. Operations Management.	3

WEB DEVELOPMENT CONCENTRATION

In addition to the Core Curriculum, Department Core, Major Core, B.S. requirements, and electives, students in the Web Development Concentration are required to complete the following:

General Requirements	6
*MATH 126. Business Calculus.	-or-
*MATH 151. Calculus and Analytical Geometry.	3
STAT 200. Introduction to Statistics.	-or-
STAT 301. Probability and Statistics I.	3
<i>*This course has been approved for Core Curriculum credit in Mathematical Sciences.</i>	

Information Technology	12
ITEC 315. Graphic User Interface Design and Implementation.	3
ITEC 325. Web Programming II.	3
ITEC 350. Introduction to Computer Networking.	3
ITEC 425. Advanced Web Development.	3

Business	3
MKTG 342. Internet Marketing.	3

Media Studies	12
COMS 226. Digital Imaging.	3
COMS 326. Web Production.	3
COMS 400. Media Law and Ethics.	3
COMS 427. Advanced Web and Multimedia Production.	3

MINORS

The following Department of Information Technology minors are available to students not already pursuing a Bachelor of Science in Computer Science and Technology or a Bachelor of Science in Information Science and Systems. Fifty percent of the hours required for the minor must be completed at Radford University. A student must have a 2.0 or higher GPA in the

minor. A student may not receive a minor in both computer science and information technology.

COMPUTER SCIENCE MINOR 17

Requirements for a computer science minor are ITEC 110, ITEC 120, ITEC 220, ITEC 225, and at least three additional hours chosen from ITEC 122 or any 200 level or above ITEC course except for ITEC 202 and ITEC 400. Each course applied to the minor must be passed with a grade of “C” or better. The minor GPA will be calculated by using the 17 best hours applied toward the minor.

INFORMATION TECHNOLOGY MINOR 18

The Information Technology minor consists of 18 credit hours of ITEC courses. Courses cross-listed as ITEC courses may be used to count toward the minor. The minor GPA will be calculated by using the 18 best hours applied toward the minor.

UNDERGRADUATE CERTIFICATE IN INFORMATION SECURITY

Students seeking the Information Security Certificate must have successfully completed Principles of Computer Science I (ITEC 120) with grade of “C” or better prior to being admitted. The certificate addresses issues across different aspects of computing, raises awareness of security risks, and improves the ability of our students to develop end-to-end security solutions. Students must complete the following three courses:

Certificate Requirements	9
ITEC 245. Introduction to Computer Security.	3
ITEC 445. Computer System and Database Security.	3
ITEC 455. Applied Cryptography and Network Security.	3

MATHEMATICS AND STATISTICS

M. Jill Stewart, Chairperson
Walker Hall 244, (540) 831-5325
www.radford.edu/~math-web/

UNDERGRADUATE PROGRAM

The Department of Mathematics and Statistics offers a broad curriculum leading to a Bachelor of Arts or Bachelor of Science degree. Concentrations in Applied Mathematics, Statistics, and Teaching Licensure are available. Depending upon the particular course of study taken, the student will be prepared for a career in industry, government, or education.

MATHEMATICS AND STATISTICS COLLABORATIVE PROGRAM IN ENGINEERING

The Department of Mathematics and Statistics at Radford University and the College of Engineering at Virginia Polytechnic Institute and State University (Virginia Tech) offer a joint program in mathematics and engineering. This is a dual degree program in which the student will receive a B.A. or B.S. in mathematics from Radford University and a B.S. in engineering from Virginia Tech. The approximate time required for a student to complete these programs is five years. During the first two to three years, the student completes the major requirements in mathematics, as well as most or all of the Core Curriculum requirements at Radford. Some introductory engineering courses should also be completed while the student is at Radford; these are typically taken during the summer. The student then transfers to Virginia Tech and, in two or three additional years, completes the requirements

for a degree in engineering. Participants in this program who have a grade point average of 3.0 or above, who meet all normal transfer requirements of Virginia Tech, who have completed the equivalent of ENGE 1024 & 1104 or 1114 at Virginia Tech, and who are recommended for admission by the dual degree program advisor at Radford University will be assured admission to the College of Engineering at Virginia Tech. Once all degree requirements for both Radford University and Virginia Tech are satisfied, the student then receives a degree from each institution.

For the dual degree program in mathematics, the student should choose, early in the program, the intended engineering major at Virginia Tech. This choice will affect the curriculum that the student undertakes at Radford. All students in this program must be prepared to take MATH 151:152 during the first year and MATH 251:252 during the second year. The student will also take MATH 260, MATH 437, ITEC 120, PHYS 221:222, Chemistry (CHEM 101 or 103), ENGL 101:102, and other Core Curriculum and upper level courses during their second and, typically, third years in the program. These Core Curriculum and upper level courses will be chosen, with the assistance of a faculty advisor, to fulfill the requirements of the major in mathematics (applied mathematics concentration), as well as to complement the student's intended engineering curriculum. The student will be encouraged to take an introduction to engineering course at Virginia Tech as early as the summer between the first and second years of the program. The remaining requirements of the mathematics major and of the chosen engineering major will then be completed after the student has transferred to Virginia Tech. Further details about this program can be obtained by contacting the department chairperson.

B.A. OR B.S. DEGREE MATHEMATICS MAJOR

The major is available with a choice of three concentrations: Applied Mathematics, Statistics, and Teaching.

To graduate with a major in Mathematics, a student must have a grade point average of 2.0 in all courses required for the major, including courses satisfying the B.S. requirements, where applicable.

Core Curriculum Requirements 43-45 (see p. 81)

Six hours of mathematics courses required for the major may be included as part of the 43-45 hour Core Curriculum requirement. Students in the Applied Mathematics concentration may count PHYS 221:222 as part of their Core Curriculum requirement as well.

Required Courses 12

All majors in mathematics must take Calculus and Analytic Geometry I, II, III and IV (MATH 151:152:251:252). A grade of at least a "C" is required in each course in the calculus sequence. Any departmental majors receiving credit for MATH 252 cannot subsequently receive credit for any 100-level mathematics course.

B.A./B.S. REQUIREMENTS

B.A. Requirements 6

The Bachelor of Arts degree requires completion of the B.A. language requirements described on p. 87 of this catalog.

B.S. Requirements 6

To satisfy the B.S. requirement, students in the Applied Mathematics and Statistics concentrations must take courses from among the following. See the descriptions of those concentrations for details.

PHIL 340. Symbolic Logic. 3

ITEC 122. Discrete Mathematics.	
ENGL 306. Professional Writing.	3
ENGL 406. Advanced Technical Writing.	3
GEOL 455. Principles of Engineering Geology.	3
MATH 423:424. Abstract Algebra.	3
MATH 445:446. Operations Research.	3
STAT 430. Statistical Packages.	3
Any ITEC course numbered 200 or above with the exception of ITEC 202 and ITEC 250.	
Any physics course numbered 300 or above.	
Any of the following Finance (FINC) courses: 331, 332, 335, 341, 381, 438, 439, 441.	
Any chemistry course. Any biology course.	

CONCENTRATIONS

Courses required for each concentration are as follows:

APPLIED MATHEMATICS CONCENTRATION	42
MATH 260. Introductory Linear Algebra.	3
MATH 280. Problem Solving.	3
MATH 346. Differential Equations.	3
MATH 430:431. Advanced Calculus.	6
MATH 434:435. Numerical Analysis I and II.	6
STAT 301:302. Probability and Statistics I and II.	6
ITEC 120. Principles of Computer Science.	4
PHYS 221:222. Physics.*	8
Any 300- or 400-level mathematics or statistics course, with the exception of MATH 312 and MATH 325.	3

B.S. Requirements 6

To satisfy the B.S. requirement, majors with a concentration in Applied Mathematics must take at least six hours from the courses listed under B.S. Requirements above.

STATISTICS CONCENTRATION	28
STAT 301:302. Probability and Statistics I and II.	6
STAT 420. Modern Regression Analysis.	3
STAT 421. Design of Experiments.	3
MATH 260. Introductory Linear Algebra.	
or	
MATH 460. Linear Algebra.	3
MATH 430:431. Advanced Calculus I and II.	6
Three additional hours chosen from among 300- or 400-level Statistics courses.	3
ITEC 120. Principles of Computer Science.	4

B.S. Requirements

To satisfy the B.S. requirement, majors with a Statistics concentration must take ENGL 306 (Professional Writing) and at least three additional hours chosen from the list given under B.S. Requirements above, except STAT 430.

TEACHING LICENSURE	27
MATH 135. Fundamentals of Geometry.	3
MATH 142. Discrete Mathematics.	3
MATH 260. Introductory Linear Algebra.	3
MATH 300. Mathematical Foundations.	
MATH 321. History of Mathematics.	3
MATH 325. Special Methods- Secondary Mathematics Education.	3
MATH 412. Theory of Numbers.	3
MATH 423. Abstract Algebra I.	3
STAT 301. Probability and Statistics I.	3

There is no departmental B.S. requirement for students seeking teaching licensure. However, students must take appropriate courses in education. (Contact the Dean of the College of Education and Human Development for information concerning these courses.)

Electives

Students should consult with their academic advisers in selecting elective courses to complete the 120 semester hours required for graduation.

GRADUATION REQUIREMENTS

To graduate with a major in Mathematics, a student must have a grade point average of 2.0 or higher in all required MATH, STAT, ITEC, and PHYS courses for the Applied Mathematics Concentration; MATH, STAT and ITEC courses for the Statistics Concentration; MATH and STAT courses for Teaching Licensure.

MINORS

MATHEMATICS MINOR

(18 semester hours)

MATH 151, MATH 152, MATH 251 and MATH 260 and at least two courses chosen from among MATH 252, MATH 300, MATH 321, any 400 level mathematics course or any 300 or 400 level statistics course.

STATISTICS MINOR

(18 semester hours)

Eighteen semester hours are required in mathematics or statistics, including at least three semester hours in a calculus course (MATH 126 or 151). At least 12 of the 18 hours must be in statistics.

SCHOOL OF ENVIRONMENTAL AND PHYSICAL SCIENCE

Bernd H. Kuennecke, Interim Director
Cook Hall 136, (540) 831-5558

The School of Environmental and Physical Science (SEPS) provides students courses of study in Physics as well as the

Anthropology, Forensic Science, Geography, and Geology. A major theme across the disciplines is the application of biological, geological, geographical, and physical principles to the study of the physical and cultural environment and the solution of environmental problems. It also houses the Radford University Forensic Science Institute, which oversees the Interdisciplinary Minor in Forensic Science.

ANTHROPOLOGY PROGRAM

(The Anthropology program is undergoing restructuring. Please consult with Dr. Donna Boyd for curriculum questions.)

All requirements for anthropology majors are outlined below. Among the requirements are 20 semester hours of Required Courses and 21 hours of department electives.

Core Curriculum Requirements **43-45**
(see p. 81)

Required Courses

ANTH 120. Physical Anthropology.	3
ANTH/SOCY 121. Understanding Cultures.	3
ANTH 122. Introduction to Archeology.	3
SOCY 482. Practicing Ethnographic Methods.	4
ANTH 482. Quantitative and Computer Methods in Anthropology.	4
ANTH 497. Senior Seminar in Anthropology.	3
Anthropology Electives	21

A minimum of 21 hours anthropology electives, at least one course each from the following groups listed below.

Group A: Cultural Anthropology—at least 3 credits. Group A courses include: SOCY 301, 333, 411, 421, 435, 475, 486.

Group B: Physical Anthropology—at least 3 credits. Group B courses

include: ANTH 230, 320, 330, 410, 420.
 Group C: Archaeology—at least 3 credits. Group C courses include: ANTH 232, 322, 332, 492.
Courses selected must include 3 ANTH/SOCY courses at the 300- or 400-level, abiding by the prerequisites, limits, and stipulations as stated in this catalog.

B.A./B.S. Requirements **6-12**
 (see below)

Electives

Students should consult with their academic advisers in selecting elective courses to complete 120 hours required for graduation.

Total Credits Needed for Degree **120**

B.A./B.S. REQUIREMENTS

B.A. REQUIREMENTS

The Bachelor of Arts degree requires completion of the B.A. language requirements described on p. 87 of this catalog.

B.S. Requirements

Department majors pursuing the Bachelor of Science degree must complete six to eight semester hours beyond the Core Curriculum requirements in courses chosen from the following:

APST 200. Introducing Appalachia.	3
APST 460. Seminar: Current Issues in Appalachian Studies.	3
BIOL 301. Bioethics.	2
BIOL 302. Science, Technology and Society.	2
BIOL 322. Human Anatomy.	6
COMS 114. Public Speaking.	3
COMS/POSC 327. Politics and the Media.	3
ECON 203. Public Finance.	3
ENGL 306. Professional Writing.	3

ENGL 446. Appalachian Folklore.	3
GEOG 250. Introduction to GIS.	3
GEOL 320. Sedimentation and Stratigraphy.	4
GEOL 335. General Paleontology.	4
HIST 295. The Historian's Craft.	3
ITEC 100. Introduction to Information Technology.	3
POSC 335. American Public Policy.	3
SOCY 380. Introduction to Social Research Methods.	3

GRADUATION REQUIREMENTS

To graduate with a major in Anthropology, a student must have a grade point average of 2.0 or higher in all courses taken with a SOCY or ANTH prefix. Majors must complete all required courses in the major curricula listed above with a grade of "C" or better.

ANTHROPOLOGY MINOR (18 semester hours)

This minor consists of a minimum of 18 semester hours in anthropology, including ANTH 120, ANTH 121, and ANTH 122. Up to six semester hours in sociology at the 300- or 400-level may count toward a minor in anthropology.

FORENSIC SCIENCE INSTITUTE (RUFESI)

Cliff and Donna Boyd, Co-Directors
<http://rufsi.asp.radford.edu>
109 Reed Hall; 831-5948

The RU Forensic Science Institute (RUFESI) is an interdisciplinary institute whose goal is to promote and support forensic science education, research and public service. The institute faculty and affiliates are comprised of a wide range of specialists with interests in Forensic Science and include Forensic Anthropologists, Archaeologists, Biologists, Chemists, and specialists

in Physics, Geology, Criminal Justice, and Psychology. The RUFSI provides unique hands-on advanced interdisciplinary training of undergraduate students in the Forensic Sciences through the Minor in Forensic Science which prepares students for professional careers (including graduate study) in a variety of forensic medico-legal settings.

MINOR IN FORENSIC SCIENCE

The Minor in Forensic Science is an interdisciplinary preprofessional minor designed for students with interests or career goals in Forensic Science. It complements any major, but is especially appropriate for students with Biology and Chemistry majors. It provides students with the scientific academic background and work experience in basic principles of Forensic Science, including Forensic Chemistry, Biology, Anthropology, Psychology, and Criminal Justice.

The Forensic Science Minor is administered and supervised by the RU Forensic Science Institute in conjunction with an advisory group of faculty from a variety of disciplines with forensic science expertise and specialties. Students who wish to minor in Forensic Science must consult with RUFSI directors or faculty and a Forensic Science Advisory Committee for advising and assistance with meeting graduation requirements. To graduate with a Minor in Forensic Science, a student must have a grade of “C” or higher in all courses taken for the minor.

The Minor in Forensic Science consists of a minimum of 20 semester hours, as follows:

Required Courses	14
BIOL 383. Molecular Forensic Biology.	4
CHEM 465. Forensic Chemistry.	4
CRJU 341. Introduction to Forensic Science.	3
CRJU 481. Forensic Evidence.	3

Elective Courses 6

To be chosen from the following:

ANTH 230. Introduction to Forensic Anthropology.	3
ANTH 232. Forensic Archaeology.	3
ANTH 320. Human Osteology.	4
ANTH 420. Advanced Forensic Anthropology.	4
BIOL 301. Bioethics.	2
BIOL 334. Microbiology.	4
BIOL 450. Molecular Biology.	4
CRJU 350. Ethical and Moral Issues in Criminal Justice.	3
CRJU 360. Criminal Law and Evidence	3
MATH 151:152. Calculus and Analytical Geometry.	3:3
PHYS 111:112. General Physics.	4:4
PSYC 405. Forensic Psychology.	3

GEOGRAPHY PROGRAM

(The Geography program is undergoing restructuring. Please consult with Dr. Bernd Kuennecke for curriculum questions.)

The Geography program, while stressing breadth of geographical preparation, provides specialized course work for students who seek careers in planning or with environmental agencies, or who seek admission to a graduate program; training in digital cartographic techniques; and training in geospatial information systems and their applications.

The department, which offers programs leading to a Bachelor of Science or Bachelor of Arts degree, focuses on GIS, environmental studies, land use and watershed issues; regional and international studies, especially in North America, Latin America, Europe, and Russia; and cultural and economic geography. Technical strengths include geospatial information systems (GIS), digital cartographic techniques, and digital image processing.

GEOGRAPHY MAJOR

All requirements for geography majors are outlined below. All majors must take the same Required Core courses and must complete course work in one of three concentrations.

Required Core Courses	29
GEOG 101. Europe and the Americas [World Geography].	-or-
GEOG 102. Africa and Asia [World Geography].	3
GEOG 103. Introduction to Human Geography.	3
GEOG 125. Introduction to Geospatial Data.	3
GEOG 130. Physical Geography.	4
GEOG 211. Perspectives in Geography.	3
GEOG 250. Introduction to GIS.	3
GEOG 270. Introduction to Cartography.	4
GEOG 490. Field Research Methods.	3
GEOG 496. Senior Capstone.	3

Concentrations **28-48**

Majors must choose one of the three concentrations shown below.

B.A./B.S. Requirements

For all concentrations, the Bachelor of Arts degree requires completion of the B.A. language requirements described on p. 87 of this catalog. Bachelor of Science degree requirements for each concentration are described within the concentration.

Electives

Students should consult with their academic advisers in selecting elective courses to complete the 120 semester hours required for graduation.

Total Credits Needed For Degree **120**

CONCENTRATIONS

ENVIRONMENTAL STUDIES

CONCENTRATION

(39-45 semester hours)

The environmental studies concentration allows students to integrate the interdisciplinary focus and analytic skills of geography with an understanding of contemporary environmental problems.

Required Courses **15**

GEOG 140. Introduction to Environmental Studies.	3
GEOG 241. Environmental Regulation.	3
GEOG 305. Population Geography.	3
GEOG 335. Biogeography.	3
ECON 272. Natural Resource Economics.	or
ECON 375. Environmental Economics.	3

Majors must then choose one of the following tracks to complete the concentration:

Track 1 **28-30**

(for students interested in land management or environmental planning)

GEOG 302. Economic Geography.	3
GEOG 336. Human Ecology.	3
GEOG 361. Public Lands.	3
GEOG 410. Advanced GIS.	3
GEOG 425. Digital Image Processing.	4
GEOG 492. Land Use.	3
GEOG 493. Planning Techniques.	3

Two upper division courses in geography or a complementary field with approval of adviser. **6-8**

Track 2 **24-28**

(for students interested in advocacy, policy, and education)

200 level regional course in geography	3
GEOG 340. International Environmental Problems.	3

Two upper division courses in geography or a complementary field selected from among the following:

- BIOL 390. Conservation Biology.
- COMS 332. Argumentation and Advocacy.
- CRJU 360. Criminal Law and Evidence.
- ENGL 306. Professional Writing.
- ENGL 453. Literature and the Environment.
- COMS 407. Science and Environmental Writing.
- POSC 438. Constitutional Law: Governmental Powers.
- POSC 463. International Political Economy.
- SOCY 370. Environmental Sociology.

Four additional courses chosen from geography or complementary disciplines, with approval of adviser. Geography courses selected to meet this requirement must be upper-division courses. 12-16

B.S. Requirements 6-8

CHEM 101 or 115 and statistics. (if already taken as part of Core Curriculum requirements, then 6-8 hours of additional science.)

Note: A minor in a complementary field is strongly encouraged.

PLANNING CONCENTRATION (40 semester hours)

The Planning Concentration emphasizes the development of planning skills by combining 28 semester hours of physical, cultural and technical geography courses with related courses from other disciplines.

- | | |
|-------------------------------------|-----------|
| Required Geography Courses | 28 |
| GEOG 302. Economic Geography. | 3 |
| GEOG 305. Population Geography. | 3 |
| GEOG 361. Public Lands. | 3 |
| GEOG 425. Digital Image Processing. | 4 |
| GEOG 492. Land Use. | 3 |

GEOG 493. Planning Techniques. 3 One of the following regional courses 3

- GEOG 201. North America.
 - GEOG 202. Commonwealth of Virginia.
 - GEOG 203. Appalachian Geography.
- An additional 6 credit hours in geography selected from the following:*
- GEOG 140. Introduction to Environmental Studies. 3
 - GEOG 241. Environmental Regulations. 3
 - GEOG 340. International Environmental Problems. 3
 - GEOG 336. Human Ecology. 3
 - GEOG 410. Advanced GIS. 3

Required Courses Outside Geography 12

Twelve credit hours outside of geography selected from the following in consultation with an adviser:

- ACTG 416. Governmental and Not-for-profit Acct. 3
- COMS 114. Public Speaking. 3
- ECON 203. Public Finance. 3
- ECON 313. Public Planning. 3
- ENGL 306. Professional Writing.
- or
- ENGL 307. Business Writing. 3
- FINC 336. Principles of Real Estate. 3
- POSC 300. Public Administration. 3
- POSC 330. State and Local Government. 3
- POSC 331. Urban and Metropolitan Politics. 3

B.S. Requirements 6-8

Six to eight additional semester hours of mathematics, computer science, statistics and science courses. (MATH 325 does not meet requirements.)

NOTE: Internships are strongly recommended. Credit for internships may be gained through GEOG 499.

GEOGRAPHIC INFORMATION SYSTEMS CONCENTRATION (28-30 semester hours)

The Geographic Information Systems (GIS) Concentration emphasizes the de-

velopment of skills in cartography, remote sensing, and computer applications. Requirements are 19 hours of geography and 12-14 semester hours to be selected from courses listed in mathematics, statistics, computer science, and English.

Required Geography Courses 16-19

GEOG 103. Introduction to Human Geography.	3
GEOG 315. Intermediate GIS Concepts.	3
GEOG 410. Advanced GIS.	3
GEOG 425. Digital Image Processing.	4
*GEOG 480. Seminar.	-or-
*GEOG 498. Independent Study.	3
<i>*Must be in an area of applied GIS.</i>	
Required Course Outside Geography 12-14 must include	
ENGL 306. Professional Writing.	3

B.S. Requirements 6-8

Six to eight additional hours of mathematics, computer science, statistics and science courses. (MATH 325 does not meet requirements.)

Note: Internships are strongly recommended. Credit for internships may be gained through GEOG 499. Internships are taken pass/fail and cannot be used to fulfill requirements of the concentration.

GRADUATION REQUIREMENTS

To graduate with a major in geography, a student must have a grade point average of 2.3 in all courses taken for major requirements including those from departments other than geography.

GEOGRAPHY MINOR (18 semester hours)

A minor in geography consists of 18 hours of geography, subject to approval by the department. GEOG 103 and GEOG 130 are required.

GEOLOGY PROGRAM

(The Geology program is undergoing restructuring. Please consult with Dr. Chester (Skip) Watts for curriculum questions.)

The program in geology provides students with a basic framework for a professional career in the field of geology, for graduate studies in geology, or for licensure to teach earth and space science. A student may pursue a curriculum leading to a Bachelor of Science degree.

B.S. DEGREE

GEOLOGY MAJOR

All requirements for geology majors are outlined below. All majors must take the same Required Core courses and must complete course work in one of three concentrations.

Core Curriculum Requirements 43-45 (see p. 81)

Required Core Courses	28
GEOL 100. Earth Resources and Natural Hazards.*	4
GEOL 105. Exploring Earth.*	4
GEOL 106. The Earth Through Time.*	4
GEOL 310. Mineralogy.	4
GEOL 312. Petrology.	5
GEOL 440. Structural Geology.	4
GEOL 441. Geologic Field Methods.	3

* Students who have successfully completed GEOL 103 may not take GEOL 100 for credit. Students who have successfully completed GEOL 101 may not take GEOL 105 for credit. Any two of these three courses (GEOL 100, GEOL 105, and GEOL 106) have been approved for Core Curriculum credit in Natural Sciences.

CONCENTRATIONS

(Majors must choose one of the three concentrations shown below).

GENERAL GEOLOGY CONCENTRATION (41 semester hours)

The General Geology Concentration is designed for students who wish a broad, traditional overview of geology as an academic discipline. Students are encouraged to use electives to gain competency in particular topics. The concentration is appropriate for students interested in pursuing graduate studies in geology.

Required Geology Courses 16

GEOL 305. Professional Skills in Geology.	4
GEOL 320. Sedimentation Petrology and Stratigraphy.	4
GEOL 335. General Paleontology.	4
GEOL 261. Geology of Virginia.	-or-
GEOL 360. Geomorphology.	-or-
GEOL 461. Regional Geology of the United States.	4

Related Requirements 25

ITEC 100. Introduction to Information Technology.	3
MATH 151:152. Calculus and Analytic Geometry I and II.	6
CHEM 101:102. General Chemistry.	8

B.S. Requirements 8

Bachelor of Science students must take eight hours of physics courses.

Total Credits Needed for Degree 120

(Includes Core Curriculum courses, required courses, and electives.)

ENVIRONMENTAL AND ENGINEERING GEOSCIENCE CONCENTRATION (45 semester hours)

The Environmental and Engineering Geology concentration is designed for students wishing to emphasize the engineering and hydrological aspects of geology as they pertain to addressing practical problems in society.

Required Geology Courses 20

GEOL 305. Professional Skills in Geology.	4
GEOL 406. Geophysics.	4
GEOL 408. Spatial Data Applications in Geology.	4
GEOL 455. Principles of Engineering Geology.	4
GEOL 474. Hydrogeology.	4

Related Requirements 25

ITEC 100. Introduction to Information Technology.	3
MATH 151:152. Calculus and Analytic Geometry I and II.	6
CHEM 101:102. General Chemistry.	8

B.S. Requirements 8

Bachelor of Science students must take eight hours of physics courses.

Total Credits Needed for Degree 120

(Includes Core Curriculum courses, required courses, and electives.)

EARTH SCIENCES CONCENTRATION (TEACHING LICENSURE) (62 semester hours)

The Department of Geology offers courses which will qualify prospective teachers for licensure to teach earth and space sci-

ence. The appropriate courses in education must be taken. (Contact the Associate Dean of the College of Education and Human Development for information concerning these courses.)

Required Geology Courses	8
GEOL 261. Geology of Virginia.	-or-
GEOL 461. Regional Geology of the United States.	4
GEOL 365. Oceanography.	4

Other Required Courses	10
ITEC 100. Introduction to Information Technology.	3
MATH 140. Trigonometry and Analytic Geometry.	3
or	
MATH 151. Calculus and Analytic Geometry I.*	3
PHSC/PHYS 301. Meteorology.	4

* This course has been approved for Core Curriculum credit in Mathematical Sciences.

Related Requirements	4
An additional four semester hours selected from the following:	
BIOL 105. Biology for Health Science.	4
CHEM 101. General Chemistry.	4
ASTR 112. General Astronomy II.	4
GEOL 335. General Paleontology.	4

B.S. Requirements	8
Bachelor of Science students must take the following two courses:	
ASTR 111. General Astronomy I.	4
PHYS 111. General Physics.	4

Education Courses	32
(Contact the Associate Dean of the College of Education and Human Development for information concerning these courses.)	

Total Credits Needed for Degree	127
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(Includes Core Curriculum courses, required courses, and electives.)

ALL CONCENTRATIONS

Electives

Students should consult with their academic advisers in selecting elective courses to complete 120 semester hours required for graduation. Additional courses in calculus, computer science and statistics (beyond those required) are recommended for geology majors.

Total Credits Needed for Degree	120
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GRADUATION REQUIREMENTS

To graduate with a major in geology, a student must attain an overall grade point average of 2.0 or higher in all courses in geology, and in the required courses in chemistry, physics, and mathematics.

GEOLOGY MINOR (20 semester hours)

A student who wishes to elect a minor in geology is required to take GEOL 100, 105, and 106, plus a minimum of eight additional semester hours from geology courses other than GEOL 498.

PHYSICS PROGRAM

This program leads to a B.A. or B.S. degree in physics. Students may select a concentration in physical science. The physics major is the appropriate curriculum for a student contemplating a career in physics or engineering. The physical science concentration of the physics major is a more general program, suitable for a student

planning a career in industry or as a high school teacher. Both programs develop analytic and problem-solving skills which will be valuable in any future occupation.

PHYSICS MAJOR

COLLABORATIVE PROGRAM IN ENGINEERING

The School of Environmental and Physical Science at Radford University and the College of Engineering at Virginia Polytechnic Institute and State University (Virginia Tech) offer a joint program in physics and engineering. This is a dual degree programs in which the student will receive a B.S. in physics from Radford University and a B.S. in engineering from Virginia Tech. The approximate time required for a student to complete these programs is five years. During the first three years, the student completes the major requirements in physics, as well as most or all of the Core Curriculum requirements at Radford. Some introductory engineering courses should also be completed while the student is at Radford; some of these may be taken during the summer. The student then transfers to Virginia Tech and, in two additional years, completes the requirements for a degree in engineering. Participants in this program who have a grade point average of 3.0 or above are guaranteed admission to the College of Engineering at Virginia Tech. All degree requirements for both Radford University and Virginia Tech should be satisfied by the end of the fifth year. The student then receives a degree from each institution.

The student should choose, early in the program, the intended engineering major at Virginia Tech. This choice will affect the physics curriculum that the student undertakes at Radford. All students in this program must be prepared to take PHYS 221:222 and MATH 151:152 during the first year. MATH 251:252 will be taken during the

second year. Chemistry (CHEM 101:102), upper-level physics courses, and additional mathematics courses will be completed during the second and third years of the program. The upper-level physics courses will be chosen, with the assistance of a faculty adviser, to fulfill the requirements of the major in physics, as well as to complement the student's intended engineering curriculum. Appropriate courses in Core Curriculum will also be selected with the aid of an adviser. The student will be encouraged to take an introduction to engineering course at Virginia Tech as early as the summer between the first and second years of the program. The remaining requirements of the chosen engineering major will then be completed after the student has transferred to Virginia Tech. Further details about this program can be obtained by contacting the physics program coordinator.

B.A. OR B.S. DEGREE

All 42 semester hour requirements for students in this concentration are outlined below. These include 12 semester hours of Math Requirements, 36 semester hours of Required Courses, and at least 6 hours of Other Courses.

Core Curriculum Requirements 43-45 (See p. 81)

Math Requirements	12
MATH 151:152 and 251:252. Calculus and Analytic	
Geometry I, II, III and IV.	3:3:3:3

Required Courses	36
PHYS 221:222. Physics.	4:4
CHEM 101:102. General Chemistry.	4:4
PHYS 305. Modern Physics.	4
PHYS 306. Intermediate Mechanics.	3
PHYS 307. Electricity and Magnetism.	4
PHYS 320. Mechanics.	3

PHYS 421. Electromagnetic Theory I. 3
 PHYS 430. Quantum Mechanics. 3

Other Courses 6

A minimum of 6 semester hours must be selected from the following:
 PHYS 310. Optics. 4
 PHYS 330. Thermodynamics and Statistical Mechanics. 3
 PHYS 422. Electromagnetic Theory II. 3
 PHYS 450. Selected Topics in Physics. 3-4

B.A./B.S. Requirements 6-12
 (see below right)

Electives

Students should consult with their academic advisers in selecting elective courses to complete the 120 semester hours required for graduation.

Total Credits Needed For Graduation 120

PHYSICAL SCIENCE CONCENTRATION

B.A. OR B.S. DEGREE

Core Curriculum Requirements 43-45
 (See p. 81)

Math Requirements 6
 MATH 151:152. Calculus and Analytic Geometry I and II. 3:3

Required Courses 22
 PHYS 111:112. General Physics.
 or
 PHYS 221:222. Physics. 4:4
 PHYS 305. Modern Physics. 4
 PHYS 306. Intermediate Mechanics. 3

PHYS 307. Electricity and Magnetism. 4
 One PHYS course at the 300 level or above (except PHYS 470). 3

Other Courses 15

Any PHYS (except PHYS 470) or ASTR course at the 300 level or above.
 ASTR 111:112.
 CHEM 101:102.
 No more than 3 semester hours of PHYS 481, and no more than 4 semester hours of PHYS 481 and PHYS 498 combined may count in this category.

B.A./B.S. Requirements 6-12
 (see below)

Electives

Students should consult with their academic advisers in selecting elective courses to complete the 120 semester hours required for graduation.

Total Credits Needed For Graduation 120

B.A./B.S. REQUIREMENTS

B.A. Requirement 6-12
 The Bachelor of Arts degree requires completion of the B.A. language requirement described on p. 87 of this catalog.

B.S. Requirement 6
 MATH 151:152 (Calculus and Analytical Geometry I and II), required for all Physics majors, fulfills the requirement for the B.S. degree.

GRADUATION REQUIREMENTS

To graduate with a major in Physics, a student must attain an overall grade point average of 2.0 or higher in all courses attempted in the major including Calculus and Analytic Geometry.

TEACHING LICENSURE

Students seeking endorsements to teach physics must take appropriate courses in education. (Contact the College of Education and Human Development for information concerning these courses.)

ASTRONOMY MINOR (22 semester hours)

The minor in Astronomy consists of 22 semester hours selected from the following:

PHYS 111:112. General Physics.	
or	
PHYS 221:222. Physics.	4:4
ASTR 111,112. General Astronomy I and II.	4,4
ASTR 421. Solar System Astronomy.	3
ASTR 422. Galactic Astronomy and Cosmology.	3

PHYSICS MINOR (17 semester hours)

The minor in Physics consists of eight semester hours from the following:

PHYS 111:112. General Physics.	4:4
or	
PHYS 221:222. Physics.	4:4
and a minimum of nine additional semester hours in physics, except PHYS 231.	