



Francis Webster, an associate professor of chemistry and past recipient of the Donald N. Dedmon Distinguished Teaching Professor Award, gives area middle school students a hands-on learning opportunity during a scientific experiment.

COLLEGE OF SCIENCE AND TECHNOLOGY

J. Orion Rogers, Dean
Davis 127, (540) 831-5958
www.radford.edu/cst

**Susan Underwood, Advising
 Coordinator**
Stuart Hall 163, (540) 831-5601

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 Bachelor of Science degree in:

- Biology with concentrations in Biotechnology, Environmental Biology, General Biology and Medical Technology
- Chemistry with concentrations in Professional Chemist and Pre-Health Professional
- Computer Science and Technology with concentrations in Computer Science, Database, Software Engineering and Networks
- Geology with concentrations in General Geology, Environmental and Engineering Geosciences and Earth Sciences
- Information Science and Systems with

concentrations in Information Systems, Web Development and Enterprise Systems

- Mathematics with concentrations in Applied Math, Statistics, 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 and Human Services and Visual and Performing Arts). For example, a student majoring in journalism could elect to take a concentration of the college's courses on Internet development and a major in the college could elect to take a concentration of courses in technical writing or media studies. 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 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.

GENERAL EDUCATION

The General Education 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.

TECHNOLOGY IN LEARNING CENTER

The Technology in Learning Center is the focal point for training at the university. The Center implements policies and procedures for training, and promotes the expanded use of technology among faculty, staff, and students. The center raises the level of technological knowledge and skills, enhances the effective integration of technology into the teaching and learning environment and facilitates the utilization of resources by coordinating the services available through existing training units in the university.

❁BIOLOGY

Joel B. Hagen, Acting Chairperson
www.radford.edu/~biol-web/BioIndex.html

UNDERGRADUATE PROGRAM

The Biology 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. This department offers a Bachelor of Arts degree or Bachelor of Science degree. Students in the Bachelor

of Science program may prepare for state licensure to teach biology at the secondary level by completing courses in professional education in addition to General Education courses and requirements in their major.

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.

PREPROFESSIONAL DEGREE PROGRAMS

Students interested in a career in medicine, dentistry, pharmacy, physical therapy or veterinary medicine may obtain either the Bachelor of Science or Bachelor of Arts degree. An adviser in the Biology Department will assist students in choosing electives for these programs.

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 Department.

B.A. OR B.S. DEGREE

BIOLOGY MAJOR

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.

General Education Requirements
(see p. 83)

50

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

(Students concentrating in Medical Technology take a modification of this core; see below.)

*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.

Special Note: Declared biology majors normally take BIOL 131 and 132. Students who earn a grade of "B" or higher in BIOL 103, or an equivalent transfer course and decide to become biology majors may substitute BIOL 103 or the equivalent transfer course for BIOL 131. Similarly, students who earn a grade of "B" or higher in BIOL 105 or an equivalent transfer course may substitute BIOL 105 or the equivalent transfer course for BIOL 132.

Other Required Core Courses

19

CHEM 101:102. General Chemistry.

4:4

CHEM 301:302. Organic Chemistry.

4:4

STAT 200. Introduction to Statistics.

3

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. 88 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

22-26

Biology Electives

Students must take one elective from each of the following groups:

Ecology and Adaptation Electives:

BIOL 215. Plants and Society.

BIOL 216. General Zoology.

BIOL 353/PSYC 353. Comparative Behavior.

BIOL 361. Parasitology.
 BIOL 380. Ornithology.
 BIOL 390. Conservation Biology.
 BIOL 392. Pollution Biology.
 BIOL 423. General Ecology.
 BIOL 464. Vertebrate Zoology.
 BIOL 462. Invertebrate Zoology.
 BIOL 476. Field Botany

**Biology of Cells and Microorganisms
 Electives:**

BIOL 222. Cell Biology.
 BIOL 334. Microbiology.
 BIOL 337. Immunology.
 BIOL 405. Histology.
 BIOL 450. Molecular Biology.
 BIOL/CHEM 471. Biochemistry I.

**Genetics, Evolution, Development
 Electives:**

BIOL 221. Genetics.
 BIOL 425. Evolution.
 BIOL 430. Developmental Biology.
 BIOL 450. Molecular Biology

Organismal Biology Electives:

BIOL 215. Plants and Society.
 BIOL 216. General Zoology..
 BIOL 310. Human Structure & Function I.
 BIOL 311. Human Structure & Function II.
 BIOL 322. Human Anatomy & Physiology.
 BIOL 337. Immunology.
 BIOL 351. Comparative Animal Physiology.
 BIOL 353/PSYC 353. Comparative Behavior.
 BIOL 361. Parasitology.
 BIOL 476. Field Botany.

Additional Science Electives

Students must select either two additional biology courses (for a total of 22 credits of electives) or one additional biology course (for a total of 18 credits) and 8 hours of physics courses. These additional Biology electives may be chosen from ANY of the Biology courses number 200 or above, including courses not listed above. 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.

**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. (Prerequisite: 3 hrs PHIL).	3
BIOL 334. Microbiology.	4
BIOL 450. Molecular Biology.	4
BIOL 471:472 (CHEM 471:472) Biochemistry.	4:3
BIOL 495. Internship in Biology.	6-12
To count towards the Concentration, BIOL 495 must be an internship with an organization working in the area of biotechnology.	

Recommended Electives

A total of 12-19 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. Developmental Biology.	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
BIOL 495. Internship in Biology.	6-12

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 17-23 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. General Botany.	4
BIOL 216. General Zoology.	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
(BIOL 481 is recommended when it focuses on a topic in Environmental Biology.)	
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
GEOG 100. Earth Resources and Natural Hazards.	4
GEOG 365. Oceanography.	4
GEOG 474. Hydrogeology.	
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.

General Education Requirements (see p. 83) 50

Biology Core Science Curriculum 31

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

BIOL 131. Ecology and Adaptation.	4
BIOL 132. Biology of Cells and Microorganisms.	4
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

Required Courses for concentration	22
BIOL 221. Genetics.	4
BIOL 322. Human Anatomy and Physiology.	6
BIOL 334. Microbiology.	4
BIOL 337. Immunology.	4
BIOL 450 Molecular Biology.	4

Science Electives	4
Either BIOL 222 or BIOL 361 is recommended; however, students should consult with their advisers to choose the most appropriate elective from the following:	
BIOL 222. Cell Biology.	
BIOL 361. Parasitology.	
BIOL 405. Histology.	
BIOL/CHEM 471. Biochemistry.	
PHYS 111. General Physics.	
CHEM 424. Instrumental Methods of Chemical Analysis.	

Clinical Courses	31
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 127

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

- **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 Coordinator
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
Candace Lambert, MT(ASCP), BS, 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), 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 Professions, 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. 92. For specific requirements, contact the Honors Academy or department chair.

❁CHEMISTRY AND PHYSICS

Walter S. Jaronski*, Chairperson
www.radford.edu/~chem-web/

INTRODUCTION

The Department of Chemistry and Physics offers two majors, one in Chemistry and one in Physics. Within the Physics major, students may choose a Physical Science concentration. A minor program in Astronomy is also offered.

The department offers a departmental honors program for students in either major. For a general description of the Honors Program at Radford University, see p. 88. For specific requirements of this program, contact the department chairperson or the director of the Honors Program.

Students majoring in the department who plan to pursue postgraduate training in medicine, pharmacy, dentistry or physical therapy are urged to work closely with their advisers in choosing elective courses appropriate to their career objectives. More specific information on such courses can be found in the sections describing undergraduate programs. Students may pursue licensure to teach Earth Science, Chemistry, or Physics in the Bachelor of Science program.

COLLABORATIVE PROGRAMS IN ENGINEERING

The Department of Chemistry and Physics at Radford University and the College of Engineering at Virginia Polytechnic Institute and State University (Virginia Tech) offer joint programs in chemistry and chemical engineering, and in physics and engineering. These are dual degree programs in which the student will receive a B.S. in chemistry or 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 chemistry or physics, as well as most or all of the general education 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 dual degree program in chemistry is specific to chemical engineering. 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 201, 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 general education during these three years will be chosen in consultation with a faculty adviser. After transferring to Virginia Tech, the student will complete any remaining general education requirements and the requirements for the chemical engineering degree. Further details about this program can be obtained by contacting the department chairperson.

For the dual degree program in physics, 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 general education 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 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 engi-

neering, 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 predental 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.

General Education Requirements (see p. 79) 50

Required Courses	22
CHEM 101:102. General Chemistry.	4:4
CHEM 216. Inorganic Chemistry	3
CHEM 301:302. Organic Chemistry.	4:4
CHEM 401. Physical Chemistry.	3

*Satisfy the General Education science requirement

PROFESSIONAL CHEMIST CONCENTRATION

This concentration is a rigorous four-year program that provides a strong background

in chemistry for those students who plan to become professional chemists. It provides an excellent foundation for graduate study in chemistry or related fields and will prepare students for careers in industrial, academic or governmental settings.

Other Required Courses 20

CHEM 201. Quantitative Analysis.	4
CHEM 424. Instrumental Analysis.	4
CHEM 402. Physical Chemistry II.	3
CHEM 403:404. Integrated Lab I and II.	3:3
*CHEM Elective.	3
*Chemistry elective must be chosen from courses 200 level or above.	

Related Requirements 17

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 251. Calculus and Analytic Geometry III.	3
*Satisfy the General Education Math requirement.	

B.S. REQUIREMENTS

B.S. (Non Teaching) Requirements 8

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

BIOL 105. Biology for Health Science or	
BIOL 132. Biology of Cells and Microorganisms.	4
BIOL 471. Biochemistry	4

Total credits needed for this option 103

Total Credits Needed For Degree 120

(Includes General Education courses, required courses and electives. Students should consult with their academic advisers in selecting elective courses to complete the 120 semester hours required for graduation.)

PRE-HEALTH PROFESSIONAL CONCENTRATION

This concentration is a rigorous four-year program recommended for students planning a career in pharmacy, medicine, dentistry or veterinary medicine. The first three years are designed to optimally prepare students for the pre-entrance aptitude examination (PCAT, MCAT, DAT or GRE). By carefully choosing electives, this concentration can also be used to prepare for graduate study in biochemistry, pharmacology or related fields.

Other Required Courses 26

CHEM 201. Quantitative Analysis.	4
or	
CHEM 424. Instrumental Analysis.	4
CHEM 471. Biochemistry.	4
BIOL 132. Biology of Cells and Microorganisms.	4
BIOL 231. Genetics, Evolution and Development.	4
BIOL 322. Human Anatomy/Physiology.	6
BIOL 221. Genetics.	4
or	
BIOL 334. Microbiology.	4

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

*Satisfy the General Education Math Requirement.

B.S. REQUIREMENTS

B.S. (Non-Teaching Requirements) 7-8

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

One Chemistry course taken from the following list:	3-4
CHEM 201. Quantitative Analysis.	4
CHEM 424. Instrumental Analysis.	4
CHEM 402. Physical Chemistry.	3
CHEM 461. Advanced Organic Chemistry.	3
CHEM 472. Biochemistry.	3

One Biology course taken from the following list:	4
BIOL 222. Cell Biology.	4
BIOL 334. Microbiology.	4
BIOL 221. Genetics.	4
BIOL 337. Immunology.	4
BIOL 361. Parasitology.	4
BIOL 405. Histology.	4
BIOL 430. Developmental Biology.	4
BIOL 450. Molecular Biology.	4
BIOL 464. Vertebrate Zoology.	4

Total credits needed for this option 105-6

Total Credits Needed for Degree 120

(Includes General Education courses, 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 general education 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 Chemistry and Physics 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 departmental 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:

GEOL 241. Environmental Regulation. 3

GEOL 100. Earth Resources and Natural Hazards. 4

GEOL 472. Environmental Aqueous Geochemistry. 3

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.

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

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.

General Education Requirements 50
(See p. 83)

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 next page)

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

PHYSICS MAJOR

PHYSICAL SCIENCE CONCENTRATION

B.A. OR B.S. DEGREE

General Education Requirements 50
(See p. 83)

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 aca-
 demic 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 require-
 ment described on p. 88 of this catalog.

B.S. Requirement 6

MATH 151:152 (Calculus and Ana-
 lytical 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 at-
 tempted in the major including Calculus
 and Analytic Geometry.

TEACHING LICENSURE

Students seeking endorsements to teach
 physics must take appropriate courses in ed-
 ucation. (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.

✿GEOLOGY

Stephen W. Lenhart*, Chairperson
www.radford.edu/~geol-web/

UNDERGRADUATE PROGRAM

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.

General Education Requirements 50
(see p. 83)

Required Core Courses 29
GEOL 100. Earth Resources and Natural Hazards.* 4
GEOL 105. Exploring Earth.* 4
GEOL 106. The Earth Through Time.* 4
GEOL 310. Mineralogy. 5
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) satisfy the General Education science requirement.

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 and Stratigraphy. 4
GEOL 335. General Paleontology. 4
GEOL 261. Geology of Virginia. 4
or
GEOL 360. Geomorphology. 4
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 General Education 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 General Education 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 science. 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.	4
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

* These two chosen courses satisfy the General Education mathematics requirement.

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**
(Includes General Education 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

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.

❁INFORMATION TECHNOLOGY

Arthur Carter, Chairperson
Davis Hall B51, (540) 831-5381
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 govern-

ment 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 college with hardware ranging from Sun workstations to PCs to Macintosh computers, and software platforms ranging from Linux to Windows XP to MacOS. Each of the department's laboratories is connected to the campus network and to the Internet and can be accessed through the university modem pool. Students in the college are not required to purchase their own computers; instead, all courses can be completed using equipment in the department's laboratories. The college 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) 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.

Core Requirements

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

College Core 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 college majors.

BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND TECHNOLOGY

Students seeking the Bachelor of Science in Computer Science and Technology must complete the college 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.

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

Required General Education Courses	6
MATH 151. Calculus and Analytical Geometry.	3
COMM 114. Public Speaking.	3
or	
COMM 240. Teamwork and Communications.	

COMPUTER SCIENCE CONCENTRATION

In addition to the college core requirements and the degree core requirements and the B.S. requirements, 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 371. Operating Systems.	3
ITEC 380. Organization of Programming Languages.	3
ITEC 420. Computability Theory and Formal Languages.	3

Two courses selected from the following:

ITEC 340. Database I.	3
ITEC 350. Introduction to Computer Networking.	3
ITEC 370. Software Engineering I.	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

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

B.S. Requirements

7-8 additional hours

Chosen 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.

General Education Requirements	33
(see p. 83)	

Note: 17 of the 50 hours of General Education are satisfied by major requirements.

Elective Hours	11-12	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.
Total Credits Needed for Degree	120	

GRADUATION REQUIREMENTS FOR THE COMPUTER SCIENCE CONCENTRATION

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.

DATABASE CONCENTRATION

In addition to the college core requirements and the degree core requirements and the B.S. requirements, students in the Database concentration are required to complete the following:

Information Technology	27
ITEC 320. Procedural Analysis and Design.	3
ITEC 325. Web Programming II.	3
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, 400, 493, or 498)	12

B.S. Requirements

6-8 additional hours

Chosen from the following:

Any 300 level or above ITEC course (except ITEC 301 and ITEC 400); MATH 152;

General Education Requirements 41 (see p. 83)

Note: Nine of the 50 hours of General Education are satisfied by major requirements.

Elective hours	17-19
-----------------------	--------------

Total Credits Needed for Degree	120
--	------------

SOFTWARE ENGINEERING CONCENTRATION

In addition to the college core requirements and the degree core requirements and the B.S. requirements, 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, 400, 493, or 498).	12

B.S. Requirements

6-8 additional hours

Chosen from the following:

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

General Education Requirements 41
(see p. 83)
Note: Nine of the 50 hours of General Education are satisfied by major requirements

Elective Hours 17-19

Total Credits Needed for Degree 120

General Education Requirements 41
(see p. 83)
Note: Nine of the 50 hours of General Education are satisfied by major requirements

Elective hours 11-13

Total Credits Needed for Degree 120

NETWORKS CONCENTRATION

In addition to the college core requirements and the degree core requirements and the B.S. requirements, 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
ITEC 451. Network Design and Analysis. 3
ITEC 452. Distributed Computing. 3
Plus 6 additional credit hours chosen from any 300 or 400 level ITEC courses (except for ITEC 301, 400, 493, or 498). 6

Mathematics 6

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

B.S. Requirements

6-8 additional hours

Chosen from the following:

Any 300 level or above ITEC course (except ITEC 301 and ITEC 400); 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.

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, MSTD 328, MSTD 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 college 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. The Enterprise Systems Development concentration is specifically designed to produce students with a high level of expertise in business systems analysis, design, and development.

In addition to the 15 hours of Information Technology required in the degree core, the following courses are required for the Bachelor of Science in Information Science and Systems:

DEGREE CORE

15

Information Technology

6

ITEC 340. Database I.

3

ITEC 370. Software Engineering I.

3

Business

6

ACTG 211. Fundamentals of Financial Accounting.

3

MKTG 340. Principles of Marketing.

3

Required General Education Courses

3

ECON 106. Principles of Economics II.

3

B.S. Requirement

6-7 additional hours

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 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.

INFORMATION SYSTEMS CONCENTRATION

In addition to the college core requirements and the degree core requirements and B.S. requirements, students in the Information Systems Concentration are required to complete the following:

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

Required General Education Courses

12

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 Economics I.	3	or		
COMM 114. Public Speaking.		MATH 151. Calculus and Analytical		
or		Geometry I.	3	
COMM 240. Teamwork and		STAT 200. Introduction to Statistics.	3	
Communications.	3	Plus any two courses selected from the		
		following:	6	
General Education Requirements	38	COMM 114. Public Speaking.*	3	
(see p. 83)		COMM 240. Teamwork and		
Note: 12 of the 50 hours of General Educa-		Communication.*	3	
tion are satisfied by major requirements.		COMM 314.		
		Organizational Communication.	3	
Elective Hours	6-7	COMM 439. Leadership and Group		
		Communication.	3	
Total Credits Needed for Degree	120	ENGL 306. Professional Writing.	3	
		ENGL 307. Business Writing.	3	
		ENGL 406. Advanced Technical Writing.	3	
		*Satisfies part of the General Education re-		
		quirement.		
ENTERPRISE SYSTEMS		General Education Requirements	35-38	
DEVELOPMENT CONCENTRATION		(see p. 83)		
In addition to the college core require-		Note: 12-15 of the 50 hours of General Edu-		
ments, the degree core requirements and the		cation are satisfied by major requirements		
B.S. requirements, students in the Enter-				
prise Systems Development Concentration				
are required to complete the following:				
Information Technology	18	Elective Hours	3-4	
ITEC 100. Introduction to Information				
Technology.	3	Total Credits Needed for Degree	120	
ITEC 122. Discrete Mathematics.	3			
ITEC 320. Procedural Analysis and				
Design.	3			
ITEC 324. Principles of Computer		WEB DEVELOPMENT		
Science III.	3	CONCENTRATION		
ITEC 350. Introduction to Computer		In addition to the college core require-		
Networking.	3	ments, the degree core requirements and		
ITEC 495. Information Systems Capstone.	3	the B.S. requirements, students in the Web		
		Development Concentration are required to		
Business	15	complete the following:		
ACTG 212. Fundamentals of Managerial		Information Technology	12	
Accounting.	3	ITEC 315. Graphic User Interface Design		
ACTG 312. Accounting Information		and Implementation.	3	
Systems.	3	ITEC 325. Web Programming II.	3	
FINC 331. Introduction to Business		ITEC 350. Introduction to Computer		
Finance.	3	Networking.	3	
MGNT 333. Statistical Decision Support.	3	ITEC 425. Advanced Web Development.	3	
MGNT 357. Operations Management.	3			
Required General Education Courses	6	Business	3	
MATH 126. Business Calculus.		MKTG 342. Internet Marketing.	3	

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 general education 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 general education and upper level courses during their second and, typically, third years in the program. These general education 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.

General Education Requirements 50 (see p. 83)

Six hours of mathematics courses required for the major may be included as part of the 50-hour general education requirement. Students in the Applied Mathematics concentration may count PHYS 221:222 as part of their general education 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. 88 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.	3
ENGL 306. Professional Writing.	3
ENGL 406. Advanced Technical Writing.	3
GEOL 405. Computer Applications in Geology.	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****33**

MATH 260. Applied Linear Algebra and Matrices	
or	
MATH 460. Linear Algebra.	3
MATH 430:431. Advanced Calculus.	6
MATH 436:437. Numerical Analysis: Differential Equations.	6
STAT 301:302. Probability and Statistics I and II.	6
ITEC 120. Principles of Computer Science.	4
PHYS 221:222. Physics.*	8

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. Applied Linear Algebra and Matrices.	
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. Applied Linear Algebra and Matrices.	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.)

*Satisfies the General Education science 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

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.