College of Natural and Applied Sciences

Bennett Hutchinson, Dean

The College of Natural and Applied Sciences is composed of the Departments of Biology, Chemistry, Computing and Information Systems, Mathematics, Psychology and the Lipscomb/Vanderbilt Nursing Partnership. The Raymond B. Jones School of Engineering is also housed within the college and consists of the departments of Physics and Engineering, Electrical and Computer Engineering, and Engineering Mechanics. The curricula offered are designed to provide solid foundations in the disciplines and excellent preparation for professional studies. Graduates of these programs may enter the job market directly or may pursue graduate work, medical or allied health studies.

Dedicated, competent faculty provide opportunities and experiences through which students may come to a better understanding of and appreciation for the complexity and order of the created world in which we live.
Department of Biology

Jon Lowrance, Associate Professor and Chair
James T. Arnett, Professor
James A. Carpenter, Associate Professor
C. Phillip Choate, Professor
Tamera Klingbyll, Instructor
Larry N. Latson, Professor
James A. Carpenter, Associate Professor
Jeffrey M. McCormack, Visiting Professor
Linda D. Roberson, Professor
C. Phillip Choate, Professor
Linda D. Roberson, Professor
Oliver Yates, Langford-Yates Distinguished Professor

The mission of the Department of Biology at Lipscomb University is to enable the student to develop a basic understanding of and an appreciation for the biological world. The curriculum is designed to meet the needs of those students who plan to enter graduate and professional schools, those who plan to teach, and those who plan biology-oriented careers. Opportunities are available for laboratory experiences, field experiences, and independent research.

The department is housed in a modern, fully-equipped facility. The program of study is relevant, and the faculty is interested in assisting the students in achieving their career goals.

Your Future in Biology
The graduates of the Department of Biology have distinguished themselves in many ways and are presently utilizing their training in the following areas:
- Attending medical, dental, pharmacy, nursing, veterinary, medical technology, and medically-allied schools
- Pursuing advanced degrees in biology and related fields
- Serving as administrators, research assistants, and technologists at clinics, state health laboratories, hospitals, and research centers
- Working as surgical assistants
- Teaching biology at junior and senior colleges, universities, and medical schools
- Teaching biology, general science, chemistry, and physics in secondary schools
- Working as sales representatives for pharmaceutical firms
- Serving as science education coordinators for state departments of education
- Serving as biomedical librarians
- Pursuing careers in biomedical law
- Working as medical secretaries
- Serving as environmentalists, foresters, conservationists, and wildlife biologists for state and federal governments
- Working as biologists for industry

Desirable High School Background
Courses in general science, biology, chemistry, and mathematics are desirable but not required.

Suggested Schedule for First Year Biology Major

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Bible 105V</td>
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<tr>
<td>Lipscomb Seminar 1103</td>
<td>English 1123</td>
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<tr>
<td>Biol. 1134 or 1144</td>
<td>Biol. 1134 or 1144</td>
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<tr>
<td>Math 1114</td>
<td>Electives*</td>
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</table>

* Some professional programs require Mathematics 1123. Check with your advisor.

Interdisciplinary Major in Environmental Science
The degree in environmental science consists of 73-74 hours of instruction split between a generalized core and an area of concentration. Students interested in the science of the environment and who wish to pursue careers in environmental consulting and field biology should concentrate in Technology and Field Studies. Students who are interested in the politics of the environment and who wish to pursue careers as lobbyists, environmental activists, and in environmental law should strongly consider the Ethics and Public Policy concentrations. The Environmental Management concentration is designed for those students who wish to pursue managerial positions with various industrial production facilities. All three concentrations provide excellent preparation for graduate study.

Suggested Schedule for First Year Environmental Science Major

<table>
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<tr>
<td>Bible 105V</td>
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<tr>
<td>Biology 1134</td>
<td>Biology 1144</td>
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<tr>
<td>Chemistry 1113, 1211</td>
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<td>Lipscomb Seminar 1103</td>
<td>English 1123</td>
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<tr>
<td>Elective</td>
<td>Political Science 2213</td>
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Requirements for Majors

Biology Major
B.A. or B.S. degree program
Total hours required—minimum 53
Specific courses required—
- Biology Core
  - Biology 1134, 1144, 2114, 3114, 4044, 4801
- Biology electives
  - Five courses selected from: Biology 2213 or (3514 and 3524), 2424 or 3214, 2623, 2723, 2813, 3223, 3323, 3413, 3903, 4123, 4213, 4323, 4413, (450V or 460V)
- Chemistry 1113, 1123, 1211, 1221, 2113, 2213, 2221
Mathematics
- The general education requirement in Mathematics for a Biology major cannot be satisfied by a course numbered below Math 1114.

* A minimum grade of “C” in each of the core courses is required. Each biology major must take the Major Field Achievement Test in Biology prior to graduation.

The major field writing requirement is satisfied by completing Biology 3114 and 4044 with a grade of “C” or above.

Biology Teaching Major (General Science-Biology)
B.A. or B.S. degree program.
- I. General Education Required of Secondary and K-12 Teacher Education Students* (see page 114)
- II. Professional Education (see page 115)
- III. Subject Matter Specialization
  - Biology
    - Biology 1134, 1144, 2114, 2213, 3052, 3114, 4044, 4801
    - Two courses selected from: Biology 2424, 2623(F), 2723(F), 3612(F), 4123, 4213, 4413, at least one course must be field oriented(F).
  - Chemistry 1013, 1023
  - Mathematics 1114
  - Physics 1013

*Omit Biology 1003 and Mathematics 1043. Chemistry 1013 and Physics 1013 are included in subject matter specialization.

** A minimum grade of “C” in each of the Biology courses.

Students completing this major must satisfy the major field writing requirements for both the Department of Biology and the Department of Education.
In Biology, the major field writing requirement is satisfied by completing Biology 3052 with a grade of “C” or above. In Education, the writing requirement is satisfied by completing the following courses with a grade of “C” or above: Education 3332 and 3354.

Biology Teaching majors have a built-in minor in Education and are not required to take another minor.

Environmental Science Major (Technology and Field Studies Concentration)*
B.A. or B.S. degree program
Total hours required - 73
Specific courses required -
- Biology 1134, 1144, 3114, 4044, 4801
  - Chemistry 1023, 1113, 1123, 1211, 1221, 3414
  - Economics 2503
  - Environmental Science 1013, 3214, 4213, 4991
  - Management 3503
  - Mathematics 2183
  - Philosophy 2013
  - Physics 1013
  - Political Science 2213
  - Plus 12 hours selected from:
    - Biology 2623, 2723, 2813, 3214, 3413, 4413
    - Chemistry 2211, 2113**, 2123, 2221, 2314, 3313, 3321, 3613, 4313
    - Environmental Science 3903, 450V, 460V

**If taken in place of CM 1023, the student must include an additional three hours of elective credit.

Environmental Science Major (Ethics and Public Policy Concentration)*
B.A. or B.S. degree program
Total hours required - 72
Specific courses required -
- Biology 1134, 1144
  - Chemistry 1023, 1113, 1123, 1211, 1221
  - Economics 2503
  - Environmental Science 1013, 3214, 4213, 4991
  - Management 3503
  - Mathematics 2183
  - Philosophy 2013, 3433, 366V
  - Physics 1013
  - Political Science 2213, 3123, 3313, or 3323
  - Plus 12 hours selected from:
    - Environmental Science 3903, 450V, 460V
    - Philosophy 4003
    - Political Science 2253, 3113, 3153, 3283, 3413, 4213, 4223
Environmental Science Major (Environmental Management Concentration)*
B.A. or B.S. degree program
Total hours required - 72
Specific courses required -
Biology 1134, 1144
Chemistry 1023, 1113, 1123, 1211, 1221
Economics 2503
Environmental Science 1013, 3214, 4213, 4991
Management 3503, 4403
Mathematics 2163
Philosophy 2013
Physics 1013
Political Science 2213
Accounting 2503, 2513
Marketing 3503
Plus 12 hours selected from:
Accounting 3303
Economics 2513
Environmental Science 3903, 450V, 460V
Management 2453, 3363, 3613, 3623, 4443, 4453
Marketing 3533
* All required courses in the concentration must be completed with a grade of “C” or higher. Additionally, no more than half of the elective hours in any concentration may be taken from courses offered for variable credit.

Requirements for Minors

Biology Minor
Total hours required — 18
Specific courses required — None
Students seeking teaching endorsement in Biology should consult the chair of the Department of Biology.

Environmental Science Minor
Total hours required — 18
Specific courses required —
Biology 1144
Environmental Science 1013, 3214, 4213
4 additional hours of approved electives taken from the Environmental Science major requirements.

BIOLOGY (BY)

1003 Fundamentals of Biology (3) F, SP, SU
This course is offered for the non-biology major and is designed to develop an interest in the biological world of which he/she is a part. The fundamental principles of biology are covered and special consideration is given to ethical issues with a biological basis. Lecture, 3 hours.

1134 Principles of Biology: Cell and Genetics (4) F, SP
This course is required for all biology majors and minors and should be taken during the freshman year. This course is designed to introduce the student to major concepts of the life sciences with an emphasis on cellular biology. Biological chemistry, organelle structure and function, membrane transport, cell cycles, energy metabolism, genetics and cell synthesis will be covered. Appropriate lab activities are included. Lecture, 3 hours; laboratory, 2 hours.

1144 Principles of Biology: Diversity and Ecology (4) F, SP
This course is required of all biology majors and minors and should be taken during the freshman year. This course is designed to introduce the student to major concepts of the life sciences with an emphasis in botany, zoology, and ecology. Surveys of the kingdoms, plant structure and function, plant hormones, animal structure and function, animal development, animal behavior, and basic ecological concepts will be some of the topics covered. Appropriate lab activities are included. Lecture, 3 hours; laboratory, 2 hours.

2114 Cell Biology (4) F, SP
This course is designed to cover the general principles of cell biology. History of cell biology, cytological techniques, cell boundary, cell physiology, organization of cytoplasm, comparative cytology, cell reproduction, cell inheritance and development are major areas covered. Laboratory experiences include types of microscopy, morphology of procells and eucells, selected exercises in cell physiology, membrane transport, mitosis and meiosis, and special cytological and histological techniques. Prerequisite: Biology 1134 with a minimum grade of “C.” Lecture, 3 hours; laboratory, 2 hours.

2213 Introductory Human Anatomy and Physiology (3) SP, SU
Fundamental anatomy and physiology of the human body are examined by lectures, readings, and laboratory exercises. The organ systems and their relationships are reviewed with emphasis on practical application when possible. No prerequisites. Lecture, 2 hours; laboratory, 2 hours.

2321 Medical Terminology (1) F, SP
The terminology of the biomedical sciences is reviewed. The use of combining forms, prefixes, and suffixes is emphasized with a goal of better comprehension of written material. No prerequisites. Lecture, 1 hour. Does not count toward the biology major.

2424 Introductory Microbiology (4) SP, SU
Structure, growth and metabolism of microorganisms are discussed briefly with the major emphasis in the course on practical aspects of bacteriology including control of bacterial growth, bacteria of medical interest, and microorganisms in the food and dairy industry. Lecture, 3 hours; laboratory, 3 hours. WC.

2623 Field Botany (3) SP*
A field oriented course designed to familiarize the student with the flowering plants including wildflowers, vines, flowering shrubs, and trees. The general principles of plant systematics are also covered. The field experience will include day trips to natural areas and state parks. One weekend field trip is required (a fee will be charged). Prerequisite: Biology 1144. Lecture, 2 hours; laboratory, 3 hours.

2723 Algae (3) SP*
A study designed for those interested in the morphology, physiology, ecology, and systematics of freshwater algae. Consideration is also given to algae and water supplies, especially those of industrial and municipal concern. Field experiences constitute an integral part of the course. Prerequisite: Biology 1144 recommended. Lecture, 2 hours; laboratory, 3 hours.
Field Zoology (3) F*
This course is designed to acquaint the student with a variety of field techniques in the collection and identification of animals. The topics covered will also include the preparation and cataloging of specimens. Field experiences will be emphasized. Prerequisite: Biology 2114. Lecture, 2 hours; laboratory, 3 hours.

Teaching Resources Seminar (2) F
This course is designed to familiarize the student with a wide variety of sources of biological teaching materials including instrumentation and computer applications. The course also provides experience in planning, in applying the methods of science, and in conducting laboratory and field activities involving students. Special consideration is given to identifying and maintaining the highest level of safety procedures. Lecture-laboratory, 2 hours. Open to biology teaching majors only. WC.

Genetics (4) F, SP
An introduction to the basic concepts and principles of heredity. An historical approach is used to cover both classical and modern genetics including molecular genetics. The laboratory work includes experiments with fruit flies, plants, fungi, and microorganisms. Prerequisite: Biology 1134 with a minimum grade of “C.” Lecture, 3 hours; laboratory, 2 hours. WC.

Microbiology (4) F
This course is designed to provide a foundation in bacteriology. The first half of the course deals with structure, growth, and metabolism of bacteria; the remainder of the course is spent on several aspects of applied microbiology and includes a survey of medically important bacteria. Prerequisite: Biology 2114 recommended. Lecture, 3 hours; laboratory, 3 hours. WC.

Virology (3) SP*
This course serves to acquaint the student with fundamental aspects of viral structure and reproduction, using bacterial and animal viruses as examples. The latter part of the course includes a survey of viruses important in human disease. Prerequisite: Biology 2114. Lecture, 3 hours.

Immunology (3) SP*
This course is designed to acquaint the student with basic aspects of immunology including antigenicity, antibody structure, detection and measurement of antigen-antibody reactions, and hypersensitivity reactions. Prerequisite: Biology 2114. Recommended: Biology 3114. Lecture, 3 hours.

Limnology (3) SU*
This course instructs the student in the basic aspects of the physical, chemical, and biotic factors of inland (fresh) waters. Both lentic and lotic systems are studied. An extensive use is made of local lakes and streams for laboratory investigation. Lecture, 2 hours; laboratory, 3 hours.

Human Anatomy and Physiology I (4) F
The structure and function of the human body are examined with emphasis upon control mechanisms. The nervous, integumentary, muscular and skeletal systems are studied with lecture and laboratory experiences. There is a regional approach to the anatomy of the extremities, head and neck. Lecture, 3 hours; laboratory, 2 hours.

Human Anatomy and Physiology II (4) SP
This course is a continuation of Biology 3514. The circulatory, respiratory, digestive, excretory, endocrine and reproductive systems are studied with emphasis upon homeostasis. Acid balance, fluid balance, and immunity are also integrated into the systematic approach. Prerequisite: Biology 3514 or permission of the instructor. Lecture, 3 hours; laboratory, 2 hours.

Nature Study (2) F, SP, SU
An elementary introduction to the study of the natural world. The course is laboratory and field oriented with both living and non-living materials being used to introduce the student to several natural surroundings. Emphasis is placed upon the student’s developing the ability to identify such things as insects, birds, reptiles, trees, wild flowers, rocks, and minerals. No prerequisites. Lecture, 2 hours; laboratory, 2 hours. Does not count towards a biology major.

Conservation of Natural Resources (2) F, SP, SU
This course is designed to provide the student with a basic understanding of the extent of our natural resources and the problems associated with their conservation. Interrelationships between the biotic and abiotic elements of environment; population dynamics and the effects of population changes on biotic and abiotic resources; ecological processes; and pollution of natural resources are studied to provide a factual basis on which action can be taken to properly use our resources and improve our environment. No prerequisites. Lecture, 2 hours. Does not count towards biology major.

Internship in Biology (3) F, SP, SU
The internship provides the opportunity for hands-on experience by working for various agencies, companies, zoos, laboratories, or other groups involved in some aspect of biology. Evaluation will be based on supervisor assessment, regular progress reports, and a summary report at the end of the semester. Arrangements for the internship should be made during the semester preceding the one in which the student plans to register for the course. Prerequisites: Junior standing, completion of at least 19 hours of biology coursework, and permission of the department chair.†

Ecology (4) F, SP
An overview of the science of ecology. Three levels are examined: the individual, the population and community, and the ecosystem. Some major concepts covered include abiotic environmental limitations, energy and nutrient flow, population ecology and genetics, and community and ecosystem level interactions. Ecosystems worldwide are discussed, but North American ecosystems are emphasized. Prerequisites: Biology 1134, 1144, 3114. Lecture, 3 hours; laboratory, 3 hours. WC.

Molecular Biology (3) SP*
This course focuses on current issues in molecular biology. Topics include DNA structure and replication, transcription, RNA processing, translation, regulation of gene expression and variability in DNA. The laboratory covers basic molecular techniques including electrophoresis of DNA, restriction endonuclease digestion and Southern blotting. Prerequisites: Biology 2114, 3114. Lecture, 2 hours; laboratory, 3 hours.

Embryology (3) SP*
A course which emphasizes developmental stages as well as the mechanisms of developmental processes. The emphasis is on mechanisms rather than organisms in the class work. The laboratory work is concerned with experimental embryology and developmental stages of selected organisms. Prerequisite: Biology 3114. Lecture, 2 hours; laboratory, 2 hours.

Histology (3) SP
The study of microscopic anatomy of the human is undertaken with the emphasis upon visual materials. The primary tissues are reviewed in detail, followed by a survey of selected organs. Prerequisite: Biology 2114. Lecture, 2 hours; laboratory, 2 hours.

Vertebrate Zoology (3) F*
A general survey of vertebrate animals, with special emphasis on comparative anatomy. Laboratory assignments include considerable dissection and often require independent lab work. Prerequisite: Biology 1144. Lecture, 2 hours; laboratory, 2 hours.

† No student may be approved for Independent Study, Research, or Internship until the Chairperson has received the appropriate form with the general topic, hours credit, and signatures of the student and directing instructor. Forms are available from the chair or instructor.
450V  Independent Research (1, 2) F, SP, SU

The student chooses an area of particular interest, and together with the instructor a research problem is selected. The emphasis may be either field or laboratory oriented. A paper is written and submitted at the end of the course. The course is designed to provide the student an opportunity to pursue independent research and provide experience in scientific writing. Prerequisite: Permission of instructor and department chair.†

460V  Special Topics in Biology (1-4) F, SP, SU

Selected topics from the field of biology are offered. The course may be either lecture or laboratory-oriented depending upon the topic selected. The study represents an in-depth approach to a specific area of interest to the student. Prerequisite: Permission of instructor. The following are some of the most recently offered special topics: science and culture, ethnobotany, medical entomology, parasitology, herpetology, and advanced physiology.

4801  Capstone Course (1) F, SP

In this course the theory of evolution will be investigated in a historical, religious, and scientific context. The focus of the discussion-oriented class will be on macroevolutionary theory. Arguments and evidences in various disciplines used to support the theory are presented with discussion of strengths and weaknesses. The course relies heavily on outside readings from classic and current articles, and books by both creationist and evolutionist apologists. Worldview and its influence on theory formation and acceptance, with emphasis on Christian and naturalistic worldviews, is discussed. Limitations of science and impacts which evolutionary theory has had on other disciplines are also included. Prerequisites: senior standing and a minimum grade of “C” in all major core courses. WC.

ENVIRONMENTAL SCIENCE (EV)

1013  Environmental Biology (3) F*

A freshman-level course in environmental science. A study of the natural environment as it relates to ecology, ecosystems, human population growth, soil formation and conservation, biotechnology, toxicology, air and water quality, biodiversity, land use management, energy resources, and waste management. Discussions will include the ethics and policy-making process related to these issues. Lecture, 3 hours.

3214  Environmental Chemistry (4) SP* (offered in even numbered years)

A study of the chemistry of the environment, including: chemical cycles, aquatic chemistry, atmospheric chemistry, soil and geochemistry, water pollution, gaseous inorganic and organic air pollutants, hazardous wastes, and environmental chemical analysis. Laboratory experience is field oriented and makes use of HPLC (high performance liquid chromatography), GC-MS (gas chromatography and mass spectrometry), and AA (atomic absorption spectrometry) to examine common environmental pollutants. Prerequisites: Chemistry 1023, 1113, and 1123. Lecture, 3 hours; laboratory, 3 hours.

3903  Internship in Environmental Science (3) F, SP, SU

The internship provides the opportunity for on-site training in the field of environmental science. Each student is assigned to work with a major corporation or environmentally related agency in conjunction with his/her program of study. Evaluation will be based on supervisor assessment, regular progress reports, and a summary report at the end of the semester. Arrangements for the internship should be made during the semester preceding the one in which the student plans to register for the course. Prerequisites: Junior standing and permission of the instructor. Course limited to environmental science students.†

4213  Environmental Law and Policy (3) F* (offered in even numbered years)

A course designed to familiarize the student with significant environmental legislation including: national environmental policy act (NEPA), clean water act (CWA), endangered species act, clean air act (CAA), resource conservation and recovery act (RCRA), comprehensive environmental response compensation and liability act (CERCLA), and federal insecticide, fungicide and rodenticide act (FIFRA). The course includes fact based discussion on topics of national and global environmental topics such as: protection of the global atmosphere, international trade and the environment, and industrial development in the “Third World.” Prerequisites: Chemistry 1123. Lecture, 3 hours. WC.

450V  Independent Study and/or Research (1-3) F, SP, SU

The student chooses an area of particular interest, and together with an instructor a research problem is selected. The emphasis may be either library or laboratory oriented. A paper is written and submitted at the end of the course. The course is designed to provide the student an opportunity to pursue independent research and provide experience in scientific writing. Prerequisite: permission of instructor.†

460V  Special Topics in Environmental Science (1-4) F, SP, SU

The following are some of the most recently offered special topics: coastal ecosystems, arid lands ecosystems, biodiversity and the temperate rain forest, ecosystems of Yellowstone and Teton National Parks, and subarctic ecosystems: Alaska.

4991  Seminar in Environmental Science (1) SP

A course designed to introduce the student to selected periodicals and reference works pertaining to the environment. Assignments are designed to enable the student to make intelligent searches for desired scientific information. The course includes student seminars on environmental topics that are in the format of a formal scientific presentation. Course may also include seminars from invited environmental professionals. Prerequisite: junior standing. Lecture, 1 hour. WC.

† No student may be approved for Independent Study, Research, or Internship until the Chairperson has received the appropriate form with the general topic, hours credit, and signatures of the student and directing instructor. Forms are available from the chair or instructor.
The mission of the Department of Chemistry is to provide a general knowledge of chemistry for the student desiring a liberal arts education. Chemistry offers to the liberal arts student an appreciation and understanding of great discoveries, laws, and theories that relate to the composition of matter. It also offers an insight into and training in the type of reasoning which brought about these discoveries.

The Professional Chemistry major at Lipscomb is approved by the Committee on Professional Training of the American Chemical Society.

A comprehension of the science of chemistry helps a student to understand and employ in his/her service many of the material changes taking place in nature and in industrial processes.

This department provides the chemistry background necessary for all medically-related studies. These include medicine, osteopathic medicine, podiatric medicine, chiropractic, veterinary medicine, optometry, dentistry, pharmacy, medical technology, nursing, dental hygiene, physical therapy, physician’s assistant, and many others.

**Professional Opportunities**

Professional Chemistry Majors (B.A. degree)

Graduates with this degree are prepared to enter graduate school in chemistry at the M.S. or Ph.D. level or to enter employment in the chemical industry, government agencies, or private institutions.

Biochemistry Major (B.A. or B.S. degree)

Students receiving this degree are prepared to enter graduate school in biochemistry and related subject areas or to seek employment in industry or with government agencies. This major offers a superb background for medical studies. Examples of medically-related professional schools attended by graduates with this major are medical schools, osteopathic medical schools, and dental schools.

Applied Chemistry or Applied Biochemistry Major (B.A. or B.S. degree)

This program is planned for preprofessional students and liberal arts students who do not plan to do graduate work in chemistry. The program consists of a core program in chemistry along with studies in special interest areas. This degree provides a background for students entering medically-related professions such as medicine, osteopathic medicine, podiatric medicine, dentistry, chiropractic, pharmacy, and others.

Students receiving this degree are prepared for graduate work in chemistry-related professions. Examples are environmental sciences, health professions administration, chemical engineering (additional mathematics required), and other studies requiring a good chemistry background.

Students may also elect to enter the job market with private industry or governmental agencies.

**Desirable High School Background**

The chemistry curriculum allows for the high school student to enter at his/her own achievement level. However, a student will be able to take maximum advantage of opportunities in chemistry at Lipscomb if he/she has studied the following subjects in high school: four years of high school mathematics, general science, biology, chemistry and physics; two years of modern foreign language; and four years of English.

**Suggested Schedule for First Year**

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<tr>
<td>Communication 1103</td>
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**Interdisciplinary Major in Environmental Science**

The degree in environmental science consists of 73-74 hours of instruction split between a generalized core and an area of concentration. Students interested in the science of the environment and who wish to pursue careers in environmental consulting and field biology should concentrate in Technology and Field Studies. Students who are interested in the politics of the environment and who wish to pursue careers as lobbyists, environmental activists, and in environmental law should strongly consider the Ethics and Public Policy concentrations. The Environmental Management concen-
titation is designed for those students who wish to pursue managerial positions with various industrial production facili-
ties. All three concentrations provide excellent preparation for graduate study.

See Biology Department, page 138-139, for requirements.

Requirements for Majors
All chemistry majors must take the Major Field Achievement Test in chemistry prior to graduation. This test is a part of Chemistry 4921.

Biochemistry Major
B.A. or B.S. degree program
Total hours required—70
Specific courses required—
Chemistry 1113, 1123, 1211, 1221, 2113, 2123, 2211, 2221, 2314, 3114, 3124, 3313, 3321, 3414, 4613, 4911, 4921
Computing & Information Systems 1041
Mathematics 1314, 2314, 2324
Physics 2414, 2424
Eight hours of Biology courses that would apply to a Biology major. These courses will be based on the individual’s needs and interests.
The major field writing requirement is satisfied by completing Chemistry 2221 and Chemistry 3414 with a grade of “C” or above.

Biochemistry Major-Applied
B.A. or B.S. degree program
Total hours required—72
Specific courses required—
Chemistry 1113, 1123, 1211, 1221, 2113, 2123, 2211, 2221, 2314, 3313, 3321, 3414, 3713, 4911, 4921
Computing & Information Systems 1041
Mathematics 1114, 1123, 1314
Physics 1214, 1224
Eighteen hours selected from courses that count toward a Biology major. The following courses are highly recommended: Biology 1144, 2114, 3114, 3214, 3514, 3524, 4123, 4213.
Chemistry 4613 may be taken as an elective.
The major field writing requirement is satisfied by completing Chemistry 2221 and Chemistry 3414 with a grade of “C” or above.

Chemistry Major-Applied
B.A. or B.S. degree program
Total hours required—62-70
Specific courses required—
Chemistry 1113, 1123, 1211, 1221, 2113, 2123, 2211, 2221, 2314, 3114, 3124, 3414, 3613, 3713, 4911, 4921
Computing & Information Systems 1041
Mathematics 1114, 1123, 1314
Physics 1214, 1224
In addition to the above, the student must select an emphasis in one of the subjects below.
These subjects constitute the student’s minor.

**Emphasis in Business:** Accounting 2503, 2513; Economics 2503, 2513; and six hours selected from Finance 3303, Management 3503, Marketing 3503

**Emphasis in Computer Science:** Computing and Information Systems 1514, 2113, 3113 and six additional hours chosen from Computing and Information Systems offerings with the approval of the department chair

**Emphasis in Mathematics:** Mathematics 2314 and two courses selected from Mathematics 2203, 2324, 3123, 3133, 3213

**Emphasis in other academic areas:** The Chemistry Department will consider proposals from students who wish to emphasize areas other than those listed above. This will be done in consultation with the department chair. The area selected must be one which will compliment the student’s academic progress and professional goals.

This program is designed for students who do not plan to do graduate work in chemistry.
The major field writing requirement is satisfied by completing Chemistry 2221 and Chemistry 3414 with a grade of “C” or above.

Chemistry Major-Professional
B.A. or B.S. degree program
Total hours required—65
Specific courses required—
Chemistry 1113, 1123, 1211, 1221, 2113, 2123, 2211, 2221, 2314, 3114, 3124, 3414, 3613, 4221, 4911, 4921 and any two of 4213, 4313, 4413, 4513
Computing & Information Systems 1041
Mathematics 1314, 2314, 2324
Physics 2414, 2424
German is highly recommended as the foreign language for the B.A. option.
The major field writing requirement is satisfied by completing Chemistry 2221 and Chemistry 3414 with a grade of “C” or above. Those seeking American Chemical Society CPT certification must also complete Chemistry 3313.

Chemistry Teaching Major (General Science—Chemistry)
B.A. or B.S. degree program
I. General Education Required of Secondary and K-12 Teacher Education Students* (see page 114)
II. Professional Education (see page 115)
III. Subject Matter Specialization
   Biology 1003, 3712, and 2213 or 2424
   Chemistry 1113, 1123, 1211, 1221, 2113, 2123, 2211, 2221, 2314, 3051, 3414, 3613, 3713, 4911, 4921
   Mathematics 1114, 1123

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**Chemistry Minor**

Total hours required—18

Specific courses required—None

Eighteen hours of chemistry courses numbered 1113 and above

(Students seeking teaching endorsement in chemistry should consult the chair of the Department of Chemistry.)

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**CHEMISTRY (CM)**

**1013** Introduction to Chemistry (3) F, SP, SU

An introduction to chemistry, intended for non-science majors, which emphasizes the structure of matter and its chemical consequences. Some topics include chemical change, toxic substances in the environment, consumer chemistry, applications of organic and basic structures in biochemistry. Lecture, 2 hours; laboratory, 2 hours.

**1023** Introduction to Chemistry—Organic (3) SP

A survey of the types of organic compounds and their reactions—designed to meet the needs of Home Economics majors. Special emphasis is given to consumer chemistry, including such topics as food and textile chemistry. Prerequisite: Chemistry 1013. Lecture, 2 hours; laboratory, 2 hours.

**1024** Chemistry for Health Sciences (4) SP

An introduction to chemistry that covers the general structure of matter and types of bonding. Special emphasis is given to the different classes of organic compounds and their reactions. This course is designed to meet the needs of nursing majors. Special emphasis is given to application of organic chemistry to medically related topics. Lecture, 3 hours; laboratory, 2 hours.

**1034** Introduction to Chemistry—Biochemistry (4) F

An elementary level course dealing with the fundamental concepts of biochemistry. Special attention is given to chemical composition of the three major classes of foodstuffs—carbohydrates, lipids, and proteins, and the interrelationships of the various metabolic pathways. Prerequisite: Chemistry 1023 or Chemistry 1024. Lecture, 3 hours; laboratory, 2 hours.

**1113, 1123** General Chemistry Lectures I, II (3, 3) 1113-F, SP, SU; 1123-F, SP, SU

This sequence of courses is designed to meet the needs of chemistry, biology, pre-engineering, premedical, pre-dental, and other science-oriented subjects. Subjects covered include symbols, formulas, equations, stoichiometry, structure of the atom, chemical bonding, descriptive inorganic chemistry, gas laws, periodic law, liquid and solid states, solutions, colloids, acids, bases and salts kinetics, equilibria, ionic equilibrium, solubility product, thermodynamics, radiochemistry, oxidation-reduction, nuclear chemistry, coordination compounds, and introduction to organic chemistry. Prerequisite: Score of 18 or higher on math placement test or 20 on ACT in math (460 on SAT) or credit in Mathematics 1114. Corequisite, respectively: Chemistry 1211, 1221. Lecture, 3 hours.

**1211, 1221** General Chemistry Laboratories I, II (1, 1) 1211-F, SP, SU; 1221-F, SP, SU

These two courses are designed to complement General Chemistry Lectures, Chemistry 1113 and Chemistry 1123 respectively. Each laboratory must be taken with its corresponding lecture course. The laboratory experiments serve to introduce students to such topics as density, specific heat, chemical composition, chemical change, spectrophotometric analysis, single replacement reactions, molecular weight determination, gas laws, solubility of salts, calorimetry, titrations, pH indicators, reaction rates, inorganic preparations, and inorganic qualitative analysis. Corequisites: Chemistry 1113 and 1123. Laboratory, 3 hours.

**1144** General Chemistry for Engineering Students (4) F

This course is designed to meet the needs of engineering students who need one semester of general chemistry with laboratory. Subjects covered in the lecture and laboratory are developed based in part on the topics on the Fundamentals for Engineering Exam. These subjects include atomic structure, periodic table, chemical bonding, oxidation numbers, moles and molecular weight, radioactive decay, gases and ideal gas laws, colligative properties, thermochromism, equilibrium, concentration and properties of solutions, kinetics, organic chemistry, spectroscopic methods. Courses must be taken in sequence. Prerequisite: Chemistry 1211 and 2211. Corequisites, respectively: Chemistry 2113 and 2221. Lecture, 3 hours, each.

**2113, 2123** Organic Chemistry Lectures I, II (3, 3) 2113-F, SU; 2123-S, SP, SU

Both aliphatic and aromatic compounds are studied. These courses are presented in such a way as to require an understanding of principles and an application of those principles to solve problems rather than just to memorize the isomerism, reactions, reaction mechanisms, stereochemistry, and applications of spectroscopic methods. These courses are designed to fit the needs of the chemistry major, the biology major and the premedical student. These courses complement the organic laboratory courses, Chemistry 2211 and 2221, and must be taken in sequence. Prerequisites: Chemistry 1123 and 2121. Corequisite, respectively: Chemistry 2211 and 2221. Lecture, 3 hours, each.

**2211, 2221** Organic Chemistry Laboratories I, II (1, 1) 2211-F, SU; 2221-F, SU

These two courses are designed to complement the organic chemistry lecture courses 2113 and 2123. These courses introduce the student to basic laboratory skills and techniques often used by organic chemists. The laboratory work includes separation and purification techniques, synthesis of different types of classes of organic compounds, and organic qualitative analysis properties of various spectroscopic methods. Courses must be taken in sequence. Prerequisite: Chemistry 1123 and 2121. Corequisite, respectively: Chemistry 2113 and 2123. Laboratory, 4 hours, each. Chemistry 2221, WC.

**2314** Analytical Chemistry (4) F

Theory and practice in elementary gravimetric and volumetric analyses are presented. Laboratory experiences include these areas: precipitation, acid-base, oxidation-reduction, and complex ions. Chemical equilibrium and the treatment of analytical data are emphasized. Prerequisites: Chemistry 1123 and Computing and Information Systems 1041. Lecture, 3 hours; laboratory, 4 hours.

**2401** Clinical Laboratory Observation (1)

A one-hour course designed for pre-medical and all related majors to introduce them to clinical and/or clinical laboratory work. The student spends approximately 50 hours in observing or performing assigned tasks in a clinic, hospital, or clinical laboratory. Specific requirements vary depending on the field of study chosen by the student. A written report is required. Prerequisites: Chemistry 1123 and 2221; Chemistry 2123 and 2221 recommended. Offered on demand.
The impact of computing on the daily life of all citizens is inescapable. Revolutionary advances in electronics have transformed the personal computer into both an essential business tool and a household appliance. At the same time, large-scale computing systems have become faster and more powerful, while miniaturization techniques have produced microchips that pervade almost every device used by the general public — automobiles, microwave ovens, refrigerators, telephones, traffic signals, watches. The list is almost endless. Students who are interested in participating in the activities that influence the use of computing resources in business, science and society will find that Lipscomb offers a variety of strong curricula to assist them in achieving that goal.

**Computer Science Major and Minor**

The impact of computing on the daily life of all citizens is inescapable. Revolutionary advances in electronics have transformed the personal computer into both an essential business tool and a household appliance. At the same time, large-scale computing systems have become faster and more powerful, while miniaturization techniques have produced microchips that pervade almost every device used by the general public — automobiles, microwave ovens, refrigerators, telephones, traffic signals, watches. The list is almost endless. Students who are interested in participating in the activities that influence the use of computing resources in business, science and society will find that Lipscomb offers a variety of strong curricula to assist them in achieving that goal.

**Information Systems Major and Minor**

The Information Systems major and minor are offered by the College of Natural and Applied Sciences with the cooperation of the College of Business. This program is designed to prepare students for graduate studies in information systems, or for employment in a wide variety of commercial computing environments. Examples include banks, insurance companies, health care corporations, distribution centers, retail stores, Internet service providers and telecommunications, as well as small businesses, private consulting and federal, state and local government.

The core of the Information Systems major focuses on the fundamentals of both business and computing knowledge. The student may choose one of two concentrations, the application concentration or the management concentration. The application concentration is designed to provide the student with an emphasis in the technical aspects of computing, whereas the management concentration is designed to provide a broader business experience. The major with either concentration consists of a total of 73 semester hours.

The Information Systems minor is designed to provide students with a general knowledge of the requirements of commercial computing. The minor can be very helpful to business students who expect to be involved in corporate computing issues. This program matches very well with any of the majors offered by the College of Business.

**Career Opportunities**

The latest analyses of career opportunities in computing-related positions indicate that demand will significantly exceed the supply for the next decade and beyond. Graduates with computing emphases will find many employment opportunities, for example, as:

- Application Programmers
- Database Administrators
- Information Systems Managers
- Network Specialists and Managers
- Operations Managers
- Systems Analysts and Programmers
- Telecommunication Specialists

The variety of curricula offered at Lipscomb provide a solid foundation on which to continue lifelong learning in various computing environments. Graduates may elect to pursue graduate training at the master's or doctoral level.

**Desirable High School Background**

A student who wishes to pursue one of the majors offered in this department should take as many academic courses as possible. Algebra (first and second year), geometry, and keyboarding (or typing) should be taken. Introductory computing courses in word processing and spreadsheets and in structured programming will be useful, but should not displace academic courses in the high school curriculum. Academic courses in speech or communication and in the basic sciences, especially physics or chemistry, will also be helpful.
Introductory Courses

Introduction to Computing is a lecture course that provides an overview of computer technology. Information Systems Applications I is designed to introduce the student to some of the capabilities of the microcomputer. Structured Programming is the primary computing language course for computing majors.

Suggested Schedule for First Year

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<tr>
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<th>Fall</th>
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<tbody>
<tr>
<td>Bible 105V</td>
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<td>Bible 106V</td>
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<td>Comp. &amp; Info. Sys. 1012, 1021</td>
<td>3</td>
<td>Comp. &amp; Info. Sys. 2043</td>
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<td>Lipscomb Seminar 1103</td>
<td>3</td>
<td>English 1123</td>
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<tr>
<td>History 1113</td>
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<td>Mathematics 1314 or 2314</td>
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<td>Mathematics 1123 or 1314</td>
<td>3 or 4</td>
<td>Communication 1003</td>
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<td>Keyboarding Proficiency</td>
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INFORMATION SYSTEMS

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<td>Comp. &amp; Info. Sys. 1012, 1021</td>
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<td>Comp. &amp; Info. Sys. 2043</td>
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<td>Lipscomb Seminar 1103</td>
<td>3</td>
<td>English 1123</td>
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<tr>
<td>History 1113</td>
<td>3</td>
<td>Management 2453</td>
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<tr>
<td>Mathematics 1114</td>
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<td>Communication 1003</td>
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<tr>
<td>Keyboarding Proficiency</td>
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<td>P.E.</td>
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</tbody>
</table>

Requirements for Majors

Computer Science Major
B.A. or B.S. degree program
Total hours required — 77
Specific courses required—
  Bible 421V (counts as general education requirement for daily Bible)
  Computing and Information Systems 1012, 1021, 1514, 2043*, 2113, 3113*, 3213, 3353, 3513, 3613, 3703, 3803, 4213, 4613
  Six additional hours selected from:
  Computing and Information Systems 2053, 3313, 3323, 3413, 4113, 450V
  Mathematics 1314, 2103, 2183 or 3123, 2314, 2903
  Philosophy 3433 (counts as general education requirement for humanities)
  *Keyboarding proficiency is required as a prerequisite for Computing and Information Systems 2043 and for Computing and Information Systems 3113. See note at the beginning of the course descriptions.
  The minor requirement in Pure Mathematics is automatically satisfied if Mathematics 3123 is selected in place of 2183; otherwise, one additional course selected from the approved list is needed to complete this minor.
  The major field writing requirement is satisfied by completing Computing and Information Systems 4613 with a grade of “C” or above.

Information Systems Major (Application Concentration)
B.A. or B.S. degree program
Total hours required — 73
Specific courses required —
  Accounting 2503, 2513
  Business Administration 3703
  Communication 2703
  Computing and Information Systems 1012, 1021, 1514, 2043*, 2053, 2113, 3113*, 3213, 3313, 3323, 3613, 4613
  Economics 2503
  Management 2453, 3503, 4403
  Mathematics 2103, 2183
  Nine hours selected from:
  Computing and Information Systems 2313, 3513, 3703, 3803, 4213, 450V
  *Keyboarding proficiency is required as a prerequisite for Computing and Information Systems 2043 and for Computing and Information Systems 3113. See note at the beginning of the course descriptions.
  The major field writing requirement is satisfied by completing Business Administration 3703 and Computing and Information Systems 4613 with a grade of “C” or above.
Information Systems Major (Management Concentration)
B.A. or B.S. degree program
Total hours required — 73
Specific courses required —
- Accounting 2503, 2513
- Business Administration 3703
- Communication 2703
- Computing and Information Systems 1012, 1021, 1514, 2043*, 2053, 2113, 3113*, 3213, 3313, 3323, 3613, 4613
- Economics 2503, 2513
- Management 2453, 3503, 4403, 4443
- Marketing 3503
- Mathematics 2183
Three hours selected from:
- Accounting 3303, 4523
- Finance 3503
- Management 3603, 3613, 4203
- Marketing 3553
*Keyboarding proficiency is required as a prerequisite for Computing and Information Systems 2043 and for Computing and Information Systems 3113. See note at the beginning of the course descriptions.

The minor requirement in General Business is automatically satisfied.

The major field writing requirement is satisfied by completing Business Administration 3703 and Computing and Information Systems 4613 with a grade of "C" or above.

Requirements for Minors

Computer Science Minor
Total hours required—18 or 19
Specific courses required—
- Computing and Information Systems 1012, 1021, 1514, 2113, 3113*
Five hours of electives chosen from Computing and Information Systems offerings with approval of the Department Chair.
*Keyboarding proficiency is required as a prerequisite for Computing and Information Systems 2043 and for Computing and Information Systems 3113. See note at the beginning of the course descriptions.

Information Systems Minor
Total hours required — 25 or 26
Specific courses required —
- Accounting 2503
- Computing and Information Systems 1012, 1021, 1514, 2043*, 2053, 3313, 3323
- Management 3503
*Keyboarding proficiency is required as a prerequisite for Computing and Information Systems 2043 and for Computing and Information Systems 3113. See note at the beginning of the course descriptions.

COMPUTING AND INFORMATION SYSTEMS (CS)

In addition to lecture, computing courses require appropriate programming exercises. Keyboarding proficiency is a prerequisite for Computing and Information Systems 2043, 2313, and 3113, and therefore is required of all majors and minors in the department. Proficiency may be established in one of three ways: (1) An opportunity to establish keyboarding proficiency will be provided at no charge as part of Computing and Information Systems 1021; (2) successful completion of a proficiency examination (fee required), which will be administered on three different dates during the fall and spring semesters, and once at the beginning of the summer session; (3) college-level transfer credit from another college or university for a typing or keyboarding course with a grade of “C" or better. For details about the proficiency examination, see the department chair.

Note: CS 1021 as the corequisite or prerequisite may be replaced by satisfaction of the Information Technology Proficiency requirement.

1012 Introduction to Computing (2) F, SP, SU
Historical survey of computing milestones, computer components, I/O devices, storage, number systems, structured programming, algorithm design, computer systems, and social impact of computers. Corequisite: Computing and Information Systems 1021. Lecture, 2 hours. Will not be offered after the 2005-06 academic year.

1021 Information Systems Applications I (1) F, SP, SU
Introduction to the use of computer application environments, including the campus network applications, and word processing, spreadsheet, presentation and internet access software. An opportunity to establish keyboarding proficiency will be provided at no charge, with opportunity to practice skills prior to the test. Keyboarding skill is not included in the grading for the course. Laboratory, 2 hours.
Will not be offered after the 2005-06 academic year.

1041 Computer Applications - Math/Science (1) F, SP
Use of computer software for mathematical and scientific applications. Problem solving with application software including graphical representation of solutions and data, equation editing, symbolic mathematics, statistical software, scientific internet resources, images, and animation. Corequisite: Computing and Information Systems 1021. Laboratory, 2 hours.

1514 Structured Programming (4) F, SP
Structured and modular program design and introduction to standard programming techniques. Details of an object-oriented programming language. Elementary applications from several areas. Prerequisite: Computing and Information Systems 1021 with a minimum grade of "C" and at least a 19 ACT or 460 SAT mathematics score or Mathematics 1030 with a minimum grade of “C.” Lecture, 3 hours; Laboratory, 3 hours.

2043 Information System Applications II (3) F, SP, SU
Heavy emphasis will be placed upon using the microcomputer as a decision-making tool. Theory and applications of various software packages, including word processing, electronic spreadsheets, databases, and presentation software are discussed. Prerequisite: Computing and Information Systems 1021 with a minimum grade of "C," and keyboarding proficiency. Lecture/Laboratory, 3 hours.

2053 Design of Internet Applications (3) F
Web site design for an organizational presence on the Internet. Topics include the use of appropriate tools for good web design including HTML, scripting languages, multimedia, plug-ins and an HTML editor. Data manipulation, validation, and evaluation in web
page design as well as web management including security, privacy, control, software evaluation, site advertisement, international languages and FTP are discussed. Prerequisite: Computing and Information Systems 2043 with a minimum grade of “C,” or 1514 with a minimum grade of “C.” Lecture, 3 hours.

2113 Intermediate Programming (3) SP
Introduction to recursion, stacks, queues, linked lists and binary trees. Sequential, random, and indexed file applications. Advanced features of the C++ programming language, including dynamic memory allocation, and pointers. Prerequisite: Computing and Information Systems 1514 with a minimum grade of “C.” Lecture, 3 hours.

2212 Fortran (2)
Details of the Fortran programming language. Looping, arrays, subprograms, searching, and sorting. Prerequisites: Mathematics 1114 with a minimum grade of “C” (or equivalent) and Computing and Information Systems 1021 with a minimum grade of “C.” Lecture, 2 hours. Offered on demand.

2313 COBOL (3)
Details of COBOL language. Applications include sorting and file manipulation. Prerequisite: Computing and Information Systems 1021 and keyboarding proficiency. Offered on demand. Lecture, 3 hours.

3113 Data Structures (3) F
String processing, searching and sorting, stacks, queues, linked lists, trees, graphs, and file maintenance. Prerequisite: Computing and Information Systems 2113 with a minimum grade of “C” and keyboarding proficiency. Lecture, 3 hours.

3213 Data Base Management Systems (3) SP
Data relationships. Hierarchical, network, and relational models. Data description languages and query facilities. File security and integrity. Prerequisite: Computing and Information Systems 2113 with a minimum grade of “C” and 2043 with a minimum grade of “C.” Lecture, 3 hours.

3313 Systems Analysis (3) F
Project management, system design and specification, data management, I/O methods, procedures and control, documentation, and implementation. Prerequisite: Computing and Information Systems 1012 and 1514 or 2043 or 2212 or 2313 with a minimum grade of “C.” Lecture, 3 hours.

3323 Systems Design (3) SP
An in-depth discussion on how to design and implement a new data processing system. Includes a study of the tools used in designing a system, hardware/software consideration, file or database design, evaluating software, etc. Prerequisite: Computing and Information Systems 3313. Lecture, 3 hours.

3353 Introduction to Software Engineering (3) F
This course is a survey of techniques, methods, and theories used in the analysis, design and testing of software. Prerequisite: Computing and Information Systems 2113 with a minimum grade of “C.” Lecture, 3 hours.

3413 Numerical Algorithms (3) F
Finding roots of equations, error analysis, simultaneous linear equations, numerical integration, least squares approximations, and numerical solution of ordinary differential equations. Prerequisites: Mathematics 2314 and either Computing and Information Systems 1514 or 2212 with a minimum grade of “C.” Lecture, 3 hours.

3513 Computer Organization (3) SP
Introduction to architecture of computer systems including, logic design, CPU organization, assembly language, implementation of I/O systems, memory management, and communications. Prerequisite: Mathematics 2103, and Computing and Information Systems 1514 with a minimum grade of “C.” Lecture, 3 hours.

3613 Network Principles (3) SP
Overview of current computer network theory and practice. Hardware requirements, network media and topologies, protocols and access methods, Internet addressing and protocols, protocol layering (ISO model, etc.). Prerequisite: Computing and Information Systems 1514 with a minimum grade of “C.” Lecture, 3 hours.

3703 Introduction to GUI Programming (3) SP
An introduction to Human-Computer Interaction and Graphical User Interface development. Discussions on theoretical and practical aspects of designing and implementing graphical user interfaces including window management, interacting with an operating system’s graphics library, widgets, and event handling. Prerequisite: Computer and Information Systems 2113 with a minimum grade of “C.” Lecture, 3 hours.

3803 Introduction to AI and Expert Systems (3) SP
A survey of artificial intelligence topics including advanced searching techniques, heuristics, knowledge representation, intelligent agents, and expert systems. Prerequisite: Mathematics 2103 and Computing and Information Systems 1012 with a minimum grade of “C.” Lecture, 3 hours.

4113 Comparative Programming Languages (3) SP
Formal language grammar and syntax, data types and control structures, and implementation and comparison of strengths and weaknesses of various programming languages. Prerequisite: Computing and Information Systems 3113 with a minimum grade of “C.” Lecture, 3 hours.

4213 Operating Systems (3) F
Dynamic procedure activation, system structure, memory management, concurrent processes, and multiprogramming systems. Prerequisite: Computing and Information Systems 2113 with a minimum grade of “C.” Lecture, 3 hours.

450V Special Topics in Computing (1, 2, or 3)
Selected topics from the field of computing are offered. The course may be either lecture or laboratory oriented depending upon the topic selected. The study represents an in-depth approach to specific areas of interest to the students. This course may be repeated for credit with departmental approval. Prerequisite: Consent of instructor. Offered on demand.

4613 Senior Project (3) F, SP
The student will design and implement a suitable computer project. Prerequisites: Senior standing and 20 hours of computing courses including Computing and Information Systems 3323 or 3353 with a minimum grade of “C.” Lecture/recitation, 3 hours. WC.

INFORMATION SYSTEMS (INFS)

1000 Basic Computer Literacy (0) F, SP, SU
Introduction to computers and the use of computer applications, including the campus network applications, word processing, spreadsheets, presentations, and internet access. Upon completion, students will be prepared to use computing resources in the university setting. Open only to students who have not satisfied the Information Technology Proficiency requirement by examination. Lecture/Laboratory, 1 hour.
Department of Mathematics

Carroll G. Wells, Professor and Chair
John J. Beauchamp, Associate Professor
Randy E. Bouldin, Assistant Professor
Gary C. Hall, Professor

The mission of the Department of Mathematics is to teach courses with the intent of increasing literacy and competency in mathematics and providing the academic foundation for those who desire to be professional mathematicians, mathematics educators, or to work in areas that require a strong mathematical background. There is a constant and growing demand for training in the mathematical sciences in our modern technological society. Students may select from a wide range of course offerings including courses designed for general education, for preprofessional studies (engineering, medicine, law, and so forth), and for major programs. Both the B.A. and B.S. degrees are offered with either the regular major or the teaching major in mathematics.

Professional Opportunities

Professional opportunities in mathematics are plentiful and varied. The regular major is designed to prepare the student for graduate study or work in government and industry. Such fields as operations research, statistics, computer science, quality control, and actuarial work are open to majors in mathematics. The teaching major program prepares the student for teaching at the secondary school level. The demand for teachers in mathematics has exceeded the supply for several years, and this trend is expected to continue.

Desirable High School Background

A strong academic background will be valuable. Specific courses recommended for a potential mathematics major are these: two years of algebra, plane and solid geometry, trigonometry, chemistry, physics, and keyboarding.

Suggested Schedule for First Year

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<th>Fall</th>
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<tbody>
<tr>
<td>Bible 105V</td>
<td>Bible 106V</td>
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<tr>
<td>Math 1314</td>
<td>Math 2314</td>
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<tr>
<td>Lipscomb Seminar 1103</td>
<td>English 1123</td>
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<td>P.E.</td>
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<tr>
<td>Art 1813 or Music 1503</td>
<td>Communication 1003 - WC</td>
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<tr>
<td>Comp. &amp; Info. Sys. 1021, 1041</td>
<td>Biology 1003</td>
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Requirements for Majors

Mathematics Major — Regular
B.A. or B.S. degree program
Total hours required—41
Specific courses required—
Computing and Information Systems 1041
Mathematics 1314, 2103, 2314, 2324, 2903, 3123, 3133, 3213, 3992, 4113, 4213, 4903 or Engineering 3303, 4992
Enrollment and a passing grade in Mathematics 2000 are required for two semesters.
The major field writing requirement is satisfied by completing Mathematics 2903 and Mathematics 3992 with a grade of “C” or above.

Mathematics Teaching Major
B.A. or B.S. degree program
I. General Education Required of Secondary and K-12 Teacher Education Students (see page 114)  
II. Professional Education (see page 115)  
III. Subject Matter Specialization
   Computing and Information Systems 1041
   Mathematics 1314, 2103, 2314, 2324, 2903, 3123, 3133, 3213, 4023, 4113, 4153, 4992
   Enrollment and a passing grade in Mathematics 2000 are required for four semesters.

Students completing this major must satisfy the major field writing requirements for both the Department of Mathematics and the Department of Education.
In Mathematics, the writing requirement is satisfied by completing Mathematics 2903 and Mathematics 4023 with a grade of “C” or above. In Education, the writing requirement is satisfied by completing the following courses with a grade of “C” or above: Education 3332 and 3354.
Mathematics Teaching majors have a built-in minor and are not required to take another minor.

Requirements for Minors

Applied Mathematics Minor
Total hours required—18
Specific courses required—
Mathematics 1314, 2314, 2324, 3133
Choice of:
Engineering 3303 or Mathematics 3123
Pure Mathematics Minor
Total hours required—17
Specific courses required—
Mathematics 1314, 2103, 2314
Two courses selected from:
Mathematics 2324, 2903, 3123, 3133, 3213, 4113, 4553, 4213, 4903

MATHEMATICS (MA)

Note: Prerequisites for mathematics courses below are not suggestions. They are requirements for entrance into a course.

1020 Introductory Algebra (3 non-credit hours) F
A review of high school algebra that includes a review of real numbers, equations, inequalities, problem solving, graphing, polynomials, factoring, and systems of equations. Students who score below 15 on the ACT or 360 on the SAT in math will be required to take this course. This is a developmental non-credit course. (See pages 44 and 61 of this catalog concerning Developmental Non-Credit Courses.)

1030 Intermediate Algebra (3 non-credit hours) F, SP
A review of high school algebra that includes factoring, inequalities and problem solving, rational expressions, functions, exponents and radicals, and quadratic equations and functions. This is a developmental non-credit course. (See pages 44 and 61 concerning Developmental Non-Credit Courses.) Prerequisite: At least a 15 ACT (or 360 SAT) math score or Mathematics 1020 with a minimum grade of “C.”

1043 Survey of the Fundamentals of Mathematics (3) F, SP, SU
An introduction to mathematics at the same level of difficulty as college algebra, although Mathematics 1043 cannot be used as a substitute for college algebra. Topics covered are problem solving, logic, numeration systems, calculators, basic concepts of number theory and algebra, sequences, series and finance mathematics. Required of most students who plan to teach. (See Education section of this catalog.) Prerequisite: At least a 19 ACT (or 460 SAT) math score or Mathematics 1030 with a minimum grade of “C.”

1053 Survey of Algebra and Statistics (3) F, SP
Topics from algebra include functions, graphs, systems of equations and inequalities, matrices, and linear programming. Topics from statistics include probability, sampling techniques, tables and graphs used to represent data, descriptive statistics, and probability distributions including the normal distribution. Required of all K-8 education students. This course does not satisfy specific program requirements of College Algebra (Mathematics 1114) or Elementary Statistics (Mathematics 2183). (It is recommended that students with a grade of “C” or higher in Mathematics 1114 complete Mathematics 2183 to fulfill state knowledge and skills requirements in these two concept areas.) Prerequisite: At least a 19 ACT (or 460 SAT) math score or Mathematics 1030 with a minimum grade of “C.”

1114 College Algebra (4) F, SP, SU
Quick review of equations and inequalities; functions and graphs; polynomial and rational functions; exponential and logarithmic functions; systems of equations and inequalities; sequences, series, and probability. Prerequisites: two years of high school algebra and at least a 21 ACT (or 500 SAT) math score, or Mathematics 1030 with a minimum grade of “C.”

1123 Trigonometry and Analytic Geometry (3) F, SP
The trigonometric and circular functions; trigonometric analysis; analytical geometry of the plane and three space including the conic sections, rotation of axes, polar coordinates, polar equations of conics, plane curves and parametric equations. Prerequisites: two years of high school algebra and at least a 24 ACT (or 550 SAT) math score, or Mathematics 1114 with a minimum grade of “C.”

1314 Calculus I (4) F, SP
Functions and limits, differentiation of polynomial functions, applications of the derivative, antiderivatives, the definite integral, transcendental functions. Prerequisite: Mathematics 1123 with a minimum grade of “C,” or a semester of high school trigonometry and at least a 24 ACT (or 550 SAT) math score.

2000 Math Lab Tutoring (0) F, SP
Tutoring in the university’s math lab two hours per week. Payment will be provided, but number of tutors allowed each semester will be limited. Required of all Teaching Math majors for a minimum of four semesters. Required of all Regular Math Majors for a minimum of two semesters. Prerequisite: Mathematics 2103.

2103 Discrete Mathematics (3) F, SP
Introduction to the mathematics of computer science, including functions, relations, trees, counting, and computability. Prerequisite: Mathematics 1114 with a minimum grade of “C,” or at least a 23 ACT (or 505 SAT) math score.

2183 Elementary Statistics (3) F, SP, SU
Data collection and presentation; measures of central tendency and variability; discrete and continuous probability distributions; confidence intervals; hypothesis testing; analysis of variance; regression. Prerequisite: Mathematics 1114 with a minimum grade of “C,” or at least a 23 ACT (or 505 SAT) math score. Computing and Information Systems 1021 or 1041 strongly recommended.

2314 Calculus II (4) F, SP
Applications of integration, techniques of integration, indeterminate forms, improper integrals, numerical methods, conics, polar coordinates, infinite series, and parametric equations. Prerequisite: Mathematics 1314 with a minimum grade of “C,” or at least a 3 on the AP exam.

2324 Calculus III (4) F, SP
Plane and space vectors, multivariable differentiation and integration, directional derivatives, gradients, extremes, and vector calculus (including line integrals, Green’s theorem, surface integrals, Gauss’ theorem, and Stokes’ theorem). Prerequisite: Mathematics 2314 with a minimum grade of “C,” or a 5 on the Advanced Placement Calculus BC exam.

2903 Logic, Proof, and Mathematical Modeling (3) SP
Introduction to higher mathematical thinking, including the study of sets, basic logic, proof techniques, and mathematical modeling. Prerequisite: Mathematics 1314 with a minimum grade of “C.” Failure to complete Mathematics 2903 by the end of the sophomore year will result in delay in graduation. WC.

3012 Methods of Teaching Secondary Mathematics (2) SP
Experiences in methods of teaching mathematics in the secondary school, exposure to current trends and issues in mathematics education, and philosophy of mathematics education. To be taken during the semester preceding Professional Semester. Prerequisites: Education 3313, 3321, 3332, and Computing and Information Systems 1021.

3053 Survey of Geometry (3) F, SP, SU
Both formal and informal methods are used to examine the basic concepts of Euclidean geometry (angles, triangles, circles, parallel lines, polygons). The course is required of all students seeking K-8 certification. It does not satisfy mathematics major or minor requirements or secondary certification requirements. Prerequisites: Mathematics 1043 and either Mathematics 1053 or 1114 with a minimum grade of “C.”
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Semester</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>3123</td>
<td>Mathematical Theory of Statistics (3) F* (even-numbered years)</td>
<td>3</td>
<td>F*</td>
<td>Probability theory, binomial, hypergeometric, Poisson, normal, gamma, t, F, chi square, and bivariate normal distributions, estimation and hypothesis testing theory with applications to means, proportions, variances, and correlation; computer applications using the Minitab statistical program. Two lecture hours plus two lab/recitation hours per week. Prerequisite: Mathematics 2314 with a minimum grade of “C.”</td>
</tr>
<tr>
<td>3133</td>
<td>Differential Equations (3) SP</td>
<td>3</td>
<td>SP</td>
<td>The solution of differential equations of first order and first degree (with applications); linear differential equations of higher order (with applications); Laplace transform methods; solutions by series. Prerequisite: Mathematics 2314 with a minimum grade of “C.”</td>
</tr>
<tr>
<td>3213</td>
<td>Linear Algebra (3) F* (odd-numbered years)</td>
<td>3</td>
<td>F*</td>
<td>Vector spaces; matrices; linear transformations; determinants; systems of equations; inner products; eigenvalues and eigenvectors; Markov chains; applications to differential equations. Prerequisite: Mathematics 2903 with a minimum grade of “C.”</td>
</tr>
<tr>
<td>3392</td>
<td>Mathematical Research and Writing (2) F* (odd-numbered years)</td>
<td>2</td>
<td>F*</td>
<td>This is an introduction to research and writing in mathematics and will require a literature search, a major paper using a standard mathematical writing style, and an oral presentation. Prerequisite: Mathematics 2903 with a minimum grade of “C.”</td>
</tr>
<tr>
<td>4023</td>
<td>History of Mathematics (3) SP* (even-numbered years)</td>
<td>3</td>
<td>SP*</td>
<td>Survey of the historical developments and achievements in mathematics from ancient civilizations to the modern era with emphasis on its integral role in the development of civilization. Required of all mathematics teaching majors and elective for all other majors. Writing assignments required. Prerequisite: Mathematics 2314 or consent of instructor. WC.</td>
</tr>
<tr>
<td>4113</td>
<td>Abstract Algebra (3) SP* (even-numbered years)</td>
<td>3</td>
<td>SP*</td>
<td>The integers; groups; rings; integral domains; fields; polynomials. Prerequisite: Mathematics 3213 with a minimum grade of “C.”</td>
</tr>
<tr>
<td>4153</td>
<td>Introduction to Higher Geometry (3) SP* (odd-numbered years)</td>
<td>3</td>
<td>SP*</td>
<td>Finite geometries; transformations; convexity; polygons and circles; constructions; inversion; projective and metric properties; duality; non-Euclidean geometries. Prerequisite: Mathematics 2903 with a minimum grade of “C.”</td>
</tr>
<tr>
<td>4213</td>
<td>Advanced Calculus (3) F* (even-numbered years)</td>
<td>3</td>
<td>F*</td>
<td>The real numbers; calculus of functions of one variable; sequences and series of functions. Prerequisites: Mathematics 2324, 2903 with minimum grade of “C.”</td>
</tr>
<tr>
<td>480V</td>
<td>Independent Study (1, 2, or 3)</td>
<td>1-3</td>
<td>WC</td>
<td>May be taken only with the approval of the mathematics faculty. Offered only to math majors who want to study a math course not in the catalog. Requires junior standing.</td>
</tr>
<tr>
<td>4903</td>
<td>Special Topics in Mathematics (3) SP* (odd-numbered years)</td>
<td>3</td>
<td>SP*</td>
<td>Selected topics from the field of mathematics are offered. The course may be either lecture or proof-oriented depending upon the topic selected. The study represents an in-depth approach to a specific area of mathematics. This course may be repeated for credit. Prerequisite: Mathematics 2903 with minimum grade of “C.”</td>
</tr>
<tr>
<td>4992</td>
<td>Senior Seminar (2) SP</td>
<td>2</td>
<td>SP</td>
<td>A review of undergraduate mathematics including practice in problem-solving.</td>
</tr>
</tbody>
</table>
The nursing program at Lipscomb University is offered as a partnership between Lipscomb University (LU) and Vanderbilt University School of Nursing (VUSN). LU provides the first five semesters of a pre-nursing liberal arts program of study and the remaining three semesters of nursing courses will be provided by VUSN as a part of the Lipscomb/Vanderbilt agreement. The pre-nursing program will provide the nursing-related prerequisite course requirements that are foundational to the nursing courses to be taught at the VUSN. Upon successful completion of the combined programs of study, a student will be awarded a Bachelor of Science in Nursing (BSN) degree from LU. A student who completes this program of study will have had the experience of an academic career in both a liberal arts environment of a small university campus and a health sciences environment of a major research university. This unique combination of study on two differently oriented campuses will provide a student with training in nursing education, strongly complemented by extensive study in the humanities and social sciences. Thus, the student will be well trained to function as a bachelor’s degree nurse and also have the necessary foundation to pursue masters and doctoral studies in nursing.

Primary funding for nursing studies at Lipscomb University is provided by a generous grant from HCA-The Healthcare Company.

Nursing Program Objectives

Graduates of the Lipscomb University BSN program will be able to:

1. Synthesize knowledge from nursing, the humanities, and the biophysical and social sciences into the practice of professional nursing.
2. Demonstrate skills in critical thinking, decision making, information management, and use of the nursing process with individuals, families and groups experiencing complex health problems.
3. Evaluate the usefulness of and apply research findings to professional nursing practice.
4. Teach and counsel individuals, families, communities, and other groups about health, illness and health-seeking behaviors.
5. Provide health care to culturally diverse populations in a variety of environments, both independently and in collaboration with other health care team members.
6. Demonstrate leadership qualities in addressing professional nursing and health issues.
7. Demonstrate accountability for decisions about nursing practice.
8. Demonstrate awareness of the historical and current aspects of economic, political, legal and ethical issues related to health care in society.
9. Demonstrate awareness of nursing roles within the health care system.

Admission/Graduation Policies

Students who are interested in nursing at LU must meet the same criteria for admission to LU. Upon admission to the university, students may declare a pre-nursing major and begin the coursework that is foundational to the upper division nursing program. Admission to the upper division nursing major will be consistent with the admission policies of VUSN. Students must complete the prescribed 85 credit hours of liberal arts courses.

The Bible requirement for students in this program will be fulfilled in the same manner as with all other Lipscomb students during the semesters they are taking classes at Lipscomb. During their clinical experiences at Vanderbilt, each student will complete a reading/spiritual reflection assignment that will be incorporated into their program requirements.

Students will be admitted to the upper division major after completing four semesters of liberal arts courses at LU conditional upon successful completion of the remaining courses. Admission to the upper division nursing program is based on the following factors:

1. Undergraduate Grade Point Average. It is recommended that the applicant have at least a cumulative B (3.0) average in the prescribed 85 credit hours of pre-requisite liberal arts courses.
2. Letters of Recommendation. Three letters of reference from faculty are required.
3. Interview. An interview survey is required.
5. Health History. Students are required to submit documentation of a negative tuberculin skin test or chest X-ray, Hepatitis B vaccine, MMR vaccine, tetanus vaccine, varicella titer (students testing negative are required to be immunized), and/or other appropriate immunizations to the Student Health Center before initial registration of clinical courses. A physical exam is required within the last six months (good physical and mental health).
6. A clear criminal background check is required by the clinical agencies.
7. Meet eligibility requirements for licensure in Tennessee.

Graduation requirements for a BSN will be completion of 85 semester hours in the general education and core curriculum requirements for LU and 47 semester hour credits in the nursing major for a total of 132 semester hours. A minimum acceptable cumulative grade point average for graduation is a 3.0 and a D is an unacceptable grade in any course required for the nursing degree. Students must also achieve a grade of a B in a clinical nursing course. Students must earn a 3.0 each semester.
**Professional Opportunities**

Graduates may enter the field of nursing immediately, working in hospitals, clinics, doctor’s offices, nursing homes. They might continue their nursing education by entering a Master of Nursing program and developing a specialty in nursing such as Family Nurse Practitioner, Psychiatric Nurse Practitioner, Nurse Midwife, Adult Nurse Practitioner, Pediatric Nurse Practitioner, Women’s Health specialist, or others.

**Desirable High School Background**

Courses in biology, chemistry, and mathematics are highly desirable but not required.

**Transfer Credit**

Students in the nursing major may transfer no more than 30 credit hours from an accredited college or university. All science courses must be taken at LU.

**Suggested Schedule for First Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Bible 105V</td>
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</tr>
<tr>
<td>Communication 1003</td>
<td>Biology 2424</td>
</tr>
<tr>
<td>Lipscomb Seminar 1103</td>
<td>English 1123</td>
</tr>
<tr>
<td>Psychology 1113</td>
<td>Psychology 2423</td>
</tr>
<tr>
<td>Math 1114</td>
<td>History</td>
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<td>P.E.</td>
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<tr>
<td>Total</td>
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<td>15</td>
<td>16</td>
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</tbody>
</table>

**Requirements for Major**

Nursing Major
- B.S.N. degree program
- Total hours required - 79

Specific courses required -
- Lipscomb courses
  - Biology 2424, 3514, 3524
  - Chemistry 1024, 1034
  - Mathematics 2183 or Psychology 2503
- Nursing 3313, 4211, 4221
- Psychology 2423, 4423
- Vanderbilt courses
  - 3152, 3252, 3354, 3455, 3552, 4161, 4173, 4262, 4272, 4365, 4374, 4464, 4474, 4562

Requirements for a science minor are included.

The major field writing requirement is satisfied by completing Nursing 3455 and Nursing 4173.

**NURSING (NURS)**

3313 Orientation to Nursing (3) F
- This course introduces the beginning nursing student to the professional nursing role as it is unfolding at present in health care systems: hospitals, geriatric care facilities and the community. Current concepts of nursing will be identified. The student will be acquainted with nursing from a historical perspective, national nursing trends, other health care disciplines and health care delivery systems. Nursing research and theory, ethical, cultural and legal issues will also be introduced. The relationship of nursing to Christian service and spiritual health is also explored.

4211 Care of the Elderly Client Practicum (1) F
- This course is designed to provide the student with additional specific knowledge related to health issues facing the older adult including: aging demographics; attitudinal issues, myths, and stereotypes of aging; theories of aging; impact of ethnicity on aging; The focus of the course will be on critical thinking and utilization of the nursing process in care of older adults. The course will consist of 7 hours of classroom and 35 hours of clinical practicum experiences in care of the elderly client. Corequisite: VU course 4464.

4221 Management Practicum (1) SP
- This clinical course is intended to assist students in the integration of theory and practice as they approach the completion of the nursing major. Students will choose a clinical area for advanced clinical experience under faculty guidance. Emphasis will be placed on synthesis of previous and concurrent learning as students simulate the role of an entry level professional nurse. Clinical goals include development of independence in nursing practice, skill in clinical decision making, and application of nursing leadership and management theory. Corequisite VU course 4474.

**Courses Taken At Vanderbilt University (NURS)**

3152 Foundations of Professional Nursing I (2)
- This course is the first of a two course sequence addressing professional nursing. This course introduces the student to professional nursing. Historical beginnings, the organization and structure of the professional identity, and role development are explored. Building on this content, students are introduced to theories and models relevant to nursing. Using critical thinking, students will be introduced to clinical decision-making strategies, theory development and research methods. With guidance, students will analyze and synthesize information from a variety of sources related to professional nursing.

3252 Population-Based Health Care (2)
- This course provides the student with an opportunity to explore population-based health care principles of prevention, health maintenance and health promotion within the context of Healthy People 2010. Notably, the course will focus on how these principles are used to increase healthy lifespan, decrease discrepancies in health status and health outcomes for different populations and assure access to preventive services for all. It emphasizes epidemiologic principles and population based holistic health promotion/disease prevention as an integral part of populations at risk for illness, disability, or premature death. Further, the course explores population-based care models and
environments in which health care is delivered: community agencies, neighborhoods/communities, schools, the family, and the workplace. Legislation and policy implications for primary, secondary, and tertiary care will be discussed. **3354 Human Experience of Health and Illness Across the Lifespan I (4)**

This is the first of three didactic courses examining the human experience of health and illness across the lifespan from infancy through senescence, including the childbearing cycle. The framework incorporates the following concepts and their influence on health and the response to illness: growth and development, gender, lifestyle, value systems, spirituality, ethnic, economic, and cultural issues. The impact of these factors on individuals, families, and aggregates, populations, communities will be explored. Basic concepts/knowledge of selected interventions, i.e. pharmacologic, perioperative, and mental health will be introduced. Selected health problems involving the cardiovascular, respiratory, integumentary, and endocrine systems will be presented; the epidemiology, pathophysiology, medical management (pharmacologic, non-pharmacologic, and surgical), and nursing management will be addressed. Health promotion, prevention, inclusion, primary, secondary, and tertiary, anticipatory guidance, and patient education will be discussed. **3455 Fundamentals of Clinical Practice (5)**

This course is the first of a sequence of three clinical practice courses designed to provide the student with the opportunity to learn and practice the skills of assessment, patient care and care planning in a didactic classroom setting and a simulated laboratory and then in a clinical area for a variety of client populations across the life span (newborn, pediatric, adolescent, adult, older adult, and child-bearing families). A variety of health care settings will be used for practice. At the end of the course, the student, with minimal faculty assistance and guidance, will be able to analyze data, develop a basic plan of care, safely and accurately implement selected basic nursing interventions, and evaluate the plan’s effectiveness. Pre/corequisites: Nursing 3152, Nursing 3252, Nursing 3354. WC.

**4161 Basic Pharmacology (2)**

This course presents an introduction to pharmacologic knowledge, the clinical indications for drug use as a treatment modality, and the role of the nurse in drug therapy. The course focuses on the prototype drug (s) that are more commonly encountered in drug therapy.

**4173 Foundations of Professional Nursing II (3)**

This course is the second of a two course sequence addressing professional nursing. Students will evaluate existing nursing theories and models and apply them to practice. Students will apply appropriate research findings into practice, analyze current developments in nursing, and critique the impact of nursing care on clinical outcomes. Pre/corequisites: Nursing 3152, Nursing 3252, Nursing 3455. Corequisites: Nursing 4365, Nursing 4464.

**4262 Health Care Systems: Micro Issues (2)**

This course addresses health care systems and their related issues. Course content focuses on leadership and decision making theory, teamwork, communication and managerial skills. The course also provides information on contemporary trends in the organization and delivery of health care to individuals, families and populations. This course also provides an introduction to health care ethical, legal and policy issues. Pre/corequisites: Nursing 3152.

**4272 Health Care Systems: Macro Issues (2)**

This course addresses issues that relate to the macro system of health care. The course content provides information on contemporary trends in the organization and delivery of health care to individuals, families and populations. The impact of managed care and financial pressures on health care providers is discussed along with outcome management, informatics, financial management, and economic principles pertinent to the delivery of health care services. Pre/corequisites: Nursing 3252 and Nursing 4262.

**4365 Human Experience of Health and Illness Across the Lifespan II (5)**

This is the second of three didactic courses examining the human experience of health and illness across the lifespan--from infancy through senescence, including the childbearing cycle. The framework incorporates the following concepts and their influence on health and the response to illness: growth and development, mental health, gender, lifestyle, value systems, spirituality, ethnic, environment, and psychosocial, economic, and cultural issues. The impact of these factors on individuals, families, and aggregates will be explored. Selected health problems involving the neurologic (including selected mental health disorders with appropriate treatment modalities and settings), muscular/skeletal, gastrointestinal, sensory (eye, ear, nose), and reproductive (including maternity focus) systems will be presented. The epidemiology, pathophysiology, medical management (nonpharmacologic, and surgical), and nursing management will be addressed. Health promotion, including primary, secondary, and tertiary, anticipatory guidance, and patient education will be discussed. Pre/corequisites: Nursing 3152, Nursing 3354.

**4374 Human Experience of Health and Illness Across the Lifespan III (4)**

This is the third of three didactic courses examining the human experience of health and illness across the lifespan--from infancy through senescence, including the childbearing cycle—with an emphasis on increasingly complex and/or chronic health problems. The course provides the student with the theoretical basis to apply principles of chronic illness, including assessment and intervention skills, to at risk populations. Prerequisite: Nursing 4161, Nursing 4365.

**4464 Integration of Theoretical and Clinical Aspects of Nursing I (4)**

This course is the second of a sequence of three clinical practice courses. It is designed to provide the student with the opportunity to integrate theory and practice the skills of assessment, patient care, and care planning in a clinical area for diverse client populations across the life span (newborn, pediatric, adolescent, adult, older adult, and child-bearing families). A variety of health care settings will be utilized for practice. At the end of the course, the student with moderate faculty assistance and guidance will be able to analyze data, develop a basic plan of care, safely and accurately implement selected nursing interventions, and evaluate the plan’s effectiveness for physiologic and psychosocial health needs. Prerequisites: Nursing 3152, Nursing 3252, Nursing 3354, Nursing 3455, Nursing 3552. Corequisites: Nursing 4161, Nursing 4262, Nursing 4365.

**4474 Integration of Theoretical and Clinical Aspects of Nursing II (4)**

This course is the third of a sequence of three clinical practice courses. It is designed to give the student an opportunity to learn and practice the skills of assessment, patient care, and care planning in a clinical area for diverse client populations across the life span (newborn, pediatric, adolescent, adult, older adult, and child-bearing families). A variety of health care settings will be utilized for practice. At the end of the course, the student with minimal faculty assistance and guidance will be able to analyze data, develop a plan of care, safely and accurately implement selected nursing interventions, and evaluate the plan’s effectiveness for individuals and their families. Prerequisites: Nursing 3152, Nursing 4161, Nursing 4262, Nursing 3354, Nursing 4365, Nursing 4465, Nursing 4464; Corequisites: Nursing 4173, Nursing 4272, Nursing 4374.

**4562 Strategies for Improving Self-Care (2)**

This course builds on the knowledge of the improvement process, motivation and teaching/learning theories. The course addresses the processes necessary to change individual self-care behaviors. The student applies concepts of change, motivation, learning, and continuous improvement, to selected case studies. Pre/corequisites: Nursing 3354, Nursing 3455.
Department of Psychology

Shanna D. Ray, Assistant Professor and Chair
Dale Alden, Assistant Professor
Roy W. Hamley, Professor
Paul Turner, Professor

The goal of the Department of Psychology is to aid the student in understanding self and others better in an appreciation of the origin, nature, and process of individual differences from the psychological viewpoint; in preparing for first-level entry to the job market as a university graduate; in preparing for graduate work in the discipline, and in preparing for greater service in the home, congregation, community, nation, and world. This faculty believes that psychology has practical application in all areas and activities of life.

Your Future in Psychology

Human understanding and service is a great need among people today. Graduates find opportunities in business, governmental and private human service agencies, and teaching. Those with further training find open doors for service in counseling, testing, guidance, industry, community services, and increased opportunities in governmental and private human service agencies. Application of principles relative to human behavior is appropriate to every area of occupational and professional service.

Desirable High School Background

A strong academic background will be valuable. Specific courses that a potential psychology major should take in high school are biology and mathematics, especially algebra.

Suggested Schedule for First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bible 105V</td>
<td>2 Bible 106V</td>
</tr>
<tr>
<td>Psychology 1113</td>
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</tr>
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</tr>
<tr>
<td>P.E.</td>
<td>1 P.E.</td>
</tr>
<tr>
<td>Biology 1003</td>
<td>3 Mathematics 1114</td>
</tr>
<tr>
<td>Art 1813 or Music 1503</td>
<td>3 Psychology 2313</td>
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<tr>
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<td>15</td>
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<td>16</td>
</tr>
</tbody>
</table>

Requirements for Majors

Psychology Major
B.A. or B.S. degree program
Total hours required—45
Specific courses required—
Psychology 1113, 2313, 2603, 2423, 2503, 3413, 3463, 3543, 4423, 4523, 4543, 4613, plus nine hours of electives in Psychology
The major field writing requirement is satisfied by completing Psychology 2603 and 4613 with a grade of "C" or above.

Requirements for Minor

Psychology Minor
Total hours required—18
Specific courses required—
Psychology 1113, 2423, 3413, 3463 plus six additional hours in Psychology

PSYCHOLOGY (PS)

1113  Introduction to Psychology (3) F, SP
   An introductory course covering a variety of topics within the field of psychology such as sensation-perception, consciousness, learning and memory, motivation, emotion, development, attitudes, and others.

2121  Personal Development Workshop (1)
   A group participation course designed to build self-confidence, overcome worry and procrastination, develop better human relations, and promote achievement of goals. Students must have access to a cassette tape player. A fee of $40 for materials necessary to the course is required in addition to tuition charges. Offered on demand.

2313  Behavior Modification (3) F, SP
   A study of the application of behavioral principles (classical and operant conditioning) to applied settings. Prerequisite: Psychology 1113.

2423  Life Span Development (3) F, SP, SU
   A course designed for psychology and social work majors, though open to all students, as a practical survey of human development from conception through death and dying. Prerequisite: Psychology 1113.

2503  Behavioral Statistics (3) F, SP, SU
   The course provides an introduction to descriptive and inferential statistics with applications for the social and behavioral sciences. Special emphasis placed on applying statistical tests to a variety of experimental and quasi-experimental designs. SPSS software skills will also be introduced for data entry, data display, and statistical analysis. Not open to mathematics majors without approval from the Mathematics Department. Non-majors need approval by instructor. Prerequisite: Mathematics 1114 (or 23 ACT or 505 SAT score).

2603  Introduction to Psychological Research (3) F, SP
   An overview of research methods in psychology with a special emphasis on library research. A research paper consistent with the format specified in the Publication Manual of the American Psychological Association is required. Prerequisite: Psychology 1113. WC.

3141  Psychological Research (1) F, SP, SU
   An individual study course in which the psychology major or minor is to read selected books from the university library on a topic
assigned by the instructor. The student will write chapter summaries, after the APA style, of materials read. Credit one time only.

3243 Human Development and Learning (3) F, SP, SU
A study which applies psychological theories to the classroom setting with regard to: 1) physical, social, emotional, and mental development processes of the child from the prenatal state through the adolescent years, and 2) learning theories, individual differences, motivation, cognitive styles, and measurement and evaluation associated with the teaching-learning process. Required observation and assessment experiences are included. Open only to students seeking certification in the teaching profession. Prerequisite: Psychology 1113.

3323 Business and Industrial Psychology (3) F
A study of the characteristics and functions of those in leadership roles which facilitate others and get things done in a variety of organizations: industrial, business, educational, service, and religious. Prerequisite: Psychology 1113. Offered on demand.

3343 Psychology of Leadership (3)
A study of interpersonal human relationships with attention to person perception, attribution, nonverbal communication, altruism, affiliation, attraction, conformity, aggression and attitude formation and change.

3431 Social Psychology (3) F, SP, SU
A survey of the definitions, history, causes, and developmental and treatment processes of abnormal (maladaptive) patterns of human behavior. Prerequisite: Psychology 1113.

3453 Death and Dying (3) F, SP, SU
A study of the psychological aspects of the grief process in facing death and of bereavement in the loss of loved ones by death. Emphasis is upon developing personal, interpersonal, and religious resources to assist in facing one’s own death and for helping others who experience such loss. Prerequisite: Psychology 1113.

3463 Personality Theories (3) F, SP, SU
A study of the characteristics and functions of those in leadership roles which facilitate others and get things done in a variety of organizations: industrial, business, educational, service, and religious. Prerequisite: Psychology 1113. Offered on demand.

3513 Drugs and Behavior (3) F, SP, SU
A study of interpersonal human relationships with attention to person perception, attribution, nonverbal communication, altruism, affiliation, attraction, conformity, aggression and attitude formation and change.

3543 Psychological Measurement (3) F
An introductory study of behavior in organizations, including group behavior, individual adjustments, and special groups in organizations. Emphasis is placed upon techniques for motivating and supervising others and upon personnel selection and training in industry. Various aspects of work and career design are considered. Prerequisite: Psychology 1113.

3543 Psychological Measurement (3) F
A study of the characteristics and functions of those in leadership roles which facilitate others and get things done in a variety of organizations: industrial, business, educational, service, and religious. Prerequisite: Psychology 1113. Offered on demand.

3603 Field Practicum (3)
A course designed to provide the senior major with voluntary apprentice and practicum experience in agencies suited to the student’s goals. One hour of class per week and a minimum of 120 hours of field participation during the semester is required of and limited to psychology majors, unless specifically exempted by the Department Chair. The student should arrange for the practicum in the semester preceding the one in which the course is actually to be taken. Prerequisite: Psychology 1113. Offered on demand.

3613 History and Systems of Psychology (3) F, SP
A survey of the biological basis of behavior. The course surveys neuroanatomy, functioning of the nervous system, endocrine hormones, and other biological and chemical influences upon behavior. Prerequisite: Psychology 1113.

3623 Research Practicum (3)
Psychology research projects to be generated by the instructor with the goal of presentation at psychology meetings and/or publication. Strongly recommended for students interested in Psychology Ph.D. programs. Prerequisite: Psychology 1113. Offered on demand.
The Raymond B. Jones School of Engineering

Fred T. Gilliam, Director of the Raymond B. Jones School of Engineering
and Associate Dean of the College of Natural and Applied Sciences

The mission of the Raymond B. Jones School of Engineering is to prepare its students for engineering careers guided by a Christian understanding of the mission, methods, and structure of their profession and of the world they will serve. Engineers solve problems. They apply science, mathematics, and creativity to invent, design, test, build, and operate engineering systems that will meet the needs of society. In the latter half of the 20th Century, engineers developed the personal computer, the space shuttle, artificial hearts, cellular phones, and many other “high-tech” products. The opportunities to use technology for the benefit of 21st century society will be even greater.

The Raymond B. Jones School of Engineering provides students with an excellent opportunity to prepare for an exciting engineering career in an educational environment that also encourages Christian character and spiritual growth. In creating this opportunity for students, Mr. and Mrs. Raymond Jones have built upon the original goals of Lipscomb University that “such other branches of learning may be added ... as will promote usefulness and good citizenship among men.” In keeping with that goal, graduates of the Raymond B. Jones School of Engineering will be challenged to use their engineering education for the betterment of society, their profession, and their church.

The Raymond B. Jones School of Engineering consists of the following departments: Department of Electrical and Computer Engineering, Department of Engineering Mechanics, and Department of Physics and Engineering. The school offers six majors that lead to a bachelor of science degree from Lipscomb University; those majors are Computer Engineering, Engineering Mechanics, Engineering Science, Engineering Science (Industrial Distribution Option), Physics, and Physics Teaching. In addition, the Pre-Engineering/Dual Degree program leads to a bachelor of science degree from Lipscomb University after the student has made sufficient progress towards an engineering degree at a university offering ABET-accredited engineering programs. Dual-degree programs are available with Auburn University, Tennessee Technological University, the Nuclear Engineering Department at the University of Tennessee, and Vanderbilt University. For arrangements with other engineering schools, please see the Associate Dean of the School of Engineering or the appropriate department chair. In addition to the majors offered by the School of Engineering, the Department of Physics and Engineering also offers minors in Engineering Science and Physics.

The educational programs offered by the Raymond B. Jones School of Engineering are designed to prepare students for a rewarding professional career and to support the mission of Lipscomb University and the mission of the Raymond B. Jones School of Engineering. Each program is monitored by the faculty in order to continually improve the curriculum and the overall preparation of each graduate.

Mission Statement for the Engineering Programs:

The mission of the engineering programs at Lipscomb University is to prepare its students for engineering careers guided by a Christian understanding of the mission, methods, and structure of their profession and of the world they will serve.

Career Opportunities

Employment opportunities for those with training in science and technology are numerous. Careers available to graduates in the majors listed above include:

- Engineers in industry, government, and consulting positions
- Health Physicists and radiation safety consultants
- Research workers in governmental, industrial, and university laboratories
- Teachers in secondary schools, colleges and universities.

Any of the majors listed above provide a solid foundation on which to continue learning. Graduates may elect to pursue master’s and/or doctoral degrees.

Desirable High School Background

A student wishing to pursue one of the majors offered in this department should take as many academic courses as possible. Two years of algebra, as well as geometry and advanced mathematics, should be taken. It especially important for the student to obtain a solid foundation in trigonometry. Courses in chemistry, physics, and keyboarding will be especially helpful. Students expecting to pursue majors in engineering or physics should be sufficiently prepared to begin the calculus sequence in their first semester.

Introductory Courses

Introduction to Engineering and Fundamentals of Engineering Design constitute the freshman sequence for all engineering students. For details about specific engineering curricula, please see the department chair.

Elementary College Physics I, II is the non-calculus sequence designed for students in the life sciences who do not intend to pursue a career in a highly technical area. General Physics I and II is the calculus-based sequence designed for students with majors in engineering, physics, and professional chemistry. Pre-medical students may choose either of these sequences; however, some medical schools require the calculus-based sequence.

Fundamentals of Astronomy and Fundamentals of Physics are one-semester courses for students not pursuing a major in one of the sciences. Fundamentals of Astronomy provides a descriptive introduction to astronomy. Fundamentals of Physics is a brief overview of most of the areas in physics.
**Suggested Schedule for First Year**

**ENGINEERING MAJORS AND PRE-ENGINEERING PROGRAMS**

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<th>Spring</th>
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<td>Bible 105V</td>
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<tr>
<td>Chemistry 1113, 1211</td>
<td>English 1123</td>
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<tr>
<td>Lipscomb Seminar 1103</td>
<td>Engineering 1123</td>
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<td>Math 2314</td>
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<td>Math 1314</td>
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<td>Comp. &amp; Info. Sys. 1021*</td>
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**PHYSICS**

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<td>Bible 105V</td>
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<tr>
<td>Chemistry 1113, 1211</td>
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<td>Lipscomb Seminar 1103</td>
<td>English 1123</td>
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<td>Comp. &amp; Info. Sys. 1021*,1041</td>
<td>Mathematics 2314</td>
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* It is recommended that students in the Raymond B. Jones School of Engineering satisfy this requirement through the challenge by examination process.
The Department of Electrical and Computer Engineering is responsible for the curriculum leading to a Bachelor of Science degree with a major in Computer Engineering. This curriculum is designed to equip its graduates with the knowledge and skills necessary to entry-level computer engineering jobs in industry or to the pursuit of a graduate degree in computer engineering. Specifically, it provides a knowledge of current computer technology, the design techniques and tools pertinent to it, and a solid grounding in the mathematics and science that underlie both the current and the future technology in this field. A knowledge of current technology is required to make our graduates valuable from their first day of employment. A knowledge of the basics is required for the lifelong learning necessary to career-long professional growth in a world of rapidly advancing technological complexity. We continually strive to integrate and balance these two areas.

Lipscomb's engineering program graduates have a long and distinguished record of acceptance by industry and graduate schools. On the basis of this record and of the rapid growth of the computer industry, graduates of Lipscomb's computer engineering majors have every reason for optimism regarding their professional prospects.

Educational Objectives

The educational objectives of the Computer Engineering program at Lipscomb University are to produce graduates who will be successful in:

1. Contributing to the engineering profession as:
   • Engineers employed in industry, government, education or consulting positions;
   • Entrepreneurs in engineering markets;
   • Graduate students pursuing advanced degrees in engineering or related fields;

2. Contributing to community and society as:
   • Individuals who interact with their employers, coworkers, and neighbors in a respectful, moral and ethical manner;
   • Participants in service activities through their profession, community organizations, and church.

Requirements for Majors

Program Requirements: Major in Computer Engineering
B.S. degree program only
Total hours required - 136

I. General Education Requirements — 42 hours
See page 26 for university requirements
Specific courses required within Computer Engineering
Daily Bible: Bible 421V
Humanities: Philosophy 3433
Social Science: Economics 2503
History 1123 is recommended for history requirement
Mathematics and physical science satisfied by major/minor

II. Courses for Major — 94 hours
Computing and Information Systems 1041*, 1514*, 2113, 3513, 4213
Electrical and Computer Engineering 2214, 2223, 3013, 3233, 3243, 3331, 3813, 4254, 4823
Engineering 1114, 1123, 4942, 4953, 4991
Mathematics 1314, 2103, 2314, 2324, 3133
Physics 2414, 2424, 2434

Technical elective: 6 hours chosen with the approval of the EECE Department chair from CS 3353, CS 3513, CS 3703, CS 3803, CS 450V, EECE 3403, EECE 4513, EECE 4263, EECE 3939, or ENGR 3513.

The minor requirement in Pure Mathematics is automatically satisfied.
Mathematics 1314, Calculus I, MUST be taken during the fall semester of the freshman year in order to enroll in Physics 2414 in the spring semester. Otherwise, completion of the program may require more than eight semesters. Students who are not eligible to begin the calculus sequence should consider enrolling in Mathematics 1123 in the summer session.

The major field writing requirement is satisfied by completing Engineering 4942 and Engineering 4953 with a grade of "C" or above.

*See catalog descriptions for prerequisites

ELECTRICAL AND COMPUTER ENGINEERING (EECE)

2013
Survey of Electrical Engineering (3) F
Electric circuit analysis; analog and digital semiconductor circuits; digital systems; instrumentation; electromechanics. Corequisite: Physics 2424. Lecture, 3 hours.

2214
Electric Circuits and Signals I (4) F
Phasor analysis, single phase and balanced three-phase power distribution systems. Operational amplifiers. Filters. Fourier transform. Hands-on experience with circuit performance measurement and numerical methods. Corequisite: Physics 2424. Lecture, 3 hours; Laboratory/Recitation, 3 hours.

2223
Electric Circuits and Signals II (3) SP
3013 Random Analysis for Electrical Engineers (3) F
Fundamentals of probability, random processes, response of linear systems to random processes, optimum systems and filters. Prerequisite: Electrical and Computer Engineering 2223. Lecture 3 hours.

3233 Semiconductor Electronics I (3) F

3243 Semiconductor Electronics II (3) SP

3331 Semiconductor Electronics Laboratory (1) SP
Projects requiring the design and fabrication of semiconductor electronic circuits to meet a specification, and the design and performance of compliance tests. Appropriate documentation of each step is stressed. Corequisite: Electrical and Computer Engineering 3233. Laboratory, 3 hours.

3403 Electromagnetic Fields (3) SP*
A study of electromagnetic fields beginning with Maxwell’s equations. Interactions with conductors and dielectric media; waveguides, antennae. Prerequisite: Physics 2424. Lecture, 3 hours. Offered even years. Same as Physics 3403.

3813 Digital Computer Design I (3) SP
An introduction to the digital hardware design process and CAD tools, particularly VHDL. Review of Boolean algebra and basic logic functions. Logic gate implementation, MOS transistors, gate topology. Optimized logic function implementation is developed using the Karnaugh map, SOP & POS minimization, multilevel synthesis, and functional decomposition. Design of major functional logic blocks, e.g., addition and subtraction units, fast adders, array multipliers, multiplexers, encoders/decoders. Design of sequential logic blocks with storage elements (latches, flip-flops, registers) and then sequential circuits (counters, state machines), Mealy/Moore finite state machines, state assignment/state reduction, excitation, and output generation. Corequisite: Electrical and Computer Engineering 3233. Lecture, 2 hours; Laboratory/recitation, 3 hours.

395V Topics in Electrical and Computer Engineering (1, 2, 3, 4, or 5)
Topics from electrical/computer engineering in either lecture- or laboratory oriented format, depending on the specific topics selected. Course may be repeated for credit. Prerequisite: consent of instructor. Offered on demand.

4254 Microprocessors (4) F
The application of microprocessors, including architecture, hardware considerations, and programming methods. Laboratory design, build, and test assignments involving microprocessors in common current use. Prerequisites: Computing and Information Systems 3513, Electrical and Computer Engineering 3233. Lecture, 3 hours; laboratory 3 hours.

4263 Embedded Systems (3) SP
Special purpose computing system design is considered using a combination of microprocessors (software) and custom digital logic (hardware). Design trade-offs focus on the selection and use of software versus hardware processors for optimized performance. Includes hardware interfacing, bus protocols, peripheral systems, digital control systems, real-time constraints, and networking. Design considerations include cost, performance, power, flexibility, and maintainability. Prerequisites: Electrical and Computer Engineering 4254 and Electrical and Computer Engineering 4823 with minimum grades of “C.” Lecture, 2 hours; Laboratory/recitation, 3 hours.

4513 Digital Signal Processing I (3) SP
Introduction to digital signal processing. Topics will include Sampling Theorem, z-Transform, discrete-time Fourier transform, power spectrum, discrete Fourier transform, the FFT algorithm, and digital filter design. Prerequisites: Electrical and Computer Engineering 2223 and Mathematics 2103 with minimum grades of “C.” Lecture, 2 hours; Laboratory, 3 hours.

4823 Digital Computer Design II (3) F
Provides a more in-depth look into the digital hardware design process. Advanced modules such as programmable logic arrays and programmable read only memory will be discussed. Design methods covering topics such as stimulation, modeling, and synthesis will be covered. Verification, testing, and economics issues will be taught as well. Datapath and controller circuits will be analyzed and designed. The course will culminate in a semester end design project simulation using VHDL. Prerequisite: Electrical and Computer Engineering 3813 with a minimum grade of “C.” Lecture, 2 hours; Laboratory/recitation, 3 hours.
The Department of Engineering Mechanics is responsible for the curriculum leading to the Bachelor of Science degree with a major in Engineering Mechanics. Engineering Mechanics is one of the oldest branches of the engineering profession. Mechanical engineering, aerospace engineering, and structural engineering all have their basis in Engineering Mechanics. Lipscomb's Engineering Mechanics curriculum takes the fundamental aspects of these three engineering fields and combines them into a single unified discipline. Because of this, the student who graduates with a degree in Engineering Mechanics is equally well prepared for graduate study, as well as a wide range of engineering careers.

Engineering Mechanics is divided into two major subdivisions; Solid Mechanics and Fluid Mechanics. During the first two years, the student is given a broad education in engineering topics along with the basic mathematics and science that underlies them. Starting the junior year, the curriculum includes more intense engineering analysis courses with an emphasis on the relationship between analytical techniques and the engineering design process. Also during the junior year, the student will choose to concentrate in either fluid mechanics or solid mechanics. Finally, during the senior year the student is allowed to fully explore the "art" of engineering design through the Senior Design experience. The Senior Design experience involves students in interdisciplinary teams that are given the task of designing and producing a product that will meet a set of pre-defined requirements.

Educational Objectives

The educational objectives of the Engineering Mechanics program at Lipscomb University are to produce graduates who will be successful in:

1. Contributing to the engineering profession as:
   - Engineers employed in industry, government, education or consulting positions;
   - Entrepreneurs in engineering markets;
   - Graduate students pursuing advanced degrees in engineering or related fields:

2. Contributing to community and society as:
   - Individuals who interact with their employers, coworkers, and neighbors in a respectful, moral and ethical manner;
   - Participants in service activities through their profession, community organizations, and church.

Requirements for Majors

Program Requirements: Major in Engineering Mechanics
B.S. degree program only
Total hours required - 136

I. General Education Requirements — 42 hours
See page 26 for university requirements
Specific courses required within Engineering Mechanics
Daily Bible: Bible 421V
Humanities: Philosophy 3433
Social Science: Economics 2503
History 1123 is recommended for history requirement
Mathematics and physical science satisfied by major/minor

II. Courses for Major — 94 hours
Chemistry 1113, 1211
Computing and Information Systems 1041, 1514
Electrical and Computer Engineering 2214
Engineering 1114, 1123, 3303, 4942, 4953, 4991
Engineering Mechanics 2113, 2123, 2211, 3113, 3211, 3313, 3613, 3703, 3803, 3831, 4303, 4812
Mathematics 1314, 2314, 2324, 3133
Physics 2414, 2424
Technical electives 6 hours
One concentration selected from:
Fluid Mechanics Concentration
Specific courses required:
Engineering 3513
Engineering Mechanics 4613
Solid Mechanics Concentration
Specific course required:
Engineering Mechanics 4123
Engineering Mechanics 3413 or 4223
The minor requirement in Applied Mathematics is automatically satisfied.
Mathematics 1314, Calculus I, MUST be taken during the fall semester of the freshman year in order to enroll in Physics 2414 in the spring semester. Otherwise, completion of the program may require more than eight semesters. Students who are not eligible to begin the calculus sequence should consider enrolling in Mathematics 1123 in the summer session.
The major field writing requirement is satisfied by completing Engineering 4942 and Engineering 4953 with a grade of "C" or above.
ENGINEERING MECHANICS (EMCH)

2113  Statics (3) F  
Studies in the principles of statics, force systems and equilibrium analysis of structures, friction, centroids and center of gravity, and moments of inertia. Prerequisite: Physics 2414. Lecture, 3 hours.

2123  Dynamics (3) SP  
Studies in the principles of dynamics, rectilinear translation, curvilinear translation, rotation, plane motion, work and energy, and impulse and momentum. Prerequisite: Engineering Mechanics 2113. Lecture, 3 hours.

2211  Experimental Methods in Engineering Mechanics (1) SP  
Principles of experimental methods and procedures; measurement techniques for basic mechanical properties; Introduction to instrumentation characteristics and selection; along with proper documentation of experimental results. Prerequisites: Engineering Mechanics 2113, Engineering 1123. Lecture/Laboratory, 3 hours.

3113  Strength of Materials (3) SP  
Studies in the principles of stress, strain, torque, bending moment, Hooke’s law, torsion, shear and moment diagrams, beam theory, columns, and shafts. Prerequisite: Engineering Mechanics 2113. Lecture, 3 hours.

3211  Solid Mechanics and Materials Laboratory (1) F  
A series of experiments which demonstrate the theory of mechanics of materials and the most important characteristics of engineering materials. Corequisite: Engineering Mechanics 3113. Laboratory 3 hours.

3313  Mechanical Vibrations (3) SP  
Theory of vibrations; free and forced, damped and undamped vibrations, one and two degree of freedom systems, and computer-aided simulations. Introduction to continuous systems. Prerequisites: Engineering Mechanics 2113, Mathematics 3133, and Computing and Information Systems 1514 with a minimum grade of “C.” Lecture 3 hours.

3413  Dynamics of Machinery (3) F  
Kinematic analysis of plane mechanism linkages, analysis and synthesis of cam-follower mechanisms, and gears trains. An introduction to the synthesis of planar mechanisms-linkages and static and dynamic force and torque analysis of plane mechanisms with balancing using the computer. Prerequisites: Engineering Mechanics 2123, Mathematics 2324. Lecture, 3 hours.

3613  Fluid Mechanics (3) F  
Fundamentals of fluid flow; fluid statics, systems and control volumes; continuity, momentum, and energy equations; dynamic similarity; flow in pipes and channels; flow measurements. Prerequisites: Engineering Mechanics 2123. Lecture, 3 hours.

3703  Thermodynamics (3) F  
Concepts, models and laws; energy and the first law; properties and state; energy analysis of thermodynamics systems; entropy and the second law; conventional power and refrigeration cycles. Prerequisites: Chemistry 1113, Mathematics 2324, Physics 2424. Corequisite: Engineering Mechanics 3613. Lecture, 3 hours. Same as Physics 3703.

3803  Heat Transfer (3) SP  
Single and multidimensional steady-state and transient heat conduction; role of convection for internal and external forced flows and in buoyancy-driven flow; thermal radiation processes and properties. Prerequisites: Engineering Mechanics 3613, 3703, Mathematics 3133, and Computing and Information Systems 1514 with a minimum grade of “C.” Lecture, 3 hours.

3831  Fluid Mechanics and Thermal Science Laboratory (1) SP  
A series of experiments which demonstrate the principles of fluid mechanics, thermodynamics, and heat transfer. Particular emphasis is placed on energy transfer in fluids. Prerequisites: Engineering Mechanics 3613, 3703. Corequisite: Engineering Mechanics 3803. Laboratory 3 hours.

395V  Topics in Engineering Mechanics (1,2,3,4, or 5)  
Topics from engineering mechanics in either lecture- or laboratory-oriented format, depending on the specific topic selected. Course may be repeated for credit. Prerequisite: consent of instructor. Offered on demand.

4123  Advanced Mechanics of Materials (3) SP  
Advanced topics; fracture mechanics, fatigue and life prediction, elastic support, non-circular shafts, curved beams, thick-walled cylinders, introduction to plates, thin shells of revolution. Prerequisites: Engineering Mechanics 3113, Mathematics 3133, or consent of instructor. Lecture, 3 hours.

4223  Structural Design (3) SP  
Design of members and structures using engineering materials. Analysis and design of beams, tension members, compression members, members with combined stresses, and standard connections. Primary emphasis will be on designing with steel and aluminum. Prerequisites: Engineering Mechanics 3113, 3211. Lecture, 2 hours; laboratory/recitation 3 hours.

4303  Computational Methods in Mechanics (3) F  
Matrix formulations using flexibility and stiffness methods for structural analysis of skeletal structures. Application of finite element method in solid mechanics continuum; isoparametric formulation; plane stress, plain strain, axisymmetric, and solid elements and their applications; modeling considerations and error analysis. Prerequisites: Engineering 3303, Engineering Mechanics 3113, 3613, and Computing and Information Systems 1514 with a minimum grade of ‘C’ Lecture, 3 hours.

4613  Advanced Fluid Mechanics (3) SP  
Fundamental principles and equations; control volumes, continuity, compressible flow, thin airfoil theory; finite wings; wings in compressible flow; aerodynamic drag. Prerequisites: Engineering Mechanics 3613, 3831. Lecture, 3 hours.

4731  Measurement Laboratory (1) F  
Principles of measurement and calibration; measurement techniques for basic electrical and mechanical properties; basic instrumentation. Prerequisites: Electrical and Computer Engineering 2214, Engineering Mechanics 3613, 3803. Laboratory, 3 hours.

4812  Engineering Mechanics Design (2) F  
An exposition of the theory and practice of engineering design regarding specific aspects of design in relation to Engineering Mechanics. A major portion of this course is also devoted to advanced topics in Computer Aided Design and Analysis, culminating in the initiation of the interdisciplinary design project to be completed in the following semester. Prerequisite: Approval by Department Chair; Corequisite: ENGR 4942, Lecture/lab: 3 hours, Credit 2 hours.
Department of Physics and Engineering

W. Ralph Butler, Professor and Chair
L. Alan Bradshaw, Associate Professor
Dennis W. Hood, Professor

The influence of science and technology touches almost everyone every day in every part of the world. The Department of Physics and Engineering is dedicated to providing a variety of engineering and physics curricula for students who are interested in pursuing scientific and technical professions.

The specific curricula available in the Department of Physics and Engineering are the major programs in Engineering Science, Engineering Science (Industrial Distribution Option), Physics, and Physics Teaching, and the minor programs in Engineering Science and Physics. See pages 161-162 for suggested first-year schedules and descriptions of introductory courses.

Requirements for Majors

Program Requirements: Major in Engineering Science
B.S. degree program only
Total hours required—132

I. General Education Requirements — 42 hours
   See page 26 for university requirements
   Specific courses required within Engineering Science
   Daily Bible: Bible 421V
   Humanities: Philosophy 3433
   Social Science: Economics 2503
   History 1123 is recommended for history requirement
   Mathematics and physical science satisfied by major/minor

II. Courses for Major — 86 or 88 hours
   Chemistry 1113, 1123, 1211, 1221
   Computing and Information Systems 1021, 1514 or 2212, 3413
   Electrical and Computer Engineering 2214, 2223, 3403
   Engineering 1114, 1123, 3303, 4953, 4991
   Engineering Mechanics 2113, 2123, 2113
   Management 3503
   Mathematics 1314, 2314, 2324, 3212, 3603 or 3703, 4111 or 4121
   Physics 2414, 2424, 2434, 3212, 3603 or 3703, 4111 or 4121

III. General Electives — 2 or 4 hours
   The minor requirement in Applied Mathematics is automatically satisfied.
   Mathematics 1314, Calculus I, MUST be taken during the fall semester of the freshman year in order to enroll in Physics 2414 in the spring semester. Otherwise, completion of the program may require more than eight semesters. Students who are not eligible to begin the calculus sequence should consider enrolling in Mathematics 1123 in the summer session.

   The major field writing requirement is satisfied by completing Physics 2434 and Engineering 4953 with a grade of “C” or above.

Program Requirements: Major in Engineering Science (Industrial Distribution Option)
B.S. degree program only
Total hours required—132

I. General Education Requirements — 42 hours
   See page 26 for university requirements
   Specific courses required within Engineering Science
   Daily Bible: Bible 421V
   Humanities: Philosophy 3433
   Social Science: Economics 2503
   History 1123 is recommended for history requirement
   Mathematics and physical science satisfied by major/minor

II. Courses for Major — 84 hours
   Accounting 2503, 2513
   Chemistry 1113, 1211
   Computing and Information Systems 1021, 1041
   Electrical and Computer Engineering 2214, 2223
   Engineering 1114, 1123, 4953, 4991
   Engineering Mechanics 2113, 2123, 3113
   Management 2453, 3363, 3503, 3613, 3623
   Marketing 3503, 3543
   Mathematics 1314, 2314
   Physics 2414, 2424, 3212
   Six hours of selected from:
   Business Administration 3703
   Chemistry 1123, 1211
   Computing and Information Systems 1514 or 2212, 2313
   Mathematics 2324, 3123
   Physics 2434

III. General Electives — 6 hours
   Mathematics 1314, Calculus I, MUST be taken during the fall semester of the freshman year in order to enroll in Physics 2414 in the spring semester. Otherwise, completion of the program may require more than eight semesters. Students who are not eligible to begin the calculus sequence should consider enrolling in Mathematics 1123 in the summer session.

   The major field writing requirement is satisfied by completing Engineering 4953, and Business Administration 3343 or Physics 2434 with a grade of “C” or above.
Physics Major
B.A. or B.S. degree program
Total hours required—67
Specific courses required—
   Chemistry 1113, 1123, 1211, 1221
   Computing and Information Systems 2212
   Electrical and Computer Engineering 2214
   Engineering 3303
   Mathematics 1314, 2314, 2324, 3133
   Physics 2414, 2424, 2434, 3212, 3303, 3403, 3603, 3703, 4111, 4121, 4313, 4323, 4991
The minor requirement in Applied Mathematics is automatically satisfied.
Mathematics 1314, Calculus I, MUST be taken during the fall semester of the freshman year in order to enroll in Physics 2414 in the spring semester. Otherwise, completion of the program may require more than eight semesters. Students who are not eligible to begin the calculus sequence should consider enrolling in Mathematics 1123 in the summer session.
The major field writing requirement is satisfied by completing Physics 2434 and 4991 with a grade of “C” or above.

Physics Teaching Major (General Science—Physics)
B.A. or B.S. degree program
I. General Education Required of Secondary and K-12 Teacher Education Students* (see page 114)
II. Professional Education (see page 115)
   A. Core Professional Education
   B. Specialized Professional Education
      Physics 3051
III. Subject Matter Specialization
   Biology 1003**, 3712, and one course selected from: Biology 2213 or 2424
   Chemistry 1113, 1123, 1211, 1221
   Electrical and Computer Engineering 2214
   Mathematics 1114 (or proficiency), 1123 (or proficiency), 1314 (required), 2314 (required)
   Physics 2414, 2424, 2434, 4111 and six hours selected from Physics 3212, 3303, 3403, 3603, 3703
*Note: Omit Chemistry 1013 and Physics 1013. Biology 1003 is included in specialization subject matter.
**Biology 1114, 1124, 2114 may be substituted for Biology 1003.
Students completing this major must satisfy the major field writing requirements for both the Department of Physics and Engineering Science and the Department of Education. In Physics, the writing requirement is satisfied by completing Physics 2434 with a grade of “C” or above. In Education, the writing requirement is satisfied by completing the following courses with a grade of “C” or above: Education 3332 and 3354.

Pre-engineering/Dual Degree Program
B.S. degree program only (this major is designed to prepare students to enter upper-division engineering programs at an accredited school of engineering; for specific curricula, see department chair).
Lipscomb hours required for major — 64 or 66
Specific courses required —
   Chemistry 1113, 1123, 1211, 1221
   Computing and Information Systems 1021, 1041
   Computing and Information Systems 1514 or 2212
   Economics 2503
   Engineering 1114, 1123
   Engineering Mechanics 2113
   Mathematics 1314, 2314, 2324, 3133
   Physics 2414, 2424, 2434
   Mathematics 1314, 2314, 2324, 3133
Twelve additional hours of electives, appropriate to the anticipated field of engineering, selected from:
   Chemistry 2113, 2123, 2211, 2212, 3114, 3124
   Computing and Information Systems 3513, 4213
   Electrical and Computer Engineering 2214, 2223
   Engineering 3303
   Engineering Mechanics 2123, 3113
   Mathematics 3123
   Physics 3212, 3303, 3403, 3703
Additional requirements
   At least 90 semester hours must be completed at Lipscomb
   Satisfactory progress toward a baccalaureate degree in engineering, accredited by ABET/EAC, with at least 30 hours completed toward that degree at the engineering school.
The combined total of recorded earned credit at Lipscomb and the engineering school must be at least 132 semester hours. The major field writing requirement is satisfied by completing Physics 2434 with a grade of “C” or above, in accordance with guidelines for writing credit for the pre-engineering program.

Requirements for Minors

Engineering Science Minor
Total hours required—18
Specific courses required—None
Eighteen hours chosen from departmental offerings in Electrical and Computer Engineering, Engineering, or Engineering Mechanics with approval of the Department Chair.

Physics Minor
Total hours required—18
Specific courses required—None
Eighteen hours chosen from departmental offerings in Physics with approval of the Department Chair including at least 6 hours in Physics courses numbered above 3000
ENGINEERING (ENGR)

1114 Introduction to Engineering (4) F
The engineering profession: fields, functions, and branches of engineering; professional registration; professional ethics; education- 
al requirements, including undergraduate, graduate study, and life-long learning. The design process, problem solving procedures; solution presentation, including sketching and CAD; a design problem, the curriculum, career opportunities. Corequisite: Mathematics 1123. Lecture, 3 hours; laboratory 3 hours.

1123 Fundamentals of Engineering Design (3) SP
Fundamentals of engineering mechanics and of computer engineering are presented, and designs involving both are carried out by student teams, starting with performance specification formulated by the instructor, and culminating in a set of fabrication drawings and specifications prepared by student teams. Prerequisite: Engineering 1114. Lecture, 2 hours; laboratory, 3 hours.

3303 Applied Mathematics (3) F
Partial differential equations, vector calculus, Fourier analysis, orthogonal functions, elementary matrices, applications of complex variables, Cauchy theorem, residues, and infinite series. Prerequisites: Mathematics 3133. Lecture, 3 hours.

3513 Introduction to Control Systems (3) SP
A course intended to equip the student with a basic understanding of project management techniques, including work breakdown structures, scheduling, and resource management. It will also incorporate topics related to environment, reliability, and safety. As part of this course, the students will develop the proposal and concept for the project to be completed during Interdisciplinary Design Project. Corequisite Engineering Mechanics 4812 or Electrical and Computer Engineering 4823; lecture/lab/recitation; 3 hrs, Credit 2. WC.

3953 Interdisciplinary Design Project (3) SP
A major, realistic design experience based on the knowledge and skills acquired in prior and concurrent course work, and requiring teamwork involving more than one discipline. The project begins with a performance specification formulated by the instructor. The student team must carry out the design, generate professional design documentation, including fabrication and test drawings and specifications, and produce and test a prototype product. Prerequisite: Engineering 4942 or consent of instructor. Laboratory, 9 hours. WC.

3991 Engineering Seminar (1) F
A course intended to provide students with a broader view of the engineering profession in the context of society. This is an inter- 
disciplinary course in which a variety of topics will be presented and discussed. Topics will include contemporary issues in engineering, ethics, social and professional responsibilities, life-long learning and selected technical topics. Corequisite: Engineering 4942 or consent of instructor. Seminar, 2 hours.

PHYSICS (PH)

1003 Fundamentals of Astronomy (3) F, SP
A course intended to acquaint education majors with techniques, demonstration equipment, and audio-visual aids for use in teaching physics. Designed to acquaint education majors with techniques, demonstration equipment, and audio-visual aids for use in teaching physics. Descriptive astronomy. The solar system, stars, galaxies. Prerequisite: At least 15 ACT or 360 SAT mathematics score or Mathematics 1020 with minimum grade of "C." Lecture, 2 hours; laboratory, 3 hours.

1013 Fundamentals of Physics (3) F, SP, SU
A calculus based introduction to physics, mechanics, fluids, heat and thermodynamics, electricity and magnetism, wave motion, sound, light, and atomic and nuclear physics. Prerequisite: Mathematics 1020 with minimum grade of "C." Lecture, 2 hours; laboratory, 3 hours.

111V Special Topics in Physics (1-3)
This course will concentrate on one or more topics from the field of physics. The topics will depend upon current interests of stu- 
dents and staff. While the presentation will be at an elementary level, an attempt will be made to cover the topic in depth and to establish connections to other branches of science and human affairs. Offered on demand.

1214, 1224 Elementary College Physics I, II (4, 4) 1214-F; 1224-SP, SU
A calculus based introduction to physics. Mechanics, heat, electricity, atomic and nuclear physics. Lecture, 2 hours; laboratory, 3 hours. Prerequisite: At least 15 ACT or 360 SAT mathematics score or Mathematics 1020 with minimum grade of "C." Lecture, 2 hours; laboratory, 3 hours.

2414 General Physics I (4) SP
A calculus based introduction to general physics and its applications. Mechanics, heat, and sound. Prerequisite: Mathematics 1314. Lecture, 3 hours; laboratory, 3 hours.

2424 General Physics II (4) F
A calculus based introduction to physics and its applications. Electricity and magnetism, optics, modern physics. Prerequisites: Mathematics 2314 and Physics 2414. Lecture, 3 hours; laboratory, 3 hours.

2434 Structure of Matter (4) SP
Topics related to the modern physical theory of matter: experiment and theory related to quantum phenomena, relativity, and atomic and nuclear structure. Emphasis on condensed matter and material science appropriate for engineering curricula. Prerequisite: Physics 2424. Lecture, 3 hours; laboratory, 3 hours. WC.

3051 Teaching Resource Seminar (1)
Designed to acquaint education majors with techniques, demonstration equipment, and audio-visual aids for use in teaching physics. Designed to acquaint education majors with techniques, demonstration equipment, and audio-visual aids for use in teaching physics. To be taken during Professional Semester. Offered on demand.

3212 Electronics (2) SP
Introduction to the analysis and design of linear and digital solid state electrical devices. Transistors, gates, logic circuits, integrated circuits, operational amplifiers, feedback. Prerequisite: Electrical and Computer Engineering 2214. Lecture, 2 hours; laboratory, 3 hours. Offered on demand.
3303 Mechanics (3) F
An introduction to classical mechanics with the use of vector calculus. Particle kinematics and dynamics, free and forced harmonic motion, conservative and central forces, angular momentum, introduction to the Lagrange and Hamilton formulations. Prerequisite: Physics 2424. Corequisite: Mathematics 3133. Lecture, 3 hours.

3403 Electromagnetic Fields (3) SP*
A study of electromagnetic fields beginning with Maxwell’s equations. Interactions with conductors and dielectric media; waveguides, antennas. Prerequisite: Physics 2424. Lecture, 3 hours. Offered even years. Same as Electrical and Computer Engineering 3403.

3603 Optics (3) F*

3703 Thermodynamics (3) F
Concepts, models and laws; energy and the first law; properties and state; energy analysis of thermodynamics systems; entropy and the second law; conventional power and refrigeration cycles. Prerequisites: Chemistry 1113; Mathematics 2324, Physics 2424. Lecture, 3 hours. Same as Engineering Mechanics 3703.

4111, 4121 Advanced Lab I, II (1, 1) F, SP
Significant experiments chosen from electricity and magnetism, optics, atomic and nuclear physics. Attention is given to laboratory techniques and data analysis. Prerequisite: 6 hours of upper division physics. Laboratory, 3 hours.

4313 Quantum Theory (3) F
Introduction to quantum physics of particles at the atomic and nuclear level. The Schroedinger equation, the uncertainty principle, angular momentum and spin. Prerequisite: Physics 2434, Mathematics 2324. Lecture, 3 hours.

4323 Atomic and Nuclear Structure (3) SP
Quantum theory applied to molecules, the hydrogen atom, many-electron atoms, and nuclei. Nuclear models and structure, nuclear decay, nuclear reactions, and the Standard Model of electromagnetic and nuclear interactions. Prerequisite: Physics 4313. Lecture, 3 hours.

491V Independent Study (1, 2, 3)
Independent study or research by the student on a problem of special interest. Prerequisite: Consent of instructor. Offered on demand.

4991 Senior Seminar (1) SP
Required of all senior majors in the department. Overview of major field. Special project or research paper. Two hours each week.

WC.