The Raymond B. Jones College of Engineering

Justin Myrick, Dean
A. Fort Gwinn, Jr., Associate Dean

Engineers solve problems. They apply science, mathematics and creativity to invent, design, test, build, deliver, operate, and maintain engineering systems that 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 College 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 College of Engineering will be challenged to use their engineering education for the betterment of society, their profession and their faith community.

The Raymond B. Jones College of Engineering consists of the following academic departments: Department of Civil and Environmental Engineering, Department of Electrical and Computer Engineering and Department of Mechanical Engineering and the M.S. program in Engineering Management (see Graduate Catalog). The College offers three majors that lead to a Bachelor of Science degree from Lipscomb University. All three undergraduate engineering degrees, including mechanical engineering, electrical and computer engineering, and civil engineering, are accredited by the Engineering Accreditation Commission (EAC) of ABET, http://www.abet.org.

Off-site learning experiences (i.e. CO-OP and internship) are required in many courses of study at Lipscomb and strongly recommended in others. Students should be aware that many experiential sites require satisfactory documentation of personal identification in the form of driver’s licenses, social security cards, passports, drug screening and background checks. Students should make sure that they are aware of and can meet all documentation requirements well in advance of the timeframe for admission into the respective program and placement into these sites.

Fundamentals of Engineering Exam Requirement
Licensure is an important part of the engineering profession; therefore all undergraduate students planning to graduate from an engineering program within the Raymond B. Jones College of Engineering are required to show proof of having taken the Fundamentals of Engineering Exam in their chosen discipline prior to receiving a degree.

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M.S. in Engineering Management .............................. see Graduate Catalog
The Raymond B. Jones
College of Engineering

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.

Engineering Courses

Courses bearing the ENGR prefix are courses designed for multiple engineering majors, although they may be required within certain majors. These courses may be taught by faculty members from any department in the Raymond B. Jones College of Engineering, and certain courses may be taught by faculty members in other colleges.

Course Descriptions

Engineering (ENGR)

0110 Professional Development and Networking (0) F, SP
This course provides opportunities for students to participate in professional societies and off-campus professional development as well as networking opportunities. All full-time engineering students in the Raymond B. Jones College of Engineering are required to be enrolled in ENGR 0110 every semester. Lecture/lab, 1 hour.

1113 Introduction to Engineering (3) F
An introduction to the profession and practice of engineering. The lecture portion presents the history, role, disciplines and functions of engineering ethics and life-long learning. A series of studio/laboratory experiences exposes students to the three major disciplines in engineering—Civil, Electric/Computer, and Mechanical—combining elements of active learning, laboratory experience and lecture. Corequisite: Mathematics 1123. Combined lecture, 1 hour; Studio/Laboratory two 2-hour labs.

3122 Appropriate Technology in Engineering Missions (2) SP
The purpose of this course is to prepare students biblically, culturally and with engineering skills to effectively use appropriate technologies to serve those in developing countries in a Christian mission situation and to develop in each student the vision for living a missional lifestyle as Christian engineers. The student commits to being involved in at least one engineering mission trip. Prerequisites: Physics 1013, 1224 or 2424 and Chemistry 1013, 1113 or 1144. Lecture, 3 hours. This course may satisfy the SALT Tier II requirement.

3303 Applied Mathematics (3) F
Partial differential equations; line integrals; Green's, Stoke's and Divergence theorems; Fourier analysis; elementary matrices; applications of matrices; and some complex variables. Prerequisites: Mathematics 3133. Lecture, 3 hours.

3513 Introduction to Control Systems (3) F
Classical feedback control systems for continuous time systems. Block diagrams and performance and stability criteria. Root locus, frequency methods and state space approach. Prerequisites: Electrical and Computer Engineering 2013 or 2214; Mechanical Engineering 2013 or 2123; Mathematics 3133. Lecture, 3 hours.

395V Topics in Engineering (1-5)
Offered on demand
Selected topics from an engineering discipline in either lecture- or laboratory-oriented format, depending on the specific topic selected. Course may be repeated for credit. Prerequisite: Consent of instructor.

3980 Engineering CO-OP (0)
Co-op work experience with an engineering employer, pre-approved by the College of Engineering. The student is required to make periodic reports during the semester to a designated engineering faculty. Grades will be awarded on a pass/fail basis. Prerequisites: Approval by department chair.

481V Engineering in the Developing World Practicum (1-3)
Engineering mission trip project participation. Planning design and construction of engineering systems to meet the needs of people in developing nations. Credit received depends on the degree of involvement and the level of responsibility in the engineering project. This course may be used as a technical elective in engineering curricula if there is a high level of engineering design responsibility and you receive prior approval from your engineering department head. Prerequisite: Consent of instructor.
4942 Design Process Management (2) F
This course is 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: Mechanical Engineering 3812, Electrical and Computer Engineering 4823, or Civil and Environmental Engineering 4XX3 (any CEE senior level design course). Lecture/lab/recitation, 3 hours.

4953 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.
Department of Civil and Environmental Engineering

Joe M. Morgan, Professor and Academic Chair
David L. Davidson, Assistant Professor
Chris A. Gwaltney, Professor of Practice

The Department of Civil and Environmental Engineering is responsible for the curriculum leading to the Bachelor of Science degree with a major in civil engineering.

Building. It’s what civil engineers do. Skyscrapers, bridges, roads, fresh water systems, wastewater treatment plants. Civil engineers have designed and built the structures on which society relies from biblical times until today. As the disciples passed the temple in Jerusalem, one of them said to Jesus, “Look, Teacher! What massive stones! What magnificent buildings!” (Mark 13:1). Then as now, magnificent buildings were designed and massive stones were positioned by civil engineers.

Graduates of Lipscomb’s civil engineering program will be ready for a wide spectrum of civil engineering job opportunities or for further study in graduate school. Students will be introduced to several civil engineering sub-disciplines (e.g. structural engineering, geotechnical engineering, environmental engineering, transportation engineering, construction engineering, hydrology and hydraulic engineering) and explore at least four of those areas in some depth. Even more importantly, civil engineering students will “learn how to learn” and be well prepared for the life-long learning that will sustain them through a professional career filled with technological advancement.

Distinctives of the Civil & Environmental Engineering Department

For several years Lipscomb University has been a national leader in the design and construction of engineering projects for use in developing nations and in support of mission activities within those countries. Engineering mission projects have included pedestrian bridges in Guatemala, radio towers and a water tower in Honduras, fresh, clean water supplies to several villages in Guatemala, improvements to a seasonal camp in the Dominican Republic, etc. Civil engineering students at Lipscomb will have unique opportunities to use the engineering skills with which God has blessed them to help other people.

Civil engineering students at Lipscomb also have excellent opportunities to pursue engineering internships and cooperative education positions. A large number of civil engineering companies have major engineering design and consulting practices in Nashville and Middle Tennessee and actively recruit civil engineering students at Lipscomb for summer internships.

Program Educational Objectives for Civil Engineering

Civil engineers conceive, plan, design, construct, operate and maintain facilities and systems that serve the basic needs of our society. The educational objectives for the civil engineering program at Lipscomb University are to prepare and produce graduates who, after the first few years of their professional career, have been successful in:

1. The practice of engineering by:
   - maturing as professionals employed in industrial, governmental, educational or consulting positions with ever increasing responsibilities and influence;
   - being recognized as individuals whose interaction with their employers, coworkers and neighbors is characterized as considerate, moral and ethical;

2. The acquisition of new knowledge and skills by:
   - earning advanced degrees in engineering or related fields;
   - actively participating in ongoing professional development;
   - refining and adapting their fundamental skills to keep pace with a rapidly changing environment;

3. The application of their talents to serving others by:
   - being actively engaged in programs and initiatives which leverage their engineering competence and other skills in ways beneficial to their community, their church, their profession and to society as a whole.
Career Opportunities

Civil engineers provide the infrastructure (water supply and distribution, roads, bridges, wastewater collection and treatment, flood control, etc.) on which every community relies. For that reason, civil engineering job opportunities have traditionally been both strong and stable. A civil engineering degree also provides a solid foundation on which one can continue learning. In addition to pursuing master’s or doctoral degrees, civil engineering graduates are exceptionally good candidates for advanced degrees in business and law.

Employment opportunities for those with a civil engineering degree are numerous and include careers in areas such as:

• Construction engineering and management
• Environmental engineering
• Geotechnical engineering
• Hydrology and hydraulic engineering
• Land planning and development
• Structural engineering
• Transportation systems engineering
• Water resources engineering
• Water and wastewater treatment engineering

Requirements for Majors

Civil Engineering Major
B.S. degree program only
Total required hours— 138

I. General education requirements— 41 hours
   Refer to the general education section for university requirements.
   Specific courses required within civil engineering
   Bible 3123
   Economics 2413
   English 3143
   Biology 1013 or Environmental & Sustainability Science 1013
   Mathematics and physical science satisfied by major/minor

II. Courses for major— 97 hours
   Chemistry 1113, 1123, 1211, 1221
   Civil and Environmental Engineering 1123, 2113, 2123, 2133, 2211, 2513, 3113, 3211, 3213, 3313, 3413, 3443, 3513, 3613, 3621, 3713, 3721
   Engineering 0110, 1113, 4942, 4953, 4991
   Mathematics 1314, 2314, 2324, 3123, 3133
   Physics 2414
   Five Civil Engineering Specialty Electives (15 semester hours) chosen from
   Civil and Environmental Engineering 4213, 4222, 4313, 4413, 4513, 4613, 4713

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

Course Descriptions

Civil And Environmental Engineering (CEE)

1123 Fundamentals of Engineering Design (3) SP
   Fundamentals of engineering design as it pertains to civil engineering. Designs are carried out by student teams, starting with performance specifications formulated by the instructor, and culminating in a set of engineering drawings and specifications prepared by the student teams. Prerequisite: Engineering 1113. Lecture, 2 hours; laboratory 3 hours.

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. Corequisite: Mathematics 2314. 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. Prerequisites: Civil and Environmental Engineering 2113, Mathematics 2314. Lecture, 3 hours.

2133  **Surveying and Geomatics (3) F**  
Surveying theory and practice including horizontal, vertical and angular field measurements, analysis of measurements, errors and error analysis, and graphical or digital presentation of survey data. Introduction to GIS and GPS. Prerequisite: Engineering 1113. Lecture, 1 hour; Laboratory, 6 hours.

2211  **Experimental Methods Laboratory (1) SP**  
Principles of experimental methods and procedures, measurement techniques for basic mechanical properties, introduction to instrumentation characteristics and selection, and proper documentation of experimental results. Corequisites: Civil and Environmental Engineering 2513, Civil and Environmental Engineering 3113. Laboratory, 3 hours.

2513  **Engineering Computer Applications (3) SP**  
Introduction to the use of engineering computational tools. Students will learn to program using Excel, Mathcad, MATLAB, Engineering Equation Solver (EES) or similar computing environments. Prerequisite: Civil and Environmental Engineering 1123. Lecture, 3 hours.

3113  **Strength of Materials (3) SP**  
Studies in the principles of stress, strain, torque, bending moment, Hooke’s law, torsion, shear and bending moment diagrams, beam theory, columns and shafts. Prerequisites: Civil and Environmental Engineering 2113, Mathematics 2314. Corequisite: Civil and Environmental Engineering 2513. 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. Prerequisites: Civil and Environmental Engineering 3113. Laboratory, 3 hours.

3213  **Structural Analysis (3) F**  
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>3313</td>
<td>Environmental Engineering (3) F</td>
<td>Fundamentals of environmental engineering. Applications in water quality, water and wastewater treatment, solid waste management, air pollution and hazardous waste management. Environmental regulations. Prerequisites: Chemistry 1123 and 1221. Corequisite: Civil and Environmental Engineering 3613. Lecture, 3 hours.</td>
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<tr>
<td>3413</td>
<td>Construction (3) F</td>
<td>Fundamental concepts of construction, equipment selection, productivity, concrete and steel construction, construction contracts, economics, estimating and scheduling. Prerequisites: Civil and Environmental Engineering 2133. Lecture, 3 hours.</td>
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<tr>
<td>3443</td>
<td>Civil Engineering Materials (3) SP</td>
<td>The physical and mechanical properties of materials used in construction including aggregates, cements, concretes, masonry, ferrous and non-ferrous metals, and wood; the behavior of materials under load; and material testing standards. Prerequisites: Chemistry 1113 and 1211, Civil and Environmental Engineering 3113. Corequisite: Civil and Environmental Engineering 3211. Lecture, 2 hours; Laboratory, 3 hours.</td>
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<td>3513</td>
<td>Transportation Engineering I (3) F</td>
<td>Planning, operation and design of transportation systems with an emphasis on highway transportation. Contemporary issues in transportation policy, transportation planning models, and project evaluation and selection techniques. Fundamental principles of traffic flow theory, shockwaves, delay at intersections, queuing systems traffic control and use of the Highway Capacity Manual. Design of horizontal and vertical alignment. Introduction to transportation engineering with emphasis on highway systems, highway design and traffic flow. Applications of engineering economic analysis. Prerequisites: Civil and Environmental Engineering 2133. Lecture, 3 hours.</td>
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<tr>
<td>3613</td>
<td>Fluid Mechanics (3) F</td>
<td>Fundamentals of fluid flow; fluid statics, systems and control volumes; continuity, momentum and energy equations; dynamic similitude; flow in pipes and open channels; flow measurements. Prerequisites: Mathematics 2324, Civil and Environmental Engineering 2123. Lecture, 3 hours.</td>
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<td>3621</td>
<td>Hydraulics Laboratory (1) SP</td>
<td>A series of experiments which demonstrate the theory of fluid mechanics in civil and environmental engineering applications. Particular emphasis is placed on pumps, pipe flow and open channel flow. Prerequisites: Civil and Environmental Engineering 3613. Laboratory, 3 hours.</td>
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<tr>
<td>3713</td>
<td>Geotechnical Engineering (3) SP</td>
<td>Physical properties of soils, soil mechanics including phase relationship, soil classification, permeability, effective stress, time-settlement analysis, compaction, shear strength and bearing capacity. Prerequisites: Civil and Environmental Engineering 3113 and 3613. Lecture, 3 hours.</td>
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<tr>
<td>3721</td>
<td>Civil Engineering Laboratory (1) SP</td>
<td>A series of experiments which demonstrate fundamental principles of construction materials used in civil engineering. Corequisites: Civil and Environmental Engineering 3443, 3713. Laboratory, 3 hours.</td>
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<td>4213</td>
<td>Reinforced Concrete Structural Design (3) SP</td>
<td>Concrete and reinforcing steel properties; analysis and design of reinforced concrete beams, slabs, columns and footings. Prerequisites: Civil and Environmental Engineering 3213.Corequisite: Civil and Environmental Engineering 3443. Lecture, 3 hours.</td>
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<tr>
<td>4223</td>
<td>Structural Steel Design (3) F</td>
<td>Analysis and design of structural steel members and their connections according to the ASIC Manual of Steel Construction. Tension members, compression members, beams and beam columns. Bolted connections in tension, shear and bearing. Analysis of simple welded connections. Prerequisite: Civil and Environmental Engineering 3213. Lecture, 3 hours.</td>
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<tr>
<td>4313</td>
<td>Water and Wastewater (3) SP</td>
<td>Potable water treatment and wastewater treatment and disposal. Treatment systems; operation/process physics, chemistry and biology; operation and maintenance issues; and regulatory requirements. Prerequisites: Civil and Environmental Engineering 3313. Lecture, 3 hours.</td>
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<td>4413</td>
<td>Construction Project Planning and Management (3)</td>
<td>Planning and management of construction/engineering projects and organizations, project management techniques, skills and applications. Contracts, laws, financing and safety. Prerequisites: Civil and Environmental Engineering 3413. Lecture, 3 hours.</td>
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<td>4513</td>
<td>Transportation Engineering II (3)</td>
<td>Integrating transportation engineering principles into the design of multimodal transportation systems, including an overview of transportation design tools often utilized in the industry. Analysis of geometric design and operations management strategies to improve safety and performance; including design for non-motorized and public transport, intelligent transportation systems, signal systems and simulation. Prerequisites: Civil and Environmental Engineering 3513. Lecture, 3 hours.</td>
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<td>4613</td>
<td>Urban Hydrology and Hydraulic Systems (3) F</td>
<td>Hydrologic cycle, precipitation, infiltration, runoff with emphasis on small urban watersheds. Analysis and design of typical urban hydraulic systems/components, including curbs, inlet gutters, storm sewers, detention/retention ponds, sanitary sewer systems, pump stations, potable water transmission and distribution systems. Prerequisites: Civil and Environmental Engineering 3613. Lecture, 3 hours.</td>
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<tr>
<td>4713</td>
<td>Foundation Engineering (3) F</td>
<td>Application of soil mechanics and soil behavior in geotechnical engineering analysis and design. Slope stability, subsurface exploration, lateral earth pressure, retaining structure design, foundation bearing capacity and settlement. Principles of foundation design. Prerequisite: Civil and Environmental Engineering 3713. Lecture, 3 hours.</td>
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<td>491V</td>
<td>Special Topics in Civil Engineering (1-5)</td>
<td>Selected topics from civil and environmental engineering will be offered as opportunities develop. Course format may be lecture, lab or project depending on the specific topic selected. Prerequisites: Consent of instructor.</td>
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</table>
The Department of Electrical and Computer Engineering is responsible for the curriculum leading to the ABET accredited Bachelor of Science degree with a major in electrical and computer engineering.

The ECE major offers two tracks, or areas of concentration, specifically computer engineering and electrical engineering. Both are built upon a common set of core courses. Beyond this common core, each has its own concentration courses and technical electives, as detailed in the major requirements below.

The electrical and computer engineering curriculum is designed to equip graduates with the knowledge and skills necessary for entry-level engineering jobs in industry or for the pursuit of a graduate degree in electrical or computer engineering. Specifically, it provides knowledge of current electrical and computer technology, the design techniques and tools pertinent to it, and a solid grounding in the mathematics and science that underlie both current and future technology in this field. Knowledge of current technology is required to make our graduates valuable from their first day of employment. Knowledge of the basics is required for lifelong learning, which is necessary for career-long professional growth in a world of rapidly advancing technological complexity. We continually strive to integrate and balance these two areas.

**Distinctives of the Electrical and Computer Engineering Department**

Lipscomb’s electrical and computer engineering graduates have received numerous research and teaching assistantships at such prestigious schools as Harvard, Columbia and Vanderbilt. Likewise, graduates have taken positions in local companies, such as Bonitron; regional companies, such as Torch Technologies; and national companies, including Intel and Lexmark. Our students consistently score well above the national average on the professional engineering exam and have achieved a high placement rate upon graduation. The ECE faculty has both the academic and industrial experience to give our students the necessary preparation to be successful. On the basis of this record and the rapid growth of the electrical and computer industries, graduates have every reason for optimism regarding their professional prospects.

**Program Educational Objectives**

The educational objectives of the Electrical and Computer Engineering program at Lipscomb University are to prepare and produce graduates who, after the first few years of their professional career, have been successful in:

1. The practice of engineering by:
   - maturing as professionals employed in industrial, governmental, educational or consulting positions with ever-increasing responsibilities and influence;
   - being recognized as individuals whose interaction with their employers, coworkers and neighbors is characterized as considerate, moral and ethical;

2. The acquisition of new knowledge and skills by:
   - earning advanced degrees in engineering and related fields;
   - actively participating in ongoing professional development;
   - refining and adapting their fundamental skills to keep pace with a rapidly changing environment;

3. The application of their talents to serving others by:
   - being actively engaged in programs and initiatives which leverage their engineering competence and other skills in ways beneficial to their community, their church, their profession and society as a whole.
**Career Opportunities**

Electrical engineers design and build a wide range of electrical and electronic systems including hybrid automobile motors and batteries, communication systems (including 4G cellular phone networks), electrical power transmissions systems (such as the emerging “smart grid”) and even alternative energy sources such as solar panels and wind turbines.

Computer engineers create next-generation computer systems by developing new computer architectures, high-speed processor chips and memory systems, digital displays and digital networks. They design both large and small systems, from the super computers used in space and high-energy physics research to the tiny embedded microprocessors used in a wide variety of applications such as automobiles, airplanes, appliances, traffic control systems, heating and cooling systems and many other modern products.

Both electrical engineers and computer engineers are involved in the autonomous control of mechanical systems, commonly called robotics. In the commercial world they develop consumer electronics such as MP3 players, game consoles, printers and similar products. In our nation’s defense industry, electrical and computer engineers develop new systems to protect our freedom, while in the academic world they do research in new and innovative ways to apply technology. Also, electrical and computer engineers work to develop and deliver future green technologies to satisfy the world’s increasing demand for energy while protecting and sustaining our planet’s finite resources.

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**Requirements for Majors**

**Electrical and Computer Engineering Major**

B.S. degree program only

Total hours required — 132

ECE Computer Engineering track — 133

**I. General education requirements—38 hours**

Refer to the general education section for university requirements.

Specific courses required within electrical and computer engineering:

- **Bible 3123**
- **Economics 2413**
- **English 3143**
- Mathematics and physical science satisfied by major/minor

**II. Core courses—76 hours**

- **Chemistry 1113 and 1211**
- **Computer Science 1041, 1213, 1233, 2323**
- **Electrical and Computer Engineering 1123, 2214, 2223, 3013, 3234, 3813, 4254, 4513**
- **Engineering 1113, 4942, 4953, 4991**
- **Mathematics 1314, 2103, 2314, 2324, 3133**
- **Physics 2414, 2424**

**III. Concentration and elective courses**

**Computer Engineering track:**

- Concentration courses: 12 hours
  - **Computer Science 2233, 3523**
  - **Electrical and Computer Engineering 4263, 4823**
- Technical electives — 6 hours selected from:
  - **Computer Science 3623, 3713, 4453**
  - **Electrical and Computer Engineering 3243/3331(combined), 3523, 395V, 4523**
  - **Engineering 3513**
  - **Software Engineering 3223**

**Electrical Engineering track:**

- Concentration courses: 13 hours
  - **Computer Science 2233, 3523**
  - **Electrical and Computer Engineering 3243, 3331, 3403**
  - **Engineering 3513**
  - **Mechanical Engineering 2013**
- Technical electives — 6 hours selected from:
  - **Computer Science 2233, 3523**
  - **Electrical and Computer Engineering 3523, 3713, 395V, 4623, 4523, 4823**
  - **Physics 2434, 3503**

**Note:** The minor requirement in pure mathematics is automatically satisfied in the electrical and computer engineering majors.

**Note:** Mathematics 1314, Calculus I, **MUST** be completed before the spring 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.
Course Descriptions
Electrical and Computer Engineering (EECE)

1123  Fundamentals of Electrical and Computer Engineering (3) SP
Fundamentals of engineering design as it applies to electrical and computer engineering. Emphasis on basics of logic, number systems, digital design, state machines, and basic logic circuits. Students are introduced to programming, micro-controllers, and basic circuits through experiments using Arduino boards. Prerequisite: ENGR 1113. Lecture, 3 hours.

2013  Survey of Electrical Engineering (3) SP
A study of electric circuit DC and AC analysis, transient circuit analysis, frequency response and filters, complex power, and electromechanics. Prerequisite: Physics 2424 with a grade of “C” or higher. Lecture, 3 hours.

2214  Electric Circuits and Signals I (4) F
A study of resistor network analysis including series-parallel, wye-delta, source transformations, node voltage and mesh current analysis. Also includes: Thevenin & Norton equivalent circuits, capacitance, inductance, mutual inductance and transformers as well as AC phasor analysis of RLC circuits, single phase power systems and application of operational amplifiers. Hands-on experience with circuit performance measurement and numerical methods. Prerequisite: Electrical and Computer Engineering 1123 with a grade of “C” or higher. Corequisite: Physics 2424. Lecture, 3 hours; Laboratory/recitation, 3 hours.

2223  Electric Circuits and Signals II (3) SP
A study of transient response of RL/RC and RLC networks, Laplace and Fourier transform methods, and introduction to Z transforms. Filter design, including Butterworth filters with frequency and impedance scaling. Also, two-Port parameters. Prerequisite: Electrical and Computer Engineering 2214 with a grade of “C” or higher. Lecture, 3 hours.

3013  Random Analysis for Electrical Engineers (3) SP
Fundamentals of probability, statistical sampling and hypothesis testing. Includes probability distribution functions, random variables and processes response of linear systems to random processes, and optimum systems and filters. Prerequisite: Electrical and Computer Engineering 2223. Lecture, three hours.

3243  Semiconductor Electronics I (4) F
A study of mathematical modeling of the p-n junction; diode circuit analysis; rectifier design; mathematical modeling of the bipolar junction transistor (BJT) and the metal-oxide-semiconductor field-effect transistor (MOSFET); quiescent and small signal analysis of BJT and MOSFET amplifiers; basic NMOS and CMOS digital circuit blocks, including flip-flops and SRAM/DRAM memory; A/D conversion techniques. Prerequisite: Electrical and Computer Engineering 2214 or 2013. Lecture, three hours; Laboratory, 3 hours.

3243  Semiconductor Electronics II (3) SP
A study of mathematical modeling of the p-n junction; diode circuit analysis; rectifier design; mathematical modeling of the bipolar junction transistor (BJT) and the metal-oxide-semiconductor field-effect transistor (MOSFET); quiescent and small signal analysis of BJT and MOSFET amplifiers; basic NMOS and CMOS digital circuit blocks, including flip-flops and SRAM/DRAM memory; A/D conversion techniques. Prerequisite: Electrical and Computer Engineering 2214 or Electrical and Computer Engineering 2013 with a grade of “C” or higher. Lecture, 3 hours; Laboratory, 3 hours.

3311  Semiconductor Electronics Laboratory (1) SP
Projects requiring the design and fabrication of semiconductor electronic circuits to meet a specification. Also, hand analysis, computer simulation and bench level performance testing are progressively employed to evaluate the circuit of interest. Documentation at each phase is emphasized. Corequisite: Electrical and Computer Engineering 3243. Laboratory, 3 hours.

3403  Electromagnetic Fields (3) F
Offered odd-numbered years
A study of electric and magnetic fields and their interactions with conductors and dielectric media and Maxwell's equations. Prerequisite: Physics 2424, Math 2324. Lecture, 3 hours. Same as Physics 3403.

3523  Communication Systems (3)
Offered on demand
The theory and design of analog and digital communications systems. Signal classification, correlation, representation, analysis and transmission methods are investigated, as are amplitude and frequency modulation, signal encoding/decoding, encryption and error detection/correction. Prerequisites: Electrical and Computer Engineering 2223 and Electrical and Computer Engineering 3813. Lecture, 2 hours; Laboratory, 3 hours.

3713  Introduction to Power System Analysis (3) F
Offered on demand
A study of basic power concepts, per unit quantities, transformers, synchronous machines and power control. Also includes transmission line impedances, current and voltage relationships, one line system diagrams, symmetrical components, symmetrical and unsymmetrical fault current calculations, circuit breakers and system protection. Prerequisites: Electrical and Computer Engineering 2223 with a grade of “C” or higher. Lecture, 3 hours.

3813  Digital Computer Design I (3) SP
An introduction to the digital hardware design process and CAD tools, particularly VHDL. Review of Boolean algebra, functional optimizations and logic gate implementations. Design of adder/subtractor units, array multipliers, multiplexers, encoders/decoders. State-machine design of sequential circuits, state assignment/state reduction, excitation and output generation. Implementation of data bus and simple processor design. Prerequisite: Electrical and Computer Engineering 1123 with a grade of “C” or higher. Lecture, 3 hours.
395V  **Topics in Electrical and Computer Engineering**
(1, 2, 3, 4 or 5) Offered on demand
Topics from electrical/computer engineering 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.

4254  **Microprocessors (4) SP**
The theory and application of microprocessors, including architecture, hardware considerations and programming methods in both assembly- and higher-level languages. Theory and practice of analog-to-digital conversion, synchronous and asynchronous communications, timing, and real-time interrupts. In the laboratory, students design, build and test assignments involving state-of-the-art microprocessors, sensors and output devices. Prerequisites: Computer Science 2323, Electrical and Computer Engineering 3234, with a grade of “C” or higher, and Electrical and Computer Engineering 3813, with a grade of “C” or higher. Lecture, 3 hours; Laboratory 3 hours.

4263  **Embedded Systems (3) F**
Special fixed 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. Prerequisite: Electrical and Computer Engineering 4254 with a grade of “C” or higher. Lecture, 2 hours; Laboratory/recitation, 3 hours.

4513  **Digital Signal Processing (3) F**
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. Lab work using MatLab to explore and expand on concepts covered in lecture. Prerequisites: Electrical and Computer Engineering 2223 and Mathematics 2103 with grades of “C” or higher. Lecture, 2 hours; Laboratory, 3 hours.

4523  **Mechatronic Systems (3) SP**
An interdisciplinary course that provides both electrical and computer engineering students as well as mechanical engineering students with the necessary knowledge to apply the use of sensors, actuators, electrical equipment and microprocessors to the design and building of intelligent mechatronic systems. Prerequisites: Engineering 3513 for electrical engineering track or Electrical and Computer Engineering 4263 for computer engineering track. Lecture, 2 hours; Laboratory, 3 hours.

4823  **Digital Computer Design II (3) SP**
Provides an in-depth digital circuit design experience. Datapath and control path design concepts and practice, modeling and simulation techniques, and circuit synthesis are covered. Design analysis, verification, testing and cost issues will be taught as well. Single-cycle, multi-cycle and pipelined microprocessor architectures are modeled and implemented using hardware description languages and contemporary CAD tools. The course culminates in a cache-based microprocessor design project using VHDL. Prerequisites: Engineering 1123 and Electrical and Computer Engineering 3813 with a grade of “C” or higher. Lecture, 2 hours; Laboratory/recitation, 3 hours.
Distinctives of the Mechanical Engineering Department

Whether developing more fuel-efficient automobiles, designing robotic medical systems or helping to put an astronaut on Mars, mechanical engineers will play a critical role in maintaining our place in the world economy. The faculty in the Department of Mechanical Engineering has the academic and practical experience to provide our students with the necessary knowledge and experience to be successful.

While at Lipscomb University, mechanical engineering students have the opportunity to participate in numerous extracurricular activities through annual engineering mission trips, the student chapter of the American Society of Mechanical Engineers and the Society of Automotive Engineers BAJA SAE student design competition. Students are also encouraged to seek engineering internship opportunities in industry during the summers. Faculty members assist students in finding and securing engineering internships whenever possible.

Program Educational Objectives for Mechanical Engineering

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

1. The practice of engineering as:
   • Maturing as professionals employed in industrial, governmental, educational or consulting positions with ever-increasing responsibilities and influence;
   • Being recognized as individuals whose interaction with their employers, coworkers and neighbors is characterized as considerate, moral and ethical;

2. The acquisition of new knowledge and skills by:
   • earning advanced degrees in engineering or related fields;
   • actively participating in ongoing professional development;
   • refining and adapting their fundamental skills to keep pace with a rapidly changing environment;

3. The application of their talents to serving others by:
   • Being actively engaged in programs and initiatives which leverage their engineering competence and other skills in ways beneficial to their community, their church, their profession and society as a whole.
Career Opportunities

Employment opportunities for those with a mechanical engineering degree are numerous and include careers in areas such as:
• Aerospace
• Automotive
• Robotics
• Defense
• Energy systems development and design
• Renewable energy systems
• Machine design
• Government and private research
• Consulting
• Manufacturing

A mechanical engineering degree also provides a solid foundation on which to continue learning. In addition to pursuing master’s or doctoral degrees in their field, mechanical engineering graduates are exceptionally good candidates for advanced degrees in the areas of business, law and medicine.

Requirements for Majors

Mechanical Engineering Major
B.S. degree program only
Total required hours—133

I. General education requirement— 47 hours
Refer to the general education section for university requirements.
Specific courses required within mechanical engineering:
   Bible 3123,
   Economics 2413
   English 3143
   Mathematics and physical science -satisfied in major (listed below)

II. Courses for major— 95 hours
   Chemistry 1113, 1211
   Electrical and Computer Engineering 2013
   Engineering 1113, 3303, 3513, 4942, 4953, 4991
   Mechanical Engineering 1123, 2113, 2123, 2513, 3113, 3211, 3313, 3413, 3443, 3613, 3703, 3803, 3831, 4303, 4423 and 4513
   Mathematics 1314, 2314, 2324, 3133
   Physics 2414, 2424
   Approved technical electives 3 hours

Note: The minor requirement in applied mathematics is automatically satisfied.

Note: 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 in the calculus sequence should consider enrolling in Mathematics 1123 in the summer session.

Course Descriptions

Mechanical Engineering (ME)

1123 Fundamentals of Mechanical Engineering (3) SP
Fundamentals of engineering as it applies to mechanical engineering. Emphasis is placed on setting previously learned mathematical principles into an engineering context. Students will also be introduced to parametric modeling concepts and tools. Prerequisite: Engineering 1113. Lecture, 2 hours; Laboratory, 3 hours

2013 Survey of Mechanical Engineering (3) F
An overview in the basic principles of engineering mechanics from statics, dynamics and strength of materials. This includes both static and dynamic force systems and equilibrium, area and mass properties, and general concepts in stress and strain. Prerequisite: Physics 2414. Lecture, 3 hours

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 with a minimum grade of “C.” Corequisite: Mathematics 2314. 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: Mechanical Engineering 2113, Mathematics 2314, both with a minimum grade of “C.” Lecture, 3 hours.

2211  Experimental Methods in Mechanical Engineering (1) SP
Principles of experimental methods and procedures as well as measurement techniques for basic mechanical properties. An introduction to instrumentation characteristics and selection, along with proper documentation of experimental results. Prerequisites: Mechanical Engineering 2513 with a minimum grade of “C.” Corequisite: EECE 2013. Lecture/laboratory, 3 hours.

2513  Mechanical Engineering Computer Applications (3) F
Introduction to the use of computational tools in mechanical engineering. Students will use MATLAB, Engineering Equation Solver (EES), and other tools as appropriate to his or her area of study. Prerequisites: Mathematics 2314 with a minimum grade of “C.” Lecture, 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: Mechanical Engineering 2113, Mathematics 2314, all with a minimum grade of “C.” Lecture, 3 hours.

3211  Solid Mechanics and Materials Laboratory (1) F
A series of experiments which demonstrate the theory of mechanics of materials and important characteristics of engineering materials. Prerequisite: Mechanical Engineering 3113 with a minimum grade of “C.” Laboratory, 3 hours.

3213  Instrumentation and Measurement (3) SP
A survey of common measurement systems that are of importance to a mechanical engineer such as displacement, velocity, acceleration, pressure, flow, temperature, force, torque, and strain. Introduction to digital data acquisition systems for electronic measurements. Use of statistical analysis for experiment design and error analysis. Prerequisites: Electrical and Computer Engineering 2013, Mechanical Engineering 3113, 3613, all with a minimum grade of “C.” Lecture, 2 hours, 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: Mechanical Engineering 2123, 2513, Mathematics 3133 all with a minimum grade of “C.” Lecture, 3 hours.

3413  Dynamics of Machinery (3) SP
A study of kinematic analysis of plane mechanism linkages, analysis and synthesis of cam-follower mechanisms, and gear trains. An introduction to the synthesis of planar mechanisms-linkages, static and dynamic force and torque analysis of plane mechanisms with balancing using the computer. Prerequisites: Mechanical Engineering 2123, 2513, both with a minimum grade of “C.” Lecture, 3 hours.

3443  Engineering Materials (3) F
An introduction to the structure and behavior of modern engineering materials. Explores the relationship between the atomic, microscopic and macroscopic structure of materials and their mechanical, thermal and failure properties. Prerequisites: Mechanical Engineering 3113, Chemistry 1113/1211, all with a minimum grade of “C.” Lecture, 3 hours.

3613  Fluid Mechanics (3) F
A study of fundamentals of fluid flow; fluid statics, systems and control volumes; continuity, momentum, and energy equations; dynamic similitude; flow in pipes and channels; and flow measurements. Prerequisites: Mathematics 2324, Mechanical Engineering 2123, both with a minimum grade of “C.” Corequisite: Mechanical Engineering 3703. Lecture, 3 hours.

3703  Thermodynamics (3) F
Course topics include: 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 1113/1211, Mathematics 2324, Physics 2414, all with a minimum grade of “C.” Lecture, 3 hours. Same as Physics 3703.

3803  Heat Transfer (3) SP
A study of single and multidimensional steady-state and transient heat conduction, the role of convection for internal and external forced flows and in buoyancy-driven flow, and thermal radiation processes and properties. Prerequisites: Mechanical Engineering 2513, 3613, 3703, Engineering 3303, all with a minimum grade of “C.” Lecture, 3 hours.

3812  Advance Computer-Aided Design (2) SP
Advanced topics in computer aided design and analysis, including assemblies, drawings, and kinematic analysis using SolidWorks. Corequisite: Mechanical Engineering 3413. Lecture/laboratory, 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: Mechanical Engineering 3613, English 3143, both with a minimum grade of “C.” Corequisite: Mechanical Engineering 3803. Laboratory, 3 hours.

395V  Topics in Mechanical Engineering (1, 2, 3, 4 or 5)
Offered on demand
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.
4123 Advanced Mechanics of Materials (3) F
Offered on demand
A study of advanced topics, fracture mechanics, fatigue and life prediction, elastic support, non-circular shafts, curved beams, thick-walled cylinders, an introduction to plates, and thin shells of revolution. Prerequisites: Mechanical Engineering 3113, Mathematics 3133, both with a minimum grade of “C.” Lecture, 3 hours.

4223 Design of Pressure Systems (3)
Offered on demand
Course topics include design of pressure vessels and piping systems for stress and deflection. Emphasis will be on the use of ASME Boiler and Pressure Vessel Codes as well as the ASTM piping codes. Prerequisites: Mechanical Engineering 3113 with a minimum grade of “C.” Lecture, 3 hours.

4303 Computational Methods in Mechanics (3) F
A study of matrix formulation and modern numerical methods used in the analysis of engineering programs and the application of the finite element method in solid mechanics, heat transfer and fluid mechanics. Topics include the formulation of rod, beam, plane stress/strain, 2-D heat transfer, and other basic elements along with modeling techniques and error analysis. Prerequisites: Mechanical Engineering 3313, 3803, both with a minimum grade of “C.” Lecture, 3 hours.

4423 Design of Machine Elements (3) F
This course equips the student with a working knowledge of components commonly found in mechanical systems. The student will learn the skills necessary to properly design and select components based on function, loading, and wear characteristics. Prerequisite: Mechanical Engineering 3113, 3413 both with a minimum grade of “C.” Lecture, 3 hours.

4513 Design of Thermal-Fluid Systems (3) F
This course equips the student with a working knowledge of components commonly found in thermal-fluid systems. Examples are drawn from power generation, environmental control and industrial processes. Students work on group projects for integration of these components in the design of thermal systems. Prerequisites: Mechanical Engineering 3113, 3413 both with a minimum grade of “C.” Lecture, 3 hours.

4613 Advanced Fluid Mechanics (3) SP
Offered even-numbered years
This course provides students with an understanding of advanced fluid flow concepts beyond the introductory level and equips them with the mathematical tools and techniques to solve engineering problems involving these advanced concepts. Topics covered include: potential flow, computational fluid dynamics, aerodynamic drag, compressible flow, turbomachinery, and propulsion. Prerequisites: Mechanical Engineering 3613, 2513, both with a minimum grade of “C.” Lecture, 3 hours.

4713 Automotive Design (3)
Offered on demand
A study of the fundamentals of designing vehicles based on current and evolving technology. A broad set of topics will be addressed giving the student a basic understanding of the principles involved in vehicle design. Prerequisite: Mechanical Engineering 3703, 3413 with a minimum grade of “C.” Lecture, 3 hours.

4723 Heating Ventilating and Air Conditioning (HVAC) (3) Offered on demand
A study of the fundamental theoretical principles and practical considerations in the design of various HVAC equipment and systems. A broad set of topics will be addressed giving the student a basic understanding of the principles involved in HVAC design. Corequisite: Mechanical Engineering 3803. Lecture, 3 hours.

4733 Alternative Energy Sources (3) SP
Offered odd-numbered years
A study of the fundamental principles of alternative energy. Covers the major alternative energy sources: wind, solar, tidal and wave energy; biomass; biofuels; geothermal; fuel cells and hydrogen. Prerequisites: Electrical and Computer Engineering 2013, Mechanical Engineering 3703 both with a minimum grade of “C.”

4743 Survey of Aerospace Engineering (3)
Offered on demand
Course topics include flight and flight vehicles both within and outside the atmosphere, airfoil and wing aerodynamics, aircraft performance, an introduction to aircraft stability and control, orbital mechanics, atmospheric re-entry, air-breathing and rocket propulsion systems, aerospace structures and materials. Prerequisites: Mechanical Engineering 3613 with a minimum grade of “C.” Corequisite: Mechanical Engineering 3803. Lecture, 3 hours.