Mission Statement

Mission: Simpson University is a Christ-centered learning community committed to developing each student in mind, faith, and character for a lifetime of meaningful work and service in a constantly changing world

Program Overview

The Bachelor of Science in Engineering program equips students with a comprehensive foundation in essential engineering principles, advanced problem-solving techniques, collaborative teamwork, and innovative thinking. This interdisciplinary curriculum seamlessly blends rigorous theoretical instruction with practical, hands-on experiences across diverse fields such as civil, mechanical, electrical, and environmental engineering. Through an integrated approach that includes coursework, laboratory exercises, project-based learning, and industry internships, students cultivate both technical proficiency and analytical acumen. By graduation, they are adept in the complete engineering design process and have acquired a versatile skill set that spans digital fabrication, advanced CAD modeling, web development, programming, robotics, circuit design, manufacturing and quality control. Moreover, the program emphasizes research, effective communication, and presentation skills, preparing graduates to excel in a wide array of engineering careers and to drive innovation in a rapidly evolving technological landscape.

Program Educational Objectives

Graduates from the Simpson Engineering Program should be able to:

1. Contribute to solutions of engineering problems by applying engineering principles, technical knowledge, experience with modern industry tools while acknowledging the impact that their engineering solutions can have on global, societal, and environmental issues.
2. Assume leadership roles and demonstrate ethical behavior and responsibility in their engineering practices.
3. Engage in activities that sustain and promote their careers by securing a professional license, completing graduate courses or degree programs, and participating in events sponsored by professional societies, and pursuing informal learning opportunities.
4. Contribute to society by applying Christian-centered values to the solution of engineering problems.

Student Outcomes for Engineering:

By the end of the program students will develop:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.

4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
8. An ability to articulate a Christ-centered worldview and its personal, professional and communal embodiment through Christian virtues and ethics.

GENERAL EDUCATION 44 CREDITS

BASECAMP (37 Credits)

Take the following courses under Basecamp

MATH 2610 Statistics (3, F, Sp)

Course Description: An examination of the fundamentals of statistical theory, with an emphasis on the use and interpretation of elementary descriptive and inferential statistics. (**Prerequisite:** MATH 1520 or demonstrated algebra competency)

CHEM 1510 Chemistry I 4 Credits

Course Description: The first half of a two-semester sequence, intended for the biology major, covering the nature of atoms, molecules, and ions, chemical reactions, stoichiometry, electronic structure, periodicity, and chemical bonding. This course also introduces thermodynamics, equilibrium, precipitation, oxidation-reduction, and acid/base chemistry. Three hours of lecture and three hours of lab per week. Registration for this course restricted to declared majors, or by consent of instructor. Note*: There is a lab fee for this course.*

PHYS 2510 University Physics I (4; F)

Course Description: A calculus-based introductory physics course that covers kinematics and Newton's laws of motion; conservation laws for momentum, energy, and angular momentum; torques and static equilibrium; simple harmonic motion. (**Prerequisite:** Math 2530 - may be taken in the same semester; **Requisite**: Take PHYS-2510L concurrently; must be taken at the same time as this course.)

PHYS 2510L University Physics I Lab (1, Fall)

Course Description: Lab section of PHYS 2510. (Requisite: Take PHYS 2510 concurrently; must be taken at the same time as this course.) *Note: There is a lab fee for this course.*

PHYS 2520 University Physics II (4;Sp)

Course Description: Continuation of PHYS 2510 covering electric fields and forces, electric potential, resistors, capacitors, and DC circuits; magnetic fields and forces, electromagnetic induction and inductors, electromagnetic waves, and Maxwell's equations; and geometrical and physical optics. (Prerequisite PHYS 2510; Requisite: Take PHYS-2520L concurrently; must be taken at the same time as this course.)

PHYS 2520L University.Physics.II.Lab.(7?Fall)

Course Description: Lab section of PHYS 2520. (Requisite: Take PHYS 2520 concurrently; must be taken at the same time as this course.).Note¿There.is.a.lab.fee.for.this.course¡.

ENGR 1000 Introduction to Engineering (3, F)

Course Description: This course provides a solid foundation in fundamental skills needed for freshmen and transfer students to academically succeed and professionally prepare them for challenges within the disciplines of Engineering (specifically, mechanical, electrical, chemical, and civil) and related disciplines in Technology Management. The project-based assignments will provide students with opportunities to apply mathematics to solve basic engineering problems, acquire team-working skills, practice written and verbal communication skills, and enhance problem solving and design skills. Early understanding of these skills will assist students throughout their undergraduate experience.

ENGR 1950 Engineering Economic Analysis 2 Credits

Course Description: Capital expenditure, economic life and replacement analysis based on net present value, periodic costs, internal and incremental rates of return. Coverage of compound interest, value flows, economic equivalencies, depreciation, taxes and inflation. **Prerequisite:** ENGR 1000, Sophomore standing

EXPEDITION COURSES (4 Credits)

Choose 1 course from Trail # 2 that also satisfies the cross-cultural requirements (look for § sign preceding the course prefix) and 1 course from Trail #5

Trail #2: Cultural Perspectives (Choose at least 3 units)

Trail #5: Adventure Recreation (Choose at least 1 unit)

SUMMIT COURSE MENU (3 credits)

MUSI 3690 Music in World Cultures (3; Sp)

Course Description: An introduction to the music of cultures outside of the European tradition. Discussion of the role of ethno-musicology in missiology. This course satisfies the General Education cross-cultural requirement.

MAJOR REQUIREMENTS (81 CREDITS)

Math 17 Credits

MATH 2430: Calculus I 4 Credits

Course Description: A study of limits and continuity; differentiation and rate of change; maximaand minima problems; transcendental functions; introduction to the definite integral and area calculations. Graphic software and graphing calculators may be used to illustrate the application of calculus to real life problems. (**Prerequisite**: MATH 1830 or high school math equivalent; or placement by exam)

MATH 2530: Calculus II 4 Credits

Course Description: A study of applications of the derivative, techniques of integration, applications of the integral, improper integrals, and infinite series. Graphics software and graphing calculators may be used to illustrate the application of calculus to real-life problems. **(Prerequisite:** MATH 2430)

MATH 2630: Calculus III 3 Credits

Course Description: A study of vectors, partial derivatives, multiple integrals, optimization, and line and surface integrals. Graphics software and graphing calculators may be used to illustrate the application of calculus to real-life problems. **Prerequisites:** MATH 2530

MATH 3250 Linear Algebra 3 Credits

Course Description: A study of linear systems, matrices, determinants, linear independence, eigenvalues and eigenvectors. The study of matrices will include topics such as vector spaces, linear operators and transformations, canonical forms, scalar products, characteristic values, and Jordan normal form. (The concepts in this course will form the basis for exploring problems in other disciplines). (**Prerequisite:** MATH 2530)

MATH 3930 Differential Equations 3 Credits

Course Description: A study of linear ordinary differential equations, their solutions, and applications. Additional topics may include constant coefficient equations, power series solutions, Laplace transformations, numerical methods, and boundary value problems. **(Prerequisite**: MATH 2530)

Engineering Core Requirements Courses 54 Credits

ENGR 1060 Computer Aided Design and Modeling 3 Credits

Course Description: An introduction to design tools and practices associated with the design and development of engineering systems. Solid modeling tools, including part modeling, assembly modeling and the reading and creation of layout drawings. An introduction to Rapid Prototyping and specialized graphic applications. The project portion of the course will focus on "reverse engineering". Reverse engineering will be used to examine the design of existing systems, their assembly, and the engineering principles that form the foundation for the product. Students will model these systems and suggest possible design changes that might lead to improvements in form, function, and/or assembly. **Components:** 2 hour class, 3 hour Laboratory/Activity. **Prerequisites:** ENGR 1000 and MATH 1830 or MATH 2430

ENGR 1830 Computer Programming & Computational Methods 4 Credits

Course Description: A study of basic programming concepts including an introduction to object-oriented programming. Students will develop, implement, and validate algorithms to solve typical scientific, educational, and business problems. **Prerequisites:** MATH 1830 or higher or MATH 2610.

ENGR 2150 Statics 3 Credits

Course Description: Deals with forces acting on rigid bodies at rest covering coplanar and noncoplanar forces, concurrent and non-concurrent forces, friction forces, centroid, and moments of inertia. Much time will be spent finding resultant forces for a variety of force systems, as well as analyzing forces acting on bodies to find the reacting forces supporting those bodies. Students will develop critical thinking skills

necessary to formulate appropriate approaches to problem solutions. **Prerequisites**: MATH 2530, PHYS 2510. **Components:** 2 hour class, 3 hour Laboratory/Activity

ENGR 2250 Dynamics 3 Credits

Course Description: Kinematics and kinetics of particles and rigid bodies in translation; rotation and general plane motion; Newton's law, work-energy and impulse methods; linear and angular momentum; impacts; systems of particles and introduction to 3-D kinetics. **Prerequisites**: ENGR 2150, PHYS 2510

ENGR 2400 Principles of Material Science 4 Credits

Course Description: Course concerns the science underlying the behavior of engineering materials, including the relation between atomic structure and mechanical, electrical, and magnetic properties in metals, ceramics, polymers, composite materials, and semiconductors. Phase diagrams, heat treatment, and corrosion mechanisms are also presented. Laboratory exercises are included to enhance course theory and to provide hands-on experience with materials measurement apparatus and analysis techniques. Two lectures and one laboratory per week. Additional course fee is required. **Components:** 2 hour class, 3 hour Laboratory/Activity. **Prerequisites:** CHEM 1510

ENGR 2510 Linear Circuits I 4 Credits

Course Description: DC and sinusoidal circuit analysis, including resistive, capacitive, and inductive circuit elements and independent sources. Ideal transformer. Thevenin and Norton circuit theorems and superposition. Phasors, impedance, resonance, and AC power. Three-phase AC Circuit analysis. 3 hours discussion, 3 hours lab PHYS 2520). **Prerequisite:** MATH 2530, **Co-requisite** PHYS 2520 (may be taken concurrently).

ENGR 2600 Manufacturing Processes 3 Credits

Course Description: Overview of materials such as metals, alloys, composites and ceramics. Iron and steel making. Primary manufacturing processes such as casting, forging, rolling and extrusion. Secondary processes such as bending, forming and drawing. Mechanics and economics of metal cutting. Special processes such as powder metallurgy. Polymer processing methods. Design and Manufacturing, Manufacturing systems. Overview of CAD/CAM/CNC/CIM and Additive manufacturing systems. Components: 2 hour class, 3 hour Laboratory/Activity. **Prerequisite:** ENGR 2150, ENGR 2400.

ENGR 2910 Sophomore Project 2 Credits

Course Description: Engineering projects performed in small teams to meet the requirements of community-based clients, under the supervision of a faculty mentor. Course involves further introduction of students to tools and technologies for implementation of design and creative works. Progress reports and a final report and presentation are required. **Prerequisite:** ENGR 1000, ENGR 1060

ENGR 2940 Principles of Management 3 Credits

Course Description: A study of the theory and practice of management of organizations, with emphasis on the manager's role in strategy, organizational design, effective use of human resources, planning, organizing, integrating and controlling functions. Theory and practice will both be stressed. Course will also cover decision-making, quality, and work teams.

ENGR 3210 Signals and Systems 3 Credits

Analysis and application of continuous-time linear systems, discrete-time linear systems, and methods of signal sampling and reconstruction. Applications of Fourier Series, Fourier Transform and Laplace Transform. Transfer functions, frequency response, and Bode plots. Exploration of digital signal processing using Matlab programming. **Prerequisite:** MATH 2630 and PHYS 2510

ENGR 3410 Thermodynamics 3 Credits

Course Description: First and second laws of thermodynamics; thermodynamic properties of pure substances and applications of thermodynamic systems operating in steady state and transient processes; energy-systems analysis including conventional power cycles, refrigeration cycles and heat pump cycles. **Prerequisite:** CHEM 1510 and MATH 2530.

ENGR 3530 Control Systems 3 Credits

Course Description: Modeling, characteristics, performance, and stability of feedback control systems including Nyquist stability. Design and analysis of continuous time-domain control systems using system modeling techniques and simulation software for control algorithms. Evaluation of control system performance and design criteria including feedback, stability, sensitivity, time and frequency response. Bode plots, PID controllers, and lead-lag compensators. Introduction to similar topics in the discrete-time domains. Laboratory demonstrates the practical application of theoretical concepts. Components: Laboratory, Class. **Prerequisites:** ENGR 2510 and ENGR 3210.

ENGR 3620 Introduction to Robotics 3 Credits

Course Description: Introduction to robotic manipulation, design and control. Topics include planar and spatial kinematics, and motion planning; mechanism design for manipulators and mobile robots, multi-rigid-body dynamics, 3D graphic simulation; control design, actuators, and sensors; wireless networking, task modeling, human-machine interface, and embedded software. Weekly laboratories provide experience with servo drives, real-time control, and embedded software. Students apply the concepts in computer simulation and a physical system. 2 hours lecture, 2 hours activity. **Prerequisites:** ENGR 1830.

ENGR 3830 Principles of Engineering Design 3 Credits

Course Description: This course will demonstrate application of a systems engineering approach to all of the elements of an engineering project. This includes: the consideration of the various stages of design (which include problem identification, concept generation, concept selection and design embodiment); the fundamentals of good design practice (including aesthetics, ergonomics, and safety); and effective teamwork, resource allocation, scheduling, and project management. Graphical, written and spoken language development in the context of academic and professional engineering. The students will produce a complete set of manufacturing drawings as a team exercise and develop their written skills by producing a comprehensive engineering report. * **Prerequisites**: ENGR 1000, ENGR 1060

ENGR 3910 Engineering Design and Junior Project 2 Credits

Course Description: An exploration of design methodology and practice under the supervision of a team of faculty. Progress reports including a final report and presentation are required. For this course, the scope of the project typically includes problem definition, development of requirements, and preliminary

design work. The course also involves further introduction of students to tools and technologies for implementation of design and creative works. Students work in groups of 3-5 students. Progress reports, a final report and a public seminar are required. Hours: lecture 1 and project work. **Prerequisites**: ENGR 2910 or permission from instructor.

ENGR 4030 Quality Engineering 3 Credits

Course Description: Modern quality management philosophies, Statistical Process Control methods and tools for problem solving and ongoing process improvement in manufacturing and business environments. Acceptance sampling procedures and standards, experimental design including Taguchi techniques, quality audits. Economic aspects of quality decisions, basic concepts in reliability analysis. Basics of ISO 9000/9001 quality management system. The statistical approach to methods and procedures associated with quality assurance in manufacturing processes. Components: Laboratory, Class. **Pre-requisite:** MATH 2610

ENGR 4910W Capstone Design Project I 2 Credits

Course Description: Design methods applied to engineering systems in team-based projects, primarily from industry. Rigorous application of design processes and methods. Project definition, planning, and management. Consideration of real-life technical, economic, social, aesthetic, environmental and other constraints. Consideration of several related topics such as creativity, analysis, synthesis, project management, scheduling, time management, engineering ethics, communication, personality types, product safety and liability, copyrights and patents, design for manufacture, economics, and robust engineering. Integration of technical and management knowledge in an open-ended design environment. Oral and written presentation of capstone design results.

Initial stage of the capstone design project to be continued in ENGR 4920. Meets Writing graduation Requirement. **Components:** 1 hours lecture, 3 hours supervision. **Prerequisites**: ENGR 3920 or ENGR 3930 or ENGR 3950 and Senior Standing

ENGR 4920W Capstone Design Project II 3 Credits

Course Description: Continuation of the capstone design project from ENGR 4910 including fabrication, testing, and evaluation of a working prototype. Impact of engineering solutions in global, economic, environmental, and societal context. Ethical and professional responsibilities in engineering including continuing self-education and career development. Must be taken the semester immediately following ENGR 4910. Oral and written presentation of capstone design results.

Components: 2 hours lecture, 3 hours supervision. **Prerequisites**: ENGR 4910W, Senior Standing

Electives: 7 Credits From

ENGR 2520 Linear Circuits II 4 Credits

Course Description: Circuit analysis techniques for networks with both independent and dependent sources. Network topology. Natural and forced responses for RLC circuits. Complex frequency, poles, and zeros. Magnetically coupled circuits and two-port networks. Introduction to linear algebra, circuit simulation using PSPICE, and mathematical analysis using MATLAB. 4 hours discussion. **Prerequisite:** ENGR 2510 (Linear Circuits I).

ENGR 2370 Logic Design 3 Credits

Course Description: Covers the design and application of digital logic circuits, including combinational and sequential logic circuits. Topics include Boolean algebra, Karnaugh maps, decoders, encoders, and other topics relevant to digital logic design**.**

Components: 3 hours discussion, 3 hours laboratory. **Prerequisite(s):** ENGR 1830 and ENGR 2510.

ENGR 3110 Electronics 3 Credits

Course Description: Practical and theoretical study of fundamental components and circuits, including transistors, diodes, integrated circuits, power supplies, filters, amplifiers, control circuits and digital electronics. Analysis and design of linear amplifiers. Use of Opamps.

Prerequisite: ENGR 2510. 3 hours lecture/discussion per week.

ENGR 3850 Digital Systems Design 3 Credits

Course Description: Extends the study of digital circuits to LSI and VLSI devices. Microcontrollers, architecture, bus organization and address decoding. Design concepts for microcontroller systems, including A/D and D/A conversion, serial communications, bus interfacing, interrupt processing, power regulations, timers, pulse width modulation, programmable I/O ports, and error control coding. 2 hours lecture, 3 hours laboratory. This course requires the use of a laptop computer and appropriate software. **Prerequisite(s):** ENGR 2370, ENGR 2510

ENGR 3945 Introduction to Data Analytics (4 Credits)

Course Description: Students identify the basic concepts of data analytics as applied in various contexts. After learning the basic concepts, students will learn how to differentiate between various topics such as statistical analysis, data mining, data intelligence, data analytics, and data science to describe which approach is most suitable given a certain problem. Finally, students will gain exposure to the various tools and programming languages that are relevant to data analytics, and how these tools yield critical analysis leading to improved decisions.

ENGR 4420 Decision and Risk Analysis 3 Credits

Course Description: A study of the various types of real-life assessment necessary for realizing a large-scale engineering project, including reliability, probability of risk, decision analysis, and cost-benefit analysis. Application of the basic principles of probability theory and statistics in decision-making and an overview of the art of decision making under uncertainty. Budgeting and financing of engineering projects, public policy, economics and cost-benefit analysis of engineering projects. **Pre-requisite:** ENGR 1950, MATH 2610

ENGR 4810 Discrete System Modeling and Simulation 3 Credits

Course Description: A study of processes involving discrete events that occur at asynchronous times. Analysis of the effects of events in any component of the system on future events in other system components. Models of discrete systems account for the occurrences of events and the conditions necessary for events to occur. Design and construction of models for discrete systems, theory for the behavior of the discrete system and its components, and use of simulation software to examine the behavior of discrete systems. Topics will include modeling techniques, introduction to queueing theory,

random number generation, discrete event simulation, Monte Carlo simulation, simulated data analysis, and simulation variance reduction techniques. **Prerequisite**: MATH 2610

ENGR 4890 Special Topic in Engineering 3 Credits

Course Description: An In-depth study of a current topic of interest to the engineering profession. The topic to be covered will be identified in the course title. Components: Discussion, Laboratory, Lecture

Prerequisite(s): To be determined when the course is developed

BUSS 3810 Internet of Things 3 credits

Course Description: This course will study the use of the internet of things (IoT) in business and home environments. Students will identify and evaluate privacy, security, data collection, connectivity, machine to machine communication and the ever-growing importance of the internet. Students will evaluate the advancement in technology and efficiency made possible by IoT and examine the building blocks of the technology. (**Prerequisite:** BUSS 1910 & MATH 2830).

ENGR 4810 System Analysis & Design 4 credits

Course Description: Covers foundational methods for system classification and the use of the full system's life cycle and design processes to model and analyze engineering systems. Topics include requirements analysis, functional analysis, technical performance measurement, and development of system-level design models. Application areas, such as decision making and risk analysis, are integrated throughout. (Prerequisites: Junior Standing).

BUSS 4950 Entrepreneurship 3 credits

Course Description: This course examines main terms, concepts, and elements of the entrepreneurial process. It involves developing a business plan, examining legal issues, exploring franchises, and learning about financing and managing a new venture. Students learn concepts through both historical context and a research perspective. The course also examines the development of entrepreneurial processes and leadership.

BIOL 3510 Environmental Sciences 3 credits

Course Description: This course examines main terms, concepts, and elements of the entrepreneurial process. It involves developing a business plan, examining legal issues, exploring franchises, and learning about financing and managing a new venture. Students learn concepts through both historical context and a research perspective. The course also examines the development of entrepreneurial processes and leadership.

CHEM 1520 General Chemistry II 4 credits

Course Description: A continuation of CHEM 1510 covering properties of solids, liquids, gases, solutions, chemical kinetics, nuclear chemistry, and transition metals along with continued study of thermodynamics, electrochemistry, equilibrium, acid/base, and solution chemistry. Three hours of lecture and three hours of lab per week. **Prerequisites**: CHEM 1510 *Note: There is lab fee for this course*.

KINS 3300 Biomechanics 3 credits

Course Description: Anatomical and mechanical bases of human movement with application to more skillful and safe performance. Qualitative and quantitative methods of analysis are introduced.
Prerequisites: BIOL-1520 General Biology II, PHYS-3110 General Physics I.

Practicum and Experiential Learning: 3 credits from

Students should select one of the following courses:

ENGR 3920 Undergraduate Research (3 Credits)

Course Description: Introduction to research methods in engineering, literature review, data analysis, and design. A written report will be submitted to the sponsoring faculty member. A student may register for two to three credits in each semester for a maximum of three credits. Components: Research. **Prerequisites**: Junior standing and permission of department chair. Must be taken before taking ENGR 4910W Capstone Design I

ENGR 3930 Engineering Cooperative Experience (3 credits)

Course Description: Work experience in industry under the direction of the Faculty and the University Internship Program. During the co-op, the student is expected to work for an industry for a semester and a summer. On completion of the coop experience, a written report prepared under the direction of a faculty member is required. Components: Field Studies. **Prerequisites**: Junior standing and permission from the Chair. Must be taken before taking ENGR 4910W Capstone Design I

ENGR 3950 Engineering Internship (3 credits)

Course Description: Work experience in industry under the direction of the Faculty and Internship Program. This program is designed to cover the summer work experience. The internship is designed to provide experiential learning to the student during the summer period. Minimum duration of 400 hours of work under the direct supervision of an on-site engineering supervisor. On completion of the internship, a written report prepared under the direction of a faculty member is required. You may take this course more than once for a maximum of 3.0 units. Components: Field Studies.

Prerequisites: Junior Standing. Must be taken before taking ENGR 4910W Capstone Design I