Department of Engineering & Computer Science

Prof. David T. Crater, Chairperson

The goal of The Master's University Department of Engineering & Computer Science (ECS) is to prepare students to analyze, apply, and advance technology for the honor of Christ and Scripture and for the good of all creation. The Department prepares students to excel in an increasingly complex technical world while living lives that glorify God. An ECS degree helps prepare students for a variety of careers. ECS graduates are highly sought after by employers, and projected employment positions in these fields have a faster than average growth rate. Graduates may also pursue advanced degrees. ECS majors study engineering and computing both in theory and in practice. They also learn about the impact that technology is having on the world, and ways they can be used to honor Christ and Scripture as they pursue it in their careers.

CREDIT BY EXAMINATION

Students may receive credit by examination as follows:

- Credit may be granted for Introduction to Computer Programming (CS121P) and/or Calculus I (MA121).
- Credit may be granted if the student submits proof of earned test scores of 3 or above on the appropriate Advanced Placement tests of the College Board.
- The department reserves the right to interview and/or retest students before granting credit by examination.

COMPREHENSIVE EXAM

Students graduating with a degree in the ECS department will be required to take a comprehensive discipline-specific examination during their senior year, prior to graduation.

DEPARTMENT REQUIREMENTS

All ECS majors are required to earn a grade of C or above in all courses in their major. A student earning a grade below C must repeat the course until a grade of C or above is earned.

BACCALAUREATE PROGRAMS

The Department of Engineering & Computer Science offers three engineering degrees and one computer science degree. Computer Science can be pursued with three emphases: Artificial Intelligence, Computing Systems, or Information Systems. Engineering degrees can be achieved in Computer Engineering, Electrical Engineering, and Mechanical Engineering.

Computer Science

The Computer Science (CS) degree is designed to establish students in the core knowledge and principles of computation, both hardware and software. The goal of the program is balanced breadth and depth in the main elements of modern computing systems, languages, and technologies. Every CS student completes the core CS courses and then takes additional courses in his/her selected emphasis: Artificial Intelligence, Computing Systems, or Information Systems.

Computer Science: Artificial Intelligence

The Artificial Intelligence emphasis is designed to give students a rigorous introduction to AI and its major sub-fields. It emphasizes core AI techniques and methods while also introducing more advanced, state-of-the-art practices. The main sub-fields that are stressed are machine learning, natural language processing, and computer vision.

Computer Science: Computing Systems

The Computing Systems emphasis is designed to give students a firm foundation in the science of computers. It focuses on the technical side of computing, presenting basic theoretical material while maintaining a practical focus.

Computer Science: Information Systems

The Information Systems emphasis approaches computers from a business-oriented perspective. It emphasizes business processes and how computers can be used to improve them. Analysis and design are stressed, along with an appropriate knowledge of business principles.

Computer Engineering

The Computer Engineering (CPE) degree is designed to give students a thorough grounding in the science and applied mathematics of computing systems. The degree has some overlap with the EE degree, but with a greater emphasis on digital systems, especially computing devices. The study of hardware and of the interface between hardware and software is central to the program.

Electrical Engineering

The Electrical Engineering (EE) degree is designed to give students a thorough grounding in the science and applied mathematics of electrical and electronic systems. The degree has some overlap with the CPE degree but emphasizes electrical systems in general, including analog systems. The study, design, and control of electrical signals in hardware is central to the program.

Mechanical Engineering

The Mechanical Engineering (ME) degree is designed to provide students rigorous training in the fundamentals of mechanical system design, optimization, and control. From the forces exerted and experienced by system materials, both static and dynamic, to thermodynamics and heat transfer, to the rules of kinematic and robotic motion, to the use of computer-aided design (CAD) software, to the process of manufacturing, ME graduates are given comprehensive exposure to the theoretical and practical principles governing the physical systems humans build.

B.S. IN COMPUTER SCIENCE CORE COURSES

CS121P	Introduction to Computer Programming	3
CS132S	Data Structures & Algorithms	3
CS202H	Computer Hardware	3
CS301A	Computer Organization & Architecture	3
CS312N	Networking Principles & Architecture	3
CS321O	Operating Systems	3
CS321P	Programming Languages & Systems	3
CS322E	Software Engineering	3
CS342D	Database Management Systems	3
CS490I	Internship	2
CS492S	Senior Seminar	3
MA253	Discrete Mathematics	3
Total core courses		*35*

Artificial Intelligence Emphasis Courses

CS core courses		35
CS361A	Artificial Intelligence	3
CS361M	Machine Learning	3
CS362N	Natural Language Processing	3
CS362V	Computer Vision	3
Six units of the following		*6*
	MA121 Calculus I (3)	
	MA122 Calculus II (3)	
	MA231 Linear Algebra (3)	
	MA260 Elementary Statistics (3)	
	CS Upper Division Electives	
	General Upper Division Electives*	
Total units required for emphasis		*53*

**Upper division electives from engineering or other departments are acceptable if approved by ECS chair for incorporation into Senior Seminar Capstone Project.*

Computing Systems Emphasis Courses

CS core courses		35
CS122J	JavaScript Essentials	3
CS322X	Linux	3
CS341W	Web Application Development	3
CS351S	Computer Security I	3
Six units of the following		*6*
	MA121 Calculus I (3)	
	MA122 Calculus II (3)	
	MA231 Linear Algebra (3)	
	MA260 Elementary Statistics (3)	
	CS Upper Division Electives	
	General Upper Division Electives*	
Total units required for emphasis		*53*

**Upper division electives from engineering or other departments are acceptable if approved by ECS chair for incorporation into Senior Seminar Capstone Project.*

Information Systems Emphasis Courses

CS core courses		35
ACC210	Accounting Fundamentals I	3
MGT310	Management Theory	3
CS311C	Cloud Administration	3
CS392M	Project Management & Enterprise Software	3
Six units of the following		*6*
	MA260 Elementary Statistics (3)	
	CS Upper Division Electives	
	General Upper Division Electives*	
Total units required for emphasis		*53*

**Upper division electives from engineering or other departments are acceptable if approved by ECS chair for incorporation into Senior Seminar Capstone Project.*

Minor in Computer Science

The following courses are required for a minor in Computer Science:

CS121P	Introduction to Computer Programming	3
CS132S	Data Structures & Algorithms	3
CS202H	Computer Hardware	3
CS301A	Computer Organization & Architecture	3
CS312N	Networking Principles & Architecture	3
CS321O	Operating Systems	3
CS321P	Programming Languages & Systems	3
CS322E	Software Engineering	3
CS342D	Database Management Systems	3
Total units required for minor		*27*

ENGINEERING CORE COURSES

CS121P	Introduction to Computer Programming	3
MA121	Calculus I	3
MA122	Calculus II	3
MA221	Calculus III	3
MA231	Linear Algebra	3
CH151	General Chemistry I*	4
PS251	General Physics I*	4
MA253	Discrete Mathematics	3
MA282	Ordinary Differential Equations	3
MA365	Probability	3
Total core courses		*32*

**With corresponding lab.*

B.S. IN COMPUTER ENGINEERING COURSES

Engineering core courses		32
CS132S	Data Structures & Algorithms	3
CS202H	Computer Hardware	3
CS301A	Computer Organization & Architecture	3
CS321O	Operating Systems	3
ECE201C	Analog Circuits	3
ECE201CL	Analog Circuits Lab	1
ECE201D	Digital System Design	3
ECE201DL	Digital Design Lab	1
ECE302C	Microelectronics	3
ECE302CL	Microelectronics Lab	2
ECE302D	Digital Signal Processing	3
ECE302DL	DSP Lab	2
ECE301S	Semiconductors	3
ECE492S	Senior Design Project	3
Six units of the following		6
	ECS Upper Division Electives	
	General Upper Division Electives*	
Total units required		*74*

**Upper division electives from other departments are acceptable if approved by ECS chair for incorporation into Senior Design Project.*

B.S. IN ELECTRICAL ENGINEERING COURSES

Engineering core courses		32
CS132S	Data Structures & Algorithms	3
CS202H	Computer Hardware	3
ECE201C	Analog Circuits	3
ECE201CL	Analog Circuits Lab	1
ECE201D	Digital System Design	3
ECE201DL	Digital Design Lab	1
ECE312E	Electromagnetics	3
ECE301S	Semiconductors	3
ECE302C	Microelectronics	3
ECE302CL	Microelectronics Lab	2
ECE311S	Signals and Systems	3
ECE302D	Digital Signal Processing	3
ECE302DL	DSP Lab	2
ECE411C	Communication Systems	3
ECE492S	Senior Design Project	3
Three units of the following		3
	ECS Upper Division Electives	
	General Upper Division Electives*	
Total units required		*74*

**Upper division electives from other departments are acceptable if approved by ECS chair for incorporation into Senior Design Project.*

B.S. IN MECHANICAL ENGINEERING COURSES

Engineering core courses		32
ME201S	Statics & Mechanics of Materials	3
ME201SL	Statics Lab	1
ME211C	CAD & SolidWorks	3
ME211CL	CAD Lab	1
ECE201C	Analog Circuits	3
ECE201CL	Analog Circuits Lab	1
ME202D	Dynamics	3
ME202DL	Dynamics Lab	1
ME301F	Fluid Mechanics	3
ME302K	Kinematics & Robotics	3
ME302KL	Kinematics Lab	1
ME311T	Thermodynamics	3
ME312H	Heat Transfer	3
ME321M	Machine Design	3
ME322D	Design & Manufacturing	3
ME322DL	Manufacturing Lab	1
ME492S	Senior Design Project	3
Three units of the following		3
	ECS Upper Division Electives	
	General Upper Division Electives*	
Total units required		*74*

**Upper division electives from other departments are acceptable if approved by ECS chair for incorporation into Senior Design Project.*

Course Offerings in Engineering & Computer Science

COMPUTER SCIENCE

CS121P Introduction to Computer Programming (3)
This course introduces students to computer organization, programming, and algorithm development. The course covers data representation, storage, problem solving, and programming techniques and principles using the Python programming language.

CS122J JavaScript Essentials (3)
This course provides a grounding in modern JavaScript (ES6+). Introductory topics include data types, variables and scoping, logic operations, and common function patterns. Intermediate topics include prototypal inheritance, asynchronous events, and module importing/exporting. In addition to using JavaScript in the browser, students will incorporate NodeJS to run powerful routines on the server. Students will also leverage developer tools such as IDEs, linters, testing frameworks, and code repositories.

CS132S Data Structures & Algorithms (3)
This course continues to develop students' programming abilities, covering algorithmic analysis, internal search and sort methodology, and several commonly used data structures using the Python programming language. *Prerequisite: CS121P.*

CS202H Computer Hardware (3)
Presents an introduction to computer hardware concepts, including components, their structures, and their interfaces. Integral to this class is the tight cohesion of theory (lecture) and practice (hands-on labs).

CS208 Topics - Hardware, Computer System Organization (3)
May be repeated for credit if content is different. Topics include printed circuit boards; communication hardware, interfaces, and storage; integrated circuits; very large scale integration design; power and energy; electronic design automation; hardware validation; hardware testing; robustness; emerging technologies; architectures; embedded and cyber-physical systems; real-time systems; dependable and fault-tolerant systems and networks; etc. *Prerequisite: instructor's consent.*

CS218 Topics - Networks (3)
May be repeated for credit if content is different. Topics may include network architectures; network protocols; network components; network algorithms; network performance evaluation; network properties; network services; network types; etc. *Prerequisite: instructor's consent.*

CS228 Topics - Software, Software Engineering (3)
May be repeated for credit if content is different. Topics may include software organization and properties; software notations and tools; software creation and management; etc. *Prerequisite: instructor's consent.*

CS238 Topics - Computation: Theory, Mathematics (3)
May be repeated for credit if content is different. Topics may include models of computation; formal languages and automata theory; computational complexity and cryptography; logic; design and analysis of algorithms; randomness, geometry and discrete structures; theory and algorithms for application domains; semantics and reasoning; discrete mathematics; probability and statistics; mathematical software; information theory; mathematical analysis; continuous mathematics; etc. *Prerequisite: instructor's consent.*

CS248 Topics - Information Systems (3)
May be repeated for credit if content is different. Topics may include data management systems; information storage systems; information systems applications; World Wide Web; information retrieval; etc. *Prerequisite: instructor's consent.*

CS258 Topics - Security and Privacy (3)
May be repeated for credit if content is different. Topics may include cryptography; formal methods and theory of security; security services; intrusion/anomaly detection and malware mitigation; security in hardware; systems security;

network security; database and storage security; software and application security; human and societal aspects of security and privacy; etc. *Prerequisite: instructor's consent.*

CS261A Artificial Intelligence for Non-Majors (3)
This course introduces artificial intelligence concepts, history, current developments, methods, techniques, and approaches.

CS261M Machine Learning for Non-Majors (3)
This course will introduce students to machine learning with its basic techniques and algorithms. This course covers basic knowledge about data, popular data sources, and some of the most popular algorithms and techniques such as decision trees, neural networks, support vector machines, clustering, and various reinforcement learning algorithms.

CS268 Topics - Computing Methodologies (3)
May be repeated for credit if content is different. Topics may include symbolic and algebraic manipulation; parallel computing methodologies; artificial intelligence; machine learning; modeling and simulation; computer graphics; distributed computing methodologies; concurrent computing methodologies; etc. *Prerequisite: instructor's consent.*

CS270A Information Systems Applications (3)
This course teaches computer applications accepted as standard in the business world. Emphasis is placed on the practical implementation of end-user software in a business environment. The use of spreadsheet and database programs to support business processes will be studied in depth. Excel and Access will be used in this class. (Lab fee: $25.)

CS278 Topics - Applied Computing (3)
May be repeated for credit if content is different. Topics may include electric commerce; enterprise computing; physical sciences and engineering; life and medical sciences; law, social, and behavioral sciences; computer forensics; arts and humanities; computers in other domains; operations research; education; document management and text processing; etc. *Prerequisite: instructor's consent.*

CS288 Topics - Human-Centered Computing (3)
May be repeated for credit if content is different. Topics may include human-computer interaction; interaction design; collaborative and social computing; ubiquitous and mobile computing; visualization; accessibility; etc. *Prerequisite: instructor's consent.*

CS288W Web Design (3)

CS298 Topics - Social and Professional Computing (3)
May be repeated for credit if content is different. Topics may include professional topics; computing/technology policy; user characteristics; etc. *Prerequisite: instructor's consent.*

CS301A Computer Organization & Architecture (3)
This course introduces computer hardware organization, design, structure, and relationships. Mechanics of digital computer information storage, transfer, and control are addressed. Also explored are fundamentals of logic design, computer arithmetic, addressing, instruction sets and assembler languages, and memory organization. *Prerequisites: CS132S and CS202H.*

CS311C Cloud Administration (3)
This course covers preparation for CompTIA's Cloud+ examination. Topics include configuration and deployment, security, maintenance, management, and troubleshooting. *Prerequisites: CS342D and CS312N, or instructor's consent.*

CS312N Networking Principles & Architecture (3)
This course introduces computer networks. It includes concepts and methods of computer communications, hardware and software components, configurations, and standard layers of communication protocols. *Prerequisites or Corequisites: CS132S and CS202H.*

CS321O Operating Systems (3)
An introductory study of the organization and architecture of computer operating systems. Major principles explored include virtualization, concurrency, and persistence. *Prerequisites: CS132S and CS202H.*

CS321P Programming Languages & Systems (3)
Introduces programming language design and theory. The course covers syntax and semantic analysis, computability and complexity, and language design and models. *Prerequisite: CS132S.*

CS322E Software Engineering (3)
This course is an introduction to the concepts and practices of software engineering. Topics include software processes, development operations, Agile methodology, requirements engineering, software architecture, project planning, user stories, system design, testing and integration, test-driven development, and software maintenance. *Prerequisite: CS121P.*

CS322X Linux (3)
This course focuses upon the Linux command line, and covers learning the bash shell, configuration and the environment, common tasks and essential tools, and writing shell scripts. Students also have the option of preparing for CompTIA's Linux+ examination, which includes topics such as hardware and system configuration, systems operation and maintenance, security, Linux troubleshooting and diagnostics, automation and scripting. *Prerequisite: CS121P.*

CS341W Web Application Development (3)
This course teaches web application design and development. Students will learn to develop a web-based application using current internet technologies such as HTML, CSS, JavaScript, and Python. Topics include front- and back-end development, web services, client and server programming, and web design frameworks. *Prerequisites: CS121P, CS122J, and CS342D.*

CS342D Database Management Systems (3)
Design, implementation, and management of business database systems. Includes data analysis, design, and normalization.

CS351S Computer Security I (3)
This course covers preparation for CompTIA's Security+ examination. Topics include threats, attacks, vulnerabilities, technologies and tools, architecture and design, identity and access management, risk management, cryptography, and public key infrastructure. *Prerequisites: CS312N and CS322X, or instructor's consent.*

CS361A Artificial Intelligence (3)
This course introduces artificial intelligence concepts, history, current developments, methods, techniques, and approaches. *Prerequisites: CS132S.*

CS361M Machine Learning (3)
This course will introduce students to machine learning with its basic techniques and algorithms. This course covers basic knowledge about data, popular data sources, and some of the most popular algorithms and techniques such as decision trees, neural networks, support vector machines, clustering, and various reinforcement learning algorithms. *Prerequisites: CS132S.*

CS362N Natural Language Processing (3)
This course introduces natural language processing concepts, history, current developments, methods, techniques, and approaches. *Prerequisites: CS132S.*

CS362V Computer Vision (3)
This course introduces computer vision concepts. Topics may include image formulation, image processing, optimization and learning, deep learning, recognition, feature detection and matching, image alignment and stitching, motion estimation, computational photography, structure from motion, depth estimation, 3D reconstruction, image-based rendering. *Prerequisites: CS132S.*

CS392M Project Management & Enterprise Software (3)
This course covers preparation for CompTIA's Project+ examination. Topics include project properties, roles, responsibilities, phases, cost control, team organizational structures, schedules, Agile methodology, management, project constraints, risk strategies and activities, communication and change management, project tools, and documentation. Includes an overview of enterprise software systems, including ERP and CRM. *Prerequisite or Corequisite: CS322E.*

CS408 Topics - Hardware, Computer System Organization (3)
May be repeated for credit if content is different. Topics may include printed circuit boards; communication hardware, interfaces, and storage; integrated circuits; very large scale integration design; power and energy; electronic design automation; hardware validation; hardware testing; robustness; emerging technologies; architectures; embedded and cyber-physical systems; real-time systems; dependable and fault-tolerant systems and networks; etc. *Prerequisite: instructor's consent.*

CS408R Robotics (3)

CS418 Topics - Networks (3)
May be repeated for credit if content is different. Topics may include network architectures; network protocols; network components; network algorithms; network performance evaluation; network properties; network services; network types; etc. *Prerequisite: instructor's consent.*

CS428 Topics – Software, Software Engineering (3)
May be repeated for credit if content is different. Topics may include software organization and properties; software notations and tools; software creation and management; etc. *Prerequisite: instructor's consent.*

CS428C C/C++ Programming (3)
CS428J Java Programming (3)

CS438 Topics – Computation: Theory, Mathematics (3)
May be repeated for credit if content is different. Topics may include models of computation; formal languages and automata theory; computational complexity and cryptography; logic; design and analysis of algorithms; randomness, geometry and discrete structures; theory and algorithms for application domains; semantics and reasoning; discrete mathematics; probability and statistics; mathematical software; information theory; mathematical analysis; continuous mathematics; etc. *Prerequisite: instructor's consent.*

CS438A Algorithms (3)
CS438Q Quantum Computation (3)

CS448 Topics - Information Systems (3)
May be repeated for credit if content is different. Topics may include data management systems; information storage systems; information systems applications; World Wide Web; information retrieval; etc. *Prerequisite: instructor's consent.*

CS448D Data Science (3)

CS458 Topics - Security and Privacy (3)
May be repeated for credit if content is different. Topics may include cryptography; formal methods and theory of security; security services; intrusion/anomaly detection and malware mitigation; security in hardware; systems security; network security; database and storage security; software and application security; human and societal aspects of security and privacy; etc. *Prerequisite: instructor's consent.*

CS458A Cybersecurity Analyst (CySA+) (3)
CS458P Penetration Testing (PenTest+) (3)
CS458S CompTIA Advanced Security Practitioner (3)

CS468 Topics - Computing Methodologies (3)
May be repeated for credit if content is different. Topics may include symbolic and algebraic manipulation; parallel computing methodologies; artificial intelligence; machine learning; modeling and simulation; computer graphics; distributed computing methodologies; concurrent computing methodologies; etc. *Prerequisite: instructor's consent.*

CS468G Computer Graphics (3)
CS468P Parallel Computing (3)

CS478 Topics - Applied Computing (3)
May be repeated for credit if content is different. Topics may include electric commerce; enterprise computing; physical sciences and engineering; life and medical sciences; law, social, and behavioral sciences; computer forensics; arts and humanities; computers in other domains; operations research; education; document management and text processing; etc. *Prerequisite: instructor's consent.*

CS478B Bioinformatics (3)

CS488 Topics - Human-Centered Computing (3)
May be repeated for credit if content is different. Topics may include human-computer interaction; interaction design; collaborative and social computing; ubiquitous and mobile computing; visualization; accessibility; etc. *Prerequisite: instructor's consent.*

CS488G Game Programming (3)
CS488M Mobile Application Development (3)
CS488V Visualization (3)

CS490I Internship (2)
Provides an applied CS-related learning experience in a supervised work environment. *Prerequisites: junior or senior standing and instructor's consent.*

CS492S Senior Seminar (3)
This senior seminar course is designed to integrate the field of Computer Science into a biblical worldview, including the ethical issues relating to the field. It also provides students the opportunity to demonstrate their proficiency and knowledge through a set of research and writing assignments and a standardized Major Field Test. *Prerequisite: senior standing.*

CS498 Topics - Social and Professional Computing (3)
May be repeated for credit if content is different. Topics may include professional topics; computing/technology policy; user characteristics; etc. *Prerequisite: instructor's consent.*

CS498E Ethics in Computer Science (3)

ELECTRICAL AND COMPUTER ENGINEERING

ECE201C Analog Circuits (3)
Basic circuit analysis using Ohm's Law, Kirchhoff's Laws; independent and dependent sources; Thevenin and Norton source transformations; transient, sinusoidal, and complex frequency responses in RC, RL, and RLC circuits; phasor analysis and Laplace transforms. Students use LTSpice circuit simulation and MATLAB. *Prerequisite: MA122. Corequisites: ECE201CL, MA231.* Fee: $500

ECE201CL Analog Circuits Lab (1)
Practical, hands-on experience with topics covered in ECE201C. Students assemble prototype RC, RL, RLC circuits, learn to use laboratory equipment such as meters, power supplies, function generators, oscilloscopes, and spectrum analyzers. Students evaluate and learn to recognize ideal and non-ideal components. For some assignments, students will implement their own designs. *Corequisite: ECE201C.* Fee: $500.

ECE201D Digital System Design (3)
Hierarchical, modular design of combinational and sequential circuits, along with introductions to modeling, simulation, analysis, synthesis, and prototyping of digital systems. *Prerequisites: MA122, CS202H. Corequisite: ECE201DL.*

ECE201DL Digital Design Lab (1)
Hierarchical digital design using concepts taught in ECE201D and standard design software. Computer-aided design tools give students exposure to state-of-the-art design methods, techniques, and standards. *Corequisite: ECE201D.*

ECE301S Semiconductors (3)
Designed to bridge the fundamentals of semiconductors with applications. The course is broken down into [1] *quantitative* assessment of the fundamentals of semiconductors: band-gaps and carriers; and [2] a *qualitative* breakdown

of semiconductor applications in microelectronics: pn junction diodes and field effect devices. MATLAB is used to solve problems. *Corequisite: MA282.* Fee: $100.

ECE302C Microelectronics (3)
Advanced analog circuit analysis and design, including diodes, transistors, op amps, feedback, oscillators, and active filters. *Prerequisites: ECE201C, ECE201CL. Corequisite: ECE302CL.*

ECE302CL Microelectronics Lab (2)
Practical, hands-on experience with topics covered in ECE302C. *Prerequisites: ECE201C, ECE201CL. Corequisite: ECE302C.*

ECE302D Digital Signal Processing (3)
Fundamentals of DSP, including the Sampling Theorem, discrete-time Fourier analysis, power spectrum, fast Fourier transform (FFT), Z-transform, and digital filter design and implementation. *Prerequisites: ECE201D, ECE201DL. Corequisite: ECE302DL.*

ECE302DL DSP Lab (2)
Practical, hands-on experience with topics covered in ECE302D, emphasizing computer-based signal processing. *Corequisite: ECE302D.*

ECE311S Signals and Systems (3)
Introduction to the theory of electrical and electronic signals and systems. Continuous-time linear systems and signals, mathematical representations, Fourier and Laplace transforms, convolution, input and output responses, stability, and computational tools. *Prerequisite: ECE201C.*

ECE312E Electromagnetics (3)
Cross-listed with PS252. An introduction to the relationship between electricity and magnetism, their laws, and primary applications. Lab not required. *Prerequisites: MA121, PS251.*

ECE411C Communication Systems (3)
Frequency and time domain, detection of signals, modulation, basic information theory, noise, and introduction to radio frequency (RF) and optical systems for communications. *Prerequisites: ECE311S, ECE312E.*

ECE492S Senior Design Project (3)
This senior design course is designed to integrate the fields of electrical and computer engineering into a biblical worldview, including the ethical issues relating to the field, and provide students the opportunity to demonstrate their accumulated knowledge by designing, testing, and documenting a real system and passing a standardized Major Field Test. *Prerequisite: senior standing.*

MECHANICAL ENGINEERING

ME201S Statics & Mechanics of Materials (3)
This course covers the statics of particles, the response of rigid objects in equilibrium to applied forces, and fundamentals of mechanics of deformable bodies. Topics include vector description of forces and moments, free body diagrams, frictional forces, centroids, area moments of inertia, and distributed loads. Analysis of the stresses and deformations in structures, including axial loading of bars, torsion of circular rods, bending of beams, shearing loads, and problems with combined loadings. *Prerequisites: MA122, PS251. Corequisite: ME201SL.*

ME201SL Statics Lab (1)
Laboratory to accompany ME201S. Introduces students to fundamental concepts in statics, equilibrium of forces, and mechanical testing of materials. Students learn about friction, reaction forces, deformation of bars, plates and trusses, stress and strains, as well as the basic components of a computerized data acquisition system and how these systems are used in mechanical testing. Students also gain experience using a testing machine to determine basic mechanical properties of a range of materials, including metals, woods, composites, and elastomers. They do experiments to evaluate the behavior of bars and plates under various types of loading. *Corequisite: ME201S.*

ME202D Dynamics (3)
An introduction to dynamics and vibrations of mechanical systems. Topics covered include vector functions and fundamental laws of Newtonian mechanics, force-momentum formulation for systems of particles and rigid bodies in planar motion, work-energy concepts, impulse-momentum, force analysis, and mechanical vibration. Students become familiar with Lagrange's equations for systems of particles and rigid bodies in planar motion, and linearization of equations of motion. After this course, students will be able to evaluate free and forced vibration of linear mechanical systems and matrix eigenvalue problems. *Prerequisite: ME201S. Corequisite: ME202DL.*

ME202DL Dynamics Lab (1)
A laboratory to accompany ME202D. Investigates the dynamic properties of systems. Both linear and rotary systems are investigated. Students learn about inertia, centrifugal forces, Coriolis effect, various mechanisms, as well as gear trains and free and forced vibration of systems. *Corequisite: ME202D.*

ME211C CAD & SolidWorks (3)
Introduction to computer aided design. Students will learn to use a solid modeling design system for the purpose of creating their own designs. Design methods and techniques will be studied through development of increasingly complex devices. Each student is expected to design a device of his/her own choosing. Students master SolidWorks in order to realize their designs. *Corequisite: ME211CL.*

ME211CL CAD Lab (1)
Laboratory to accompany ME211C. The laboratory helps students use SolidWorks software to create components and assembly designs. Each student has a project of a chosen, established design to accomplish utilizing SolidWorks. *Corequisite: ME211C.* Fee: $300.

ME302F Fluid Mechanics (3)
Introduction to fluid properties, fluid statics and dynamics, and fluid flow. Topics include pressure, hydrostatics, and buoyancy; open systems and control volume analysis; mass conservation and momentum conservation for moving fluids; viscous fluid flows, flow through pipes; dimensional analysis; boundary layers, and lift and drag on objects. Students formulate the models necessary to study, analyze, and design fluid systems and develop problem-solving skills essential to engineering fluid mechanics in practical applications, such as propulsion systems, aerodynamics, and piping systems. *Prerequisites: ME202D, ME211C.*

ME302K Kinematics & Robotics (3)
An overview of robotic systems modeling and first insight into how to use these models to control robotic systems. Similarities between different types of robots, such as robot arms, legged and wheeled machines, and flying systems are used to illustrate modeling techniques. Topics include position, rotation, linear and angular velocity in moving bodies, kinematics of systems of bodies, and kinematic control methods. Dynamics using the Newton-Euler and Lagrange methods are also covered, as well as dynamics and inverse dynamics of floating base systems, joint-space and task-space dynamics control. *Prerequisites: CS121P, ME202D, ME211C. Corequisite: ME302KL.*

ME302KL Kinematics Lab (1)
Practical, hands-on experience with topics covered in ME302K. *Corequisite: ME302K.*

ME311T Thermodynamics (3)
Covers concepts and principles of thermodynamics using an engineering approach. Topics include conservation of mass and energy, entropy balance; thermodynamic laws; the properties, equations of state, and processes and cycles for reversible and irreversible thermodynamic systems. Thermodynamic principles are applied to modern engineering systems and processes including cyclic processes used for power generation and refrigeration. *Prerequisite: ME202D.*

ME312H Heat Transfer (3)
Introduces temperature and the flow of heat, and the analysis of principal heat transfer modes, such as conduction, natural and forced convection, and radiation. Both steady-state and time-varying situations are considered. Also introduces industrial applications of heat transfer such as heat exchangers, waste heat recovery, and steam generators in a nuclear plant or in a gas turbine electrical generator. *Prerequisites: ME302F, ME311T, MA282.*

ME321M Machine Design (3)
Covers the conversion of one type of motion to another, including not only motion type and direction but rotational speed and torque. Examines fundamentals of machine design, including analysis and design of mechanical components. Begins with a review and further development of stress analysis (statics). Covers shafts, fasteners, belt and chain drives, brakes, gears, springs, and bearings. Includes predicting static and fatigue failures for various loadings and materials. *Prerequisites: ME202D, ME211C.*

ME322D Design & Manufacturing (3)
Examines the design of parts, components, or products for a specific manufacturing method. Presents the study of manufacturing processes, including interrelationships between materials, the manufacturing process, and the design of components. Interpretation of experimental data, comparison of measurements to numerical/analytical predictions, and formal, engineering report writing. *Prerequisites: ME202D. Corequisite: ME322DL.*

ME322DL Manufacturing Lab (1)
Practical, hands-on experience with topics covered in ME322D. *Corequisite: ME322D.*

ME492S Senior Design Project (3)
This senior design course is designed to integrate the field of mechanical engineering into a biblical worldview, including the ethical issues relating to the field, and provide students the opportunity to demonstrate their accumulated knowledge by designing, testing, and documenting a real system and passing a standardized Major Field Test. *Prerequisite: senior standing.*