MIZZOU ENGINEERING engineering.missouri.edu

University of Missouri

Department of Biological Engineering

What is it?

BIOLOGICAL ENGINEERS develop products and systems that improve human and animal health, use bioresources and protect the environment. Mizzou's broadly based curriculum prepares students for careers in biomedical engineering (including pre-medicine), bioprocess engineering and bioenvironmental engineering.

What can you do?

You can work in industries such as medicine, food, agriculture, environmental protection and others. Advances in biomedical research and biotechnology make this a field of the future with varied career possibilities.

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AVERAGE SALARY OFFER $53,400*

DEGREES:

- Bachelor of Science in Biological Engineering BS BE
- Master of Science in Biological Engineering MS BE
- Doctoral Degree in Biological Engineering PhD BE

*2009 University of Missouri Destination Survey

TYPICAL BIOLOGICAL ENGINEERING CURRICULUM

FIRST SEMESTER			SECOND SEMESTER		
FRESHMAN YEAR					
BIO EN 1000	Intro. to Bio. Engineering	1	BIO SCI 1500	Intro to Biological Systems	5
Chem 1320	Gen. Chemistry II w/Lab	3	ECON 1014	Microeconomics	3
ENGR 1100	Engr. Design Graphics	2	ENGR 1000	Expo. & Argumentation	3
Math 1500	Analytical Geom. & Calc.	5	Math 1700	Calculus II	5
Am. History or Am. Govt. elective		3			
	TOTAL CREDIT HOURS	14		TOTAL CREDIT HOURS	16
SOPHOMORE YEAR					
Chem 2050	Intro. to Organic Chem. w/Lab	5	BIO EN 2000	Prof. Dev. in Engineering	2
Math 2300	Calculus III	3	ENGR 1200	Stats. & Elem. Strength of Mats.	3
Physcs 2750	University Physics I	5	Math 4100	Differential Equations	3
BIO EN 2080	Programming for Engineers	3	Physcs 2760	University Physics II	5
			Comm 1200	Speech	3
	TOTAL CREDIT HOURS	16		TOTAL CREDIT HOURS	16
JUNIOR YEAR					
BIO EN 2180	Engr. Analysis of Bioprocesses	3	BIO EN 3180	Heat & Mass Trans. in Bio Syst.	3
ENGR 2300	Engr. Thermodynamics	3	ENGR 2200	Intermed. Strengh of Materials	3
Technical electives/Fluid Mechanics		6	Stat 4710	Mathematical Statistics	3
Social or Behavioral Science elective		3	*Bio Science elective*		3
Math, Science, Engineering elective		3	*Humanities/Fine Arts elective*		3
TOTAL CREDIT HOURS		18		TOTAL CREDIT HOURS	15
SENIOR YEAR					
BIO EN 4980	Bio. Engineering Design	3	BIO EN 4380	Appl. Electronic Instrumentation	4
BIO EN 4280	Bio Engineering Techniques	3	*Tech electives*		9
Tech elective		3	*Social/Behavioral Science elective*		3
Bio elective		3			
Humanity/Fine Art elective		3			
	TOTAL CREDIT HOURS	15		TOTAL CREDIT HOURS	16

TOTAL CREDIT HOURS 126

Within Biological Engineering, you may choose from three emphases: BIOENVIRONMENTAL, BIOMEDICAL AND BIOPROCESSING

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University of Missouri

Department of Biological Engineering

AREAS OF EMPHASIS

Within Biological Engineering, you may choose from three emphases: Bioenvironmental, Biomedical, and Bioprocessing Engineering.

BIOENVIRONMENTAL EMPHASIS

Bioenvironmental engineering provides advances in environmental protection through water and air quality systems and advanced conservation.

- Introduction to Water Quality
- Soil and Water Conservation Engineering
- Irrigation and Drainage Engineering
- Watershed Modeling using GIS
- Solid Waste Management
- Hazardous Waste Management
- Water and Wastewater Treatment
- Water Quality

BIOMEDICAL EMPHASIS

Biomedical engineering provides health care advances through medical processes, disease diagnosis and treatment, and patient rehabilitation.

- Biomaterials
- Bioelectricity
- Interfaces for Implantable Devices
- Molecular and Cellular Mechanics
- Orthopaedic Biomechanics
- Nanobiotechnology
- Biomedical Imaging

BIOPROCESSING EMPHASIS

Bioprocessing engineering facilitates value-added products and food safety through innovative technological use of renewable biological materials and enhanced packaging, quality, and distribution of bioproducts.

- Biomaterials
- Food Process Engineering I
- Mass and Energy Balance
- Principles of Chemical Engineering I
- Principles of Chemical Engineering II
- Biochemical Engineering Operations
- Intro. to Biochemical Engineering

BIOLOGICAL ENGINEERING COURSES

BIOL EN 1000: Introduction to Biological Engineering (1-2). For first semester engineering students. Develop appreciation for professional engineering. Students will participate with senior design students to conceptualize a case-study problem.

BIOL EN 2000: Professional Development in Engineering (1-2). A review of professional opportunities, registration, ethics, and societies. Prerequisite: sophomore standing.

BIOL EN 2080: Introduction to Programming for Engineers (3). This course teaches how to write scientific programs for analysis of data and simulation of physical phenomena using Matlab. Prerequisites: Mathematics [MATH] 1500. Graded on A/F basis only.

BIOL EN 2180: Engineering Analysis of Bioprocesses (3). Material and Energy Balances. Integrating principles of physics, chemistry and mathematics to analyze steady state and transient biological/ biomedical processes. Prerequisites: Mathematics [MATH] 1700, Chemistry [CHEM] 1320, Physics [PHYSCS] 2750. Graded on A/F basis only.

BIOL EN 3001: Topics in Biological Engineering (3). Current and new technical developments in biological engineering. Prerequisite: instructor's consent.

BIOL EN 3050: Environmental Control for Biological Systems (3). Systems for controlling the
physical environments (heat, moisture, light, contaminating organism, chemicals) for plant and animal systems including livestock, aquacultures, crops and agricultural products. Prerequisites: Engineering [ENGINR] 2300 and Mathematics [MATH] 4100.

BIOL EN 3070: Biological Fluid Mechanics (3).
Basic principles of fluid mechanics applied to transport processes in biological systems. Prerequisites: Physics [PHYSCS] 2750 and Mathematics [MATH] 1700. Graded on A/F basis only.

BIOL EN 3170: Biomaterials (3). Engineering Sciences and design will be leverage for the study and design of biomaterials. Understanding the structure-property relationship between biomaterials and tissue will be addressed for implant design. Corequisite: Biological Engineering [BIOL_EN] 2180, Engineering [ENGINR] 2200 or instructor's consent.

BIOL EN 3180: Heat and Mass Transfer in Biological Systems (3). Principles of heat and mass transfer and their application to biomedical, bioenvironmental, and bioprocessing areas. Prerequisites: Engineering [ENGINR] 2300 or Chemical Engineering [CH_ENG] 3261, or concurrently.

BIOL EN 4001: Topics in Biological Engineering (3). Current and new technical developments in biological engineering. Prerequisite: instructor's consent.

BIOL EN 4070: Bioelectricity (3). Application of engineering approaches to understand bioelectricity at the cellular level including the equivalent circuit of cell membranes and the electronic design of patch-clamp amplifiers. Prerequisites: Physics [PHYSCS] 2760 and Biological Engineering [BIOL EN] 3180 or instructor's consent.

BIOL EN 4080: Engineering Computation (3).
An introduction to numerical methods relevant to biological engineering in the context of scientific computing. Prerequisite: Mathematics [MATH] 4100. Graded on A/F basis only.

BIOL EN 4085: Problems in Biological Engineering (1-5). Supervised independent study at

the undergraduate level. Prerequisite: instructor's consent.

BIOL EN 4150: Soil and Water Conservation Engineering (3). (same as Civil Engineering [CV ENG] 4710). Urban and rural run-off and erosion analysis. Design and layout of erosion control structures. Prerequisites: Biological Engineering [BIOL EN] 2180 or Civil Engineering [CV ENG] 3200 or instructor's consent.

BIOL EN 4160: Food Process Engineering (3).
Study of transport phenomena and unit operations in food processing systems. Emphasis on fluid flow and heat transfer in food processing, preservation processes, refrigeration, freezing, psychrometrics, and dehydration. Prerequisite: Biological Engineering [BIOL EN] 3180 or instructor's consent.

BIOL EN 4170: Biomaterials Interfaces of Implantable Devices (3). Surface structures and properties to improve biocompatibility will be studied. Engineering sciences and design will be leverage in the design of an improved biocompatible surface. Prerequisites: Biological Engineering [BIOL EN] 3170 or instructor's consent.

BIOL EN 4231: Transport Phenomena in Materials Processing (3). (same as Mechanical and Aerospace Engineering [MAE] 4231). Applications of fluid flow, heat transfer, and mass transfer in steady-state and unsteady-state materials processing with applications to metals, polymers, and ceramics. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3200, 3400, 4300 (or equivalent courses; and Mathematics [MATH] 4100. Graded on A/F basis only.

BIOL EN 4250: Irrigation and Drainage Engineering (3). Soil, water, plant relationships. Water supplies and design of surface, sprinkler and drip irrigation systems. Surface and tile drainage. Prerequisites: Civil Engineering [CV ENG] 3700 or Mechanical and Aerospace Engineering [MAE] 3400 or Biological Engineering [BIOL EN] 2180.

BIOL EN 4260: Food Process Engineering II (3).
Continuing study of transport phenomena and unit operations in food processing systems. Emphasis on fluid food evaporation concentration food dehydration, contact equilibrium processes and mechanical separation processes. Prerequisite: Biological Engineering [BIOL_EN] 4160 or instructor's consent.

BIOL EN 4270: Design of Experiments and Statistical Quality Control for Process Engineers (3).
(same as Chemical Engineering [CH_ENG] 4270). A practical statistical tool box for experimenters including comparison of process means, effects of variables, design and interpretation of factorial experiments, and statistical quality control. Prerequisite: experience with Excel or instructor's consent.

BIOL EN 4280: Survey of Bioengineering Techniques (3). Laboratory techniques to train students in Bioelectricity, Biomechantronics, Bioenvironment, Biomaterials, Biophotonics, Bioprocessing. Prerequisites: senior standing. Graded on A/F basis only.

BIOL EN 4315: Introduction to Bioprocess Engineering (3). (same as Chemical Engineering [CH_ ENG] 4315). This general introduction to bioprocess engineering covers the fundamentals of microbiology and biochemistry in the context of a biomass refinery. Analyses proceed through the use of mass balances, energy balances, and empirical or theoretical models. Prerequisites: Biological Engineering [BIOL EN] 2180 (for Biological Engineering students) or Chemical Engineering [CH ENG] 2225 (for Chemical Engineering students) or instructor's consent.

BIOL EN 4316: Biomass Refinery Operations (3). (same as Chemical Engineering [CH_ENG] 4316). Design and operation of processes for conversion and/or fractionation of biomass and associated upstream and downstream unit operations. Emphasis on separations and product recovery. Prerequisite: Biological Engineering [BIOL EN] 2180 or Chemical Engineering [CH ENG] 2225 (for Chemical Engineering students) or instructor's consent.

BIOL EN 4350: Watershed Modeling Using GIS (3). (same as Civil Engineering [CV ENG] 4720). Watershed evaluation using AVSWAT for hydrology, sediment yield, water quality; includes USLE, MUSLE, WEPP. Procedures for model calibration/ sensitivity data analysis. Prerequisites: Biological Engineering [BIOL EN] 2180 or Civil Engineering [CV ENG] 3200 or instructor's consent.

BIOL EN 4380: Applied Electronic Instrumentation (4). Fundamental concepts and theories, basic electronics, analog and digital circuits, signal conditioning, computer interfacing, measurement principles and techniques used in developing computer-based instrumentation systems. Prerequisite: Physics [PHYSCS] 2760.

BIOL EN 4470: Biomolecular Engineering and Nanobiotechnology (3). Generation of biotechnological products, devices through integration of engineering approaches with contemporary biology, chemistry and nanotechnology starting at the molecular level. Prerequisites: senior/graduate standing or instructor's consent. Graded on A/F basis only.

BIOL EN 4480: Physics and Chemistry of Materials (3). (same as Physics [PHYSCS] 4190 and Chemistry [CHEM] 4490 and Nuclear Engineering [NU ENG] 4319). Physics and Chemistry of Materials is a 3 credit hours undergraduate/graduate level course offered every spring semester for students from Physics, Chemistry, Engineering and Medical Departments and consists of lectures, laboratory demonstrations, two mid term and one final exam. Graduate students will submit a term paper. Prerequisite: Physics [PHYSCS] 2760/Chemistry [CHEM] 1320 or equivalent/prior approval by instructor.

BIOL EN 4550: Design of Livestock Waste Management Systems (3). Development and application of design criteria to the design of agricultural waste management facilities. Prerequisites: Chemistry [CHEM] 1310 and Civil Engineering [CV_ENG] 3700, Mechanical and Aerospace Engineering [MAE] 3400 or instructor's consent.

BIOL EN 4570: Fluorescent Imaging (3).
Principles and applications of fluorescent imaging. The course covers: Image formation in microscope; Fundamentals of fluorescence and fluorescent microscopy; molecular and cellular fluorescent imaging. Prerequisites: Biological Sciences [BIO_SC] 1500 and Biological Engineering [BIOL_EN] 2180 or instructor's consent.

BIOL EN 4575: Modeling and Experiments in Neuroscience (4). Interdisciplinary course with laboratory and modeling components. Explores basic computational and neurobiological concepts at the cellular and network levels. Introduction to neuronal processing using experimental methods in neurobiology; modeling of neurons and neuron-networks. Prerequisites: Mathematics [MATH] 1500 or equivalent and junior standing. Graded on A/F basis only.

BIOL EN 4580: Mechanical Systems Engineering (3). Fundamentals and applications of prime movers and power transmissions for the design of engineering systems. Prerequisites: Thermodynamics course, Fluid Mechanics course. Corequisite: Engineering [ENGINR] 2100 or Biological Engineering [BIOL EN] 4380 or instructor's consent.

BIOL EN 4670: Photonics and Nanotechnologies in Optical Biosensors (3). Latest applications of photonics and nanotechnologies in optical bio-chemical sensors will be reviewed. Prerequisite: Physics [PHYSCS] 2760. Graded on A/F basis only.

BIOL EN 4770: Biomedical Optics (3). Essential concepts and methods for applying optical techniques to biomedical diagnosis and therapy will be covered with major application examples being discussed. Prerequisite: Physics [PHYSCS] 2760 and Biological Engineering [BIOL_EN] 3180; or instructor's consent.

BIOL EN 4870: Molecular and Cell Mechanics (3). Application of mechanics and engineering principles to biological systems at the cellular and molecular levels. Prerequisite: Engineering [ENGINR] 2200. Graded on A/F basis only.

BIOL EN 4940: Engineering Internship (2-5).
Problem course following prior approved work experience. Problem selected by internship company representative, faculty problem adviser and student. Supervised by faculty problem advisor and presented in engineering report form. Prerequisite: advisor's consent.

BIOL EN 4980: Biological Engineering Design (3). Capstone design course for the Biological Engineering major. Design of biological system devices or processes. Prerequisite: senior standing or instructor's consent.

BIOL EN 4990: Undergraduate Research in Biological Engineering (1-5). Supervised independent study at the undergraduate level. Prerequisite: instructor's consent.

BIOL EN 4995: Undergraduate Honors Research in Biological Engineering (1-5). Open only to honor students in Biological Engineering. Independent investigation in biological engineering to be presented as a thesis. Prerequisite: advisor's consent.

Department of Chemical Engineering

What is it?

CHEMICAL ENGINEERS work with chemical processes and products to turn raw materials into useful products. They work in the interconnected fields of chemistry and biology and on environmental issues that relate to chemistry.

What can you do?

You can work in chemicals; synthetic textile fibers; plastics, air and water pollution control; chemical and nuclear radiation; food and other bioengineering chemical productions; ceramics; petrochemicals and petroleum refining; material processing; or biochemical engineering physiology.

CONTACT:
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AVERAGE STARTING SALARY of MIZZOU ENGINEERS: $56,250

DEGREES:

- Bachelor of Science in Chemical Engineering BS CHE
- Master of Science in Chemical Engineering MS CHE
- Doctoral Degree in Chemical Engineering PhD CHE

TYPICAL CHEMICAL ENGINEERING CURRICULUM

FIRST SEMESTER			SECOND SEMESTER		
FRESHMAN YEAR					
CH ENGR 1000	Intro. to Chemical Engineering	2	Chem 1330	Gen. Chemistry III w/Lab	3
Chem 1320	Gen. Chemistry II w/Lab	3	Math 1700	Calculus II	5
Eng 1000	Expo. and Argumentation	3	Phys 2750	University Physcs. I	5
Math 1500	Analytical Geom. & Calc.	5	*Humanities/Fine Arts elective*		3
Constitution Req. (Social/Behavioral Science)		3			
Advanced Stand. Cred. for Chem 1310		2			
	TOTAL CREDIT HOURS	18		TOTAL CREDIT HOURS	16
SOPHOMORE YEAR					
CH ENGR 2225	Mass and Energy Balance	3	Chem 2110	Organic Chemistry II	3
Chem 2100	Organic Chemistry	3	Chem 2130	Organic Chem. Lab I	2
Math 2300	Calculus III	3	CH ENGR 2226	Computer Aided Calculations in Chemical Engr.	3
Phys 2760	Universtiy Physics II	5	Math 4100	Differential Equations	3
Social/Behavioral Science elective		3	*Approved elective*		3
			Approved Statistics elective		3
	TOTAL CREDIT HOURS	17		TOTAL CREDIT HOURS	17
JUNIOR YEAR					
CH ENGR 3234	Principles of Chemical Engr. I	3	CH ENGR 3235	Principals of Chem. Engr. II	3
CH ENGR 3261	Engr.Thermodynamics I	3	CH ENGR 3242	Chem. Process Mngmnt. Lab	3
Chem 3200	Quantitative Meth. of Analysis	4	CH ENGR 3262	Chem. Engr. Thermodynamics II	3
Humanities/Fine Arts elective		3	*Advanced Chemistry elective*		3
Approved Technical elective		3	*Social/Behavioral Science elective*		3
	TOTAL CREDIT HOURS	16		TOTAL CREDIT HOURS	15
SENIOR YEAR					
CH ENGR 3243	Chemical Engr. Lab I	3	CH ENGR 4370	Chemical Process Control	3
CH ENGR 4363	Chemical Reaction Engr.	3	CH ENGR 4980	Process Synthesis and Design	3
CH ENGR 4385	Chemical Engineering Design I	3	ENGR 1200	Statics. & Elem. Mat. Strength	3
ENGR 2100	Circuit Theory I	3	*Approved Chemical Engineering elective*		3
Approved Chemical Engr. elective		3	*Humanities/Fine Arts elective*		3
	TOTAL CREDIT HOURS	15		TOTAL CREDIT HOURS	15

TOTAL CREDIT HOURS 129

CHEMICAL ENGINEERING COURSES

CH ENG 1000: Introduction to Chemical Engineering (2). Orientation course for freshmen-level students. Introduction to careers and opportunities in chemical engineering, basic engineering principles, simple calculations. Prerequisites: Mathematics [MATH] 1500, Chemistry [CHEM] 1320, or concurrently.

CH ENG 1000H: Introduction to Chemical Engineering - Honors (2). Orientation course for freshmen-level students. Introduction to careers and opportunities in chemical engineering, basic engineering principles, simple calculations. Prerequisites: Mathematics [MATH] 1500, Chemistry [CHEM] 1320, or concurrently. Honors eligibility required.

CH ENG 1320: Chemistry and Chemical Technology I (3). Covers fundamental principals of chemistry, gases, engineering materials, electrochemistry, and applications with instruction including numerical modeling. May be repeated for credit. Prerequisite: Mathematics [MATH] 1500 or concurrent enrollment. Graded on A/F basis only.

CH ENG 1330: Chemistry and Chemical Technology II (3). Covers fundamentals principals of chemistry, gases, engineering materials, electrochemistry, and applications with instruction including numerical modeling. May be repeated for credit. Prerequisite: Chemical Engineering [CH ENG] 1320 or Chemistry [CHEM] 1320 and Mathematics [MATH] 1500. Corequisite: Mathematics [MATH] 1500. Graded on A/F basis only

CH ENG 2118: Introduction to Energy Technology and Sustainability (3). An introductory course on energy technology and those resources and practices that allow for sustainable commercialization. Prerequisite: sophomore standing in engineering. Graded on A/F basis only.

CH ENG 2225: Mass and Energy Balance (3). Industrial stoichiometry, material and energy balances, thermophysics, thermochemistry; related topics. Prerequisites: Physics [PHYSCS] 2750 , Chemistry [CHEM] 2100, or concurrently.

CH ENG 2226: Engineering Process Computations and Laboratory (3). Engineering applications of ordinary and partial differential equations, spreadsheets, Matlab, discipline-specific software (Aspen), process simulation, data collection, data regression, and modeling of multiple experimental systems. Pre or Co - requisite: Mathematics [MATH] 1700.

CH ENG 3234: Principles of Chemical Engineering I (3). Fluid flow, heat transfer. Prerequisites: grade of C or better in Chemical Engineering [CH_ENG] 2225.

CH ENG 3235: Principles of Chemical Engineering II (3). Mass transfer. Prerequisite: Chemical Engineering [CH_ENG] 3234.

CH ENG 3243: Chemical Engineering Laboratory I (3). Laboratory study of some principal unit operations of chemical engineering. Prerequisite or Co-Requisite: Chemical Engineering [CH_ENG] 2226 and 3235.

CH ENG 3261: Chemical Engineering Thermodynamics I (3). Study of thermodynamics, with particular reference to chemical engineering applications. Prerequisites: grade of C or better in Chemical Engineering [CH_ENG] 2225.

CH ENG 3262: Chemical Engineering Thermodynamics II (3). Prerequisite: Chemical Engineering [CH_ENG] 3261.

CH ENG 4001: Topics in Chemical Engineering (3). Current and new technical developments in chemical engineering. Prerequisite: instructor’s consent.

CH ENG 4085: Problems in Chemical Engineering (2-4). Directed study of chemical engineering problems. Prerequisite: instructor's consent.

CH ENG 4220: Hazardous Waste Management (3). (same as Civil Engineering [CV_ENG] 4220). Engineering principles involved in handling, collection, transportation, processing and disposal of hazardous waste, waste minimization, legislation on hazardous wastes and groundwater contamination. Prerequisite: junior standing.

CH ENG 4270: Design of Experiments and Statistical Quality Control for Process Engineers (3).
(same as Biological Engineering [BIOL_EN] 4270). A practical statistical tool box for experimenters: process means, effects of variables, factorial experiments, and statistical quality control. Prerequisite: experience with Excel or instructor's consent.

CH ENG 4306: Advanced Engineering Math (3).
(same as Nuclear Engineering [NU_ENG] 4306). Applies ordinary and partial differential equations to engineering problems; Fourier's series; determinants and matrices; Laplace transforms; analog computer techniques. Prerequisite: Mathematics [MATH] 4100.

CH ENG 4311: Chemodynamics (3). Environmental movement of chemicals in air, water, and soil; designed to introduce students to the basic principles and techniques useful for the prediction of the movement and fate chemicals in ecosystems. Prerequisites: Chemical Engineering [CH_ENG] 3234 or instructor's consent.

CH ENG 4312: Air Pollution Control (3). Modeling of urban air pollution and control techniques. Topics treated are plume dispersion theories, photochemistry, methods of monitoring, methods of industrial abatement and legal aspects. Prerequisites: Chemical Engineering [CH_ENG] 3234 or instructor's consent.

CH ENG 4315: Introduction to Bioprocess Engineering (3). (same as Biological Engineering [BIOL EN] 4315). This general introduction to bioprocess engineering covers the fundamentals of microbiology and biochemistry in the context of a biomass refinery. Analyses proceed through the use of mass balances, energy balances, and empirical or theoretical models. Prerequisites: Biological Engineering [BIOL EN] 2180 (for Biological Engineering students) or Chemical Engineering [CH ENG] 2225 (for Chemical Engineering students) or instructor's consent.

CH ENG 4316: Biomass Refinery Operations (3). (same as Biological Engineering [BIOL_EN] 4316). Design and operation of processes for conversion and/or fractionation of biomass and associated upstream and downstream unit operations. Emphasis on separations and product recovery. Prerequisite: Biological Engineering [BIOL EN] 2180 or Chemical Engineering [CH ENG] 2225 (for Chemical Engineering students) or instructor's consent.

CH ENG 4317: Chemical Processing in Semiconductor Device (3). This course covers the current plasma processing methods used to produce semiconductor devices with emphasis on memory devices. The physics and chemistry of how plasmas are formed, sustained and interact with the semiconductor wafers being processed. Plasma chemistry and the chemical reactions used in plasma etching are discussed. Mathematics [MATH] 4100/7100.

CH ENG 4318: Energy Technology and Sustain-ability (3). An introductory course on energy technology, resources, practices, and common calculations used for energy analysis. Prerequisite: at least one engineering thermodynamics course or a Physical Chemistry course or instructor's

consent. May be repeated for credit.

CH ENG 4319: Introduction to Polymer Materials (3). An introduction to the structure and properties of polymers. Solution properties, molecular weight determination and rheological behavior are studied. Manufacturing and processing techniques are considered. Prerequisites: Chemical Engineering [CH_ENG] 3262 and Chemistry [CHEM] 2110.

CH ENG 4321: Introduction to Ceramics (3).
Introductory course in ceramics materials, crystal structure, processes and properties. The course content and level of presentation would allow an entry level engineering to be conversant with the terminology and concepts of ceramic science and engineering. Prerequisite: Chemistry and Physics.

CH ENG 4335: Transport Phenomena (3). Integrated study of momentum, heat and mass transport. Prerequisites: Chemical Engineering [CH_ENG] 3235, and Mathematics [MATH] 4100/7100.

CH ENG 4345: Special Reading in Chemical Engineering (2-5). Individually supervised special reading leading to an engineering report. Prerequisite: senior standing.

CH ENG 4363: Chemical Reaction Engineering and Technology (3). Reactor design and optimization; rate equations; thermal effects in reactor. Prerequisites: Chemical Engineering [CH_ENG] 2226, 3262, or instructor's consent.

CH ENG 4370: Process Control Methods and Laboratory (3). Stat-space modeling, simulation, and experimental validation; stability analysis; feedback design and experimental studies; methods for disturbance rejection. Prerequisites: Chemical Engineering [CH ENG] 2226.

CH ENG 4385: Chemical Engineering Design I (3). The course presents optimum design methods, cost estimation, material selection and other relevant areas for the design of chemical plants. In addition, chemical safety and risk assessment will be covered. Prerequisite: Chemical Engineering [CH_ENG] 2226, 3235, 3262, Physics [PHYSCS] 2760, Chemistry [CHEM] 2110.

CH ENG 4464: Electrochemical Reaction Engineering Science (3). Phenomenological behavior of electrochemical processes (battery emphasis). Theoretical interpretations of diffusion and reaction processes including system modeling. Prerequisite: A course in thermodynamics or physical chemistry; Chemical Engineering [CH ENG] 3261 or Mechanical and Aerospace Engineering [MAE] 2300 or Chemistry [CHEM] 3310 or instructor's consent. Graded on A/F basis only.

CH ENG 4980: Process Synthesis and Design (3).
Continuation of Chemical Engineering [CH_ENG] 4385: application of chemical analysis and modeling to a capstone design project. Prerequisite: Chemical Engineering [CH_ENG] 4385.

CH ENG 4990: Undergraduate Research in Chemical Engineering (2-4). Directed study of chemical engineering problems. Prerequisite: instructor's consent.

CH ENG 4995: Undergraduate Research in Chemical Engineering - Honors (3-6).
Individual research for a senior thesis; research is supervised by the chemical engineering faculty. The thesis is to be defended before the departmental Honors committee. Prerequisite: senior standing.

Department of Civil and Environmental Engineering

What is it?

CIVIL ENGINEERS solve problems that directly affect the health and economic activity of people and communities — including waste disposal, pollution, transportation systems, water resources, and designing, construction and rehabilitating structures such as dams, bridges, buildings, highways, railways, pipelines and waterways.

What can you do?

You can work for governmental organizations or private companies to develop structures and systems that affect people's daily lives.

CONTACT:
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AVERAGE SALARY OFFER: $48,500*

DEGREES:

- Bachelor of Science in Civil and Environmental Engineering BS CEE
- Master of Science in Civil and Environmental Engineering MS CEE
- Doctoral Degree in Civil and Environmental Engineering PhD CEE

*2009 University of Missouri Destination Survey

TYPICAL CIVIL AND ENVIRONMENTAL ENGINEERING CURRICULUM

FIRST SEMESTER			SECOND SEMESTER		
FRESHMAN YEAR					
Chem 1320	Gen. Chemistry II w/Lab	3	Math 1700	Calculus II	5
Engl 1000	Expo. & Argumentation	3	Phys 2750	University Physics I	5
ENGR 1100	Engineering Graphics	2	Geol 1100	Principles of Geology or	
Math 1500	Analytical Geom. & Calc.	5	Geol 1200	Environmental Geology	3
Social/Behavioral Science elective		3	*Humanities/Fine Arts elective*		3
	TOTAL CREDIT HOURS	16		TOTAL CREDIT HOURS	16
SOPHOMORE YEAR					
CV ENGR 3010	Dec. Meths. for Civ. Engr. Dsgn.	3	Math 4100	Differential Equations	3
CV ENGR 3200	Fund. of Environmental Engr.	4	Physcs 2760	University Physics II	5
ENGR 1200	Statics & Elem. Mat. Strength	3	ENGR 2200	Interm. Materials Strength	3
Math 2300	Calculus III	3	CV ENGR 3100	Fund. of Trans. Engr.	4
Social/Behavioral Science elective		3			
	TOTAL CREDIT HOURS	16		TOTAL CREDIT HOURS	15
JUNIOR YEAR					
CV ENGR 3300	Structural Analysis I	4	CV ENGR 3312	Reinforced Concrete Design or	
CV ENGR 3400	Fund of Geotechnical Engr.	4	CV ENGR 3313	Structural Steel Design	3
CV ENGR 3600	Civil Engr. Materials	4	CV ENGR 3702	Hydrology	4
CV ENGR 3700	Fluid Mechanics	3	CS 1040	Intro. to Prob. Solving	3
Advisor approved elective		1	*CV ENGR elective*		3
			Social/Behavioral Science elective		3
TOTAL CREDIT HOURS		16	TOTAL CREDIT HOURS		16
SENIOR YEAR					
(2) ENGR Topic elective		6	CV ENGR 4980	Civil Engr. Systems Design (WI)	3
(2) CV ENGR Topic electives elective		6	*(2) CV ENGR electives*		6
Humanities/Fine Arts elective		3	*Advisor Approved elective*		3
			Soc./Behav. Sci. or Humanities elective		3
	TOTAL CREDIT HOURS	15		TOTAL CREDIT HOURS	17

TOTAL CREDIT HOURS 126

. **CIVIL ENGINEERING COURSES**

CV ENG 1000: Introduction to Civil Engineering (1). Introduces various aspects of Civil Engineering practice. May be repeated one time for credit.

CV ENG 1001: Experimental Course (cr.arr.).
For freshman-level students. Content and number of credit hours to be listed in Schedule of Courses.

CV ENG 2001: Experimental Course (cr.arr.). For sophomore-level students. Content and number of credit hours to be listed in Schedule of Courses.

CV ENG 2080: Introduction to Dynamics (3).
Basic fundamentals of particle and rigid body dynamics; energy and momentum methods. Prerequisite: Engineering [ENGINR] 1200.

CV ENG 3001: Fundamental Topics in Civil Engineering (1-3). Special engineering topics for undergraduate students. Prerequisite: instructor's consent.

CV ENG 3010: Decision Methods for Civil Engineering Design (3). Essential features of civil engineering including the design process, design teams, experimental and computational tools, engineering economy, communication skills, and ethical considerations. Prerequisite: grade of C- or better in English [ENGLSH] 1000. Co-requisite: Engineering [ENGINR] 1200.
CV ENG 3100: Fundamentals of Transportation Engineering (4). Covers fundamentals of transportation engineering including geometric design, traffic engineering, pavements, and planning. Prerequisite: grade of C- or better in Engineering [ENGINR] 1100. Corequisite: Civil Engineering [CV_ENG] 3010.

CV ENG 3200: Fundamentals of Environmental Engineering (4). Fundamentals of water quality engineering and water resources, water and wastewater treatment, solid and hazardous and radioactive waste management, air pollution, environmental regulation, and environmental ethics. Prerequisite: grade of C- or better in Chemistry [CHEM] 1320 or equivalent; corequisite: Civil Engineering [CV_ENG] 3010.

CV ENG 3300: Structural Analysis I (4). Analysis of statically determinate beams, frames; shear and moment diagrams; influence line diagrams; beam deflections. Analysis of statically indeterminate structures; moment distribution; energy methods. Introduction to matrix analysis. Prerequisites: grade of C- or better in Engineering [ENGINR] 1200 and ENGINR 2200.

CV ENG 3312: Reinforced Concrete Design (3).
Basic principles of reinforced concrete design. Design of beams for flexture and shear; design of short and slender columns. Prerequisite: Civil Engineering [CV_ENG] 3300; Corequisite: Civil Engineering [CV_ENG] 3600.

CV ENG 3313: Structural Steel Design (3). Basic principles of structural steel design. Design of beams, axially loaded members, columns, and bolted and welded connections. Corequisites: Civil Engineering [CV_ENG] 3300 and 3600.

CV ENG 3400: Fundamentals of Geotechnical Engineering (4). Detailed study of physical and mechanical properties of soil governing its behavior as an engineering material. Prerequisite: grade of C- or better in Engineering [ENGINR] 2200 and either Geology [GEOL] 1100 OR 1200.

CV ENG 3600: Civil Engineering Materials (4). Introduces composition, structure, properties, behavior, and selection of civil engineering materials. Prerequisites: grade of C- or better in Engineering [ENGINR] 2200 or instructor's consent; co-requisite: Civil Engineering [CV_ENG] 3010.

CV ENG 3700: Fluid Mechanics (3). Statics and dynamics of fluids, principles of continuity, momentum and energy, pipe flow. Prerequisite: grade of C- or better Physics [PHYSCS] 2750.

CV ENG 3702: Hydrology (4). Fundamental concepts of hydrology in engineering; quantitative estimation of stream-flow magnitude and frequency; and open channel flow considerations from stream-flow. Fluid Mechanics lab with lab reports. Prerequisites: grade of C- or better Mathematics [MATH] 2300 and Civil Engineering [CV_ENG] 3200 and 3700.

CV ENG 4001: Topics in Civil Engineering (1-3).
Study of current and new technical developments in civil engineering. Prerequisite: instructor's consent.

CV ENG 4006: Digital Computer Applications in Engineering (3). Use of digital computer for solution of engineering problems involving roots of equations, simultaneous equations, curve fitting, integration, differentiation, and differential equations. Prerequisites: Mathematical [MATH] 2300

CV ENG 4008: Risk and Reliability for Civil Engineers (3). This course focuses on how to use probability and statistics to quantify uncertainties and consider risks when making civil engineering decisions and designing civil engineering systems. Prerequisites: grade of C- or better in Civil Engineering [CV_ENG] 3010 or other introductory probability/ statistics course.

CV ENG 4080: Advanced Surveying (3). Celestial observations for determination of position; state coordinate systems, precise surveys, introduction to geodetic surveys, principles of photogrammetry. Theory of optical surveying instruments. Prerequisites: Mathematics [MATH] 1500.

CV ENG 4085: Problems in Civil and Environmental Engineering (2-4). Directed investigation of civil engineering. Prerequisite: instructor's consent.

CV ENG 4100: Traffic Engineering (3). Characteristics and studies associated with highway traffic. Capacity analysis and evaluation of freeways, rural highways, and urban streets. Traffic signal control and coordination. Prerequisites: grade of C- or better in Civil Engineering [CV_ENG] 3100.

CV ENG 4102: Infrastructure Management (3).
Civil infrastructure condition assessment, performance modeling, deterioration processes and models, maintenance and rehabilitation strategies, management techniques, data analysis, management systems, financing, case studies, emerging technologies. Prerequisites: grade of C- or better in Civil Engineering [CV_ENG] 3100.

CV ENG 4103: Planning and Geometric Design of Highways (3). Techniques of highway planning in rural and urban areas. Design of the visible elements of highways. Prerequisites: grade of C- or better in Civil Engineering [CV_ENG] 3100.

CV ENG 4104: Pavement Materials and Design (3). Properties of materials used in roads, airports and other pavement construction. Design methods for rigid and flexible pavements. Prerequisites: grade of C- or better in Engineering [ENGINR] 2200.

CV ENG 4106: Intelligent Transportation Systems (3). This is an introductory course in Intelligent Transportation Systems (ITS). Topics include the theory of transportation networks and systems optimization, current implementations of ITS, and practical issues and implications of ITS. Prerequisite: grade of C- or better in Civil Engineering [CV_ENG] 3100.

CV ENG 4108: Bicycle and Pedestrian Transportation (3). This course teaches how to integrate pedestrian and bicyclist accommodations into the planning and design of transportation facilities. Topics include bicyclist safety, accommodation at intersections, traffic calming techniques and facility design. Prerequisite: grade of C- or better in Civil Engineering [CV_ENG] 3100.

CV ENG 4110: Transportation Simulation (3).
Theory and application of simulation in transportation engineering. Prerequisites: grade of C- or better in Civil Engineering [CV_ENG] 3100.

CV ENG 4120: Airport Engineering (3). Airport systems planning, design, and management. Prerequisite: grade of C- or better in Civil Engineering [CV_ENG] 3010.

CV ENG 4125: Transportation Legal Issues (3).
This course discusses some of the legal issues that transportation engineers encounter throughout the course of their careers. Prerequisites: Civil Engineering [CV_ENG] 3010.

CV ENG 4130: Transportation Safety (3). This course is an introduction to transportation safety. The focus will be on surface transportation. The student is expected to analyze safety data and to devise engineering solutions to safety problems. Prerequisite: Civil Engineering [CV_ENG] 3010.

CV ENG 4155: Transportation Geography (3).
(same as Geography [GEOG] 4850). Introduction to fundamental concepts and modes of analysis in transportation geography. Focus on descriptive, explanatory, as well as normative approaches. Topics reviewed include spatial organization, transportation economics, spatial interaction, network analysis, location/allocation, and urban transportation planning.

CV ENG 4165: Geographic Information Systems I (3). (same as Geography [GEOG] 4840) Introduces concepts of computer analysis of geographic data and emphasizes the techniques for handling geographic data. Application of computer-based GIS systems in coursework. Prerequisite: Geography [GEOG] 2840 and instructor's consent.

CV ENG 4200: Remote Sensing of the Environment (3). Principles, characteristics and applications of remote sensing in engineering, geosciences, agriculture and environmental projects. Topics: basic concepts, photographic, thermal multispectral and microwave systems, satellite remote sensing and digital image processing. Prerequisites: junior standing.

CV ENG 4210: Solid Waste Management (3). Engineering principles involved in generation, handling, collection, transport, processing, and disposal of solid wastes, resource recovery and reuse, legislation on solid wastes and groundwater contamination problems. Prerequisite: junior standing.

CV ENG 4220: Hazardous Waste Management (3). (same as Chemical Engineering [CH_ENG] 4220). Engineering principles involved in handling, collection, transportation, processing and disposal of hazardous wastes, waste minimization, legislation on hazardous wastes and groundwater contamination.

CV ENG 4230: Introduction to Water Quality (3). Methods for determining and

characterizing water quality, effects of pollution on streams and lakes, and an introduction to engineered systems for the distribution, collection and treatment of water and wastewater. Prerequisite: junior standing.

CV ENG 4232: Water and Wastewater Treatment Facilities (3). Physical, chemical, and biochemical processes for treating drinking water supplies and wastewaters (domestic and industrial), with emphasis on planning and design of such facilities. Prerequisites: Civil Engineering [CV_ENG] 4230/7230 or instructor's consent.

CV ENG 4240: Water Quality Analysis (3).
Chemical, physical and biological methods for analysis of streams, lakes, wastewaters and water supplies and their use in water quality management. Prerequisite: grade of C- or better in Civil Engineering [CV_ENG] 4230 or instructor's consent.

CV ENG 4250: Environmental Regulatory Compliance (3). Systems of water law; provisions of major federal environmental laws and regulations; development of regulations at the federal, state, and local levels; regulatory frameworks; permits; and enforcement.

CV ENG 4260: Environmental Public Policy (3).
Engineering and economic aspects of environmental policy. Basic understanding of environmental statutes and case law.

CV ENG 4270: Environmental Engineering Microbiology (3). Theory and application of fundamental principles of microbiology, ecology, and aquatic biology of the microorganisms of importance to sanitary engineers. Prerequisite: senior standing or instructor's consent.

CV ENG 4285: Pollution Prevention: Applied Engineering for Sustainable Business Practices (3). Identify, analyze and solve energy, water and raw materials inefficiencies common to industrial processes and facilities. Restricted to Juniors and Seniors. Prerequisites: Physics [PHYSCS] 2760, Mathematics [MATH] 2300, Chemistry [CHEM] 1320, Engineering [ENGINR] 2300 or equivalent. Graded on A-F only basis.

CV ENG 4290: Hazardous Waste and Aquatic Chemistry (3). Redox, carbonate chemistry, sorption topics. Innovative processes for hazardous waste treatment.

CV ENG 4300: Advanced Structural Steel Design (3). Design of steel structures and bridges. Topics include composite beams, plate girder design, and moment resistant connections. Prerequisite: grade of C- or better in Civil Engineering [CV_ENG] 3313.

CV ENG 4302: Prestressed/Advanced Reinforced Concrete (3). Principles of prestressing. Constituent materials, loading and allowable stresses. Working and ultimate stress analysis and design. Shear and torsion. Deflections. Prestress losses. Continuous beams. Composite beams. Compression members. footings. Co-requisite: Civil Engineering [CV_ENG] 3312.

CV ENG 4310: Structural Design and Analysis (3). Design and analysis of building frames and bridges in steel and concrete using case studies. Economic selection of structural type and material. Basic methods of analysis for statically indeterminate structures. Prerequisite: grade of C- or better in Civil Engineering [CV_ENG] 4300.

CV ENG 4320: Energy Methods in Mechanics (3). Variational mechanics including practical examples. Topics include calculus of variation of boundary value problems, energy methods such as Ritz and Galerkin methods, approximate solutions methods such as the finite element and finite difference, and eigenvalue problems. Prerequisites: senior or graduate standing required.

CV ENG 4330: Structural System Design (3).
Design of buildings in steel and reinforced concrete, including estimation of loads and design of gravity and lateral force resisting systems. Prerequisite: grade of C- or better in Civil Engineering [CV_ENG] 3312 and 3313.

CV ENG 4350: Matrix Methods of Structural Analysis (3). An introduction to the fundamentals of stiffness and flexibility methods for analysis of truss and frame structures. Application of the STRUDL and NASTRAN programs to three dimensional structures. Prerequisite: senior standing; grade of C- or better in Civil Engineering [CV_ENG] 3300.

CV ENG 4360: Bridge Engineering (3). Review of Highway Bridge Analysis and Design Fundamentals. Study of Influence Line Diagrams and Shear and Moment Envelopes. Design of Medium- and Short-Span Girder Bridges based on AASHTO LRFD specs. Prerequisite: grade of C- or better in Civil Engineering [CV_ENG] 3312 and 3313.

CV ENG 4404: Geotechnical Earthquake Engineering (3). This course provides an introduction to geotechnical aspects of earthquake engineering. Topics include: basic seismology, seismic hazard analysis, dynamic soil properties, site response analysis and soil liquefaction. Prerequisite: grade of C- or better in Civil Engineering [CV_ENG] 3400 or instructor's consent.

CV ENG 4406: Geotechnics of Landfill Design (3). This course will focus on geotechnical and construction aspects in the analysis, design and construction of waste containment facilities (landfills) including expansions of existing facilities. Prerequisite: instructor's consent.

CV ENG 4410: Foundation Engineering (3).
Subsurface exploration. Design of basic foundation structures, shallow foundations, retaining walls, deep foundations. Prerequisites: grade of C- or better in Civil Engineering [CV_ENG] 3400.

CV ENG 4412: Earthwork Engineering and Design (3). Study of concepts, theories, and design procedures for modern earthwork engineering including: compaction and densification of soils and soil improvement, seepage and drainage, slope stability and performance, and earth retaining structures. Prerequisite: grade of C- or better in Civil Engineering [CV_ENG] 3400.

CV ENG 4500: Introduction to Construction Management (3). Structure of the construction industry; construction drawings and specifications; estimating and bidding; construction contracts, bonds and insurance; planning and scheduling of construction operations; project management; computer techniques. Prerequisite: junior standing.

CV ENG 4600: Advanced Mechanics of Materials (3). (same as Mechanical and Aerospace Engineering [MAE] 4600). Analysis of more complicated problems in stresses, strains. Prerequisite: grade of C- or better in Engineering [ENGINR] 2200.

CV ENG 4610: Sensors and Experimental Stress Analysis (3). Sensors and instrumentation for stress analysis, mechanical measurement and health monitoring of civil structures. Application and design of data acquisition systems, basic digital signal processing. Electronics and instrumentation circuits. Prerequisite: grade of C- or better in Engineering [ENGINR] 2200 and Physics [PHYSCS] 2760.

CV ENG 4660: Vibration Analysis (3). (same as Mechanical and Aerospace Engineering [MAE] 4660). Vibration theory with application to mechanical systems. Prerequisites: grade of C- or better in Civil Engineering [CV_ENG] 2080 and Mathematics [MATH] 4100.

CV ENG 4692: Introduction to Structural Dynamics (3). Theory of structural response to dynamic loads. Computation of dynamic response of structures to dynamic loads like blast and earthquake. Modal analysis and single degree of freedom methods will be covered. Prerequisite: grade of C- or better in Civil Engineering [CV_ENG] 3300.

CV ENG 4700: Hydraulics of Open Channels (3).
Gradually varied flow and theory of the hydraulic jump. Slowly varied flow involving storage; rating curves. Prerequisite: grade of C- or better in Civil Engineering [CV_ENG] 3700.

CV ENG 4703: Applied Hydrology (3). Modern methods of applied hydrologic analysis and synthesis of hydrologic records. Prerequisites: grade of C- or better in Civil Engineering [CV_ENG] 3700 and 3702 or instructor's consent.

CV ENG 4710: Soil and Water Conservation Engineering (3). (same as Biological Engineering [BIOL EN] 4150). Urban and rural run-off and erosion analysis. Design and layout of erosion control structures. Prerequisites: Biological Engineering [BIOL EN] 2180 or Civil Engineering [CV_ENG] 3200 or instructor's consent.

CV ENG 4720: Watershed Modeling Using GIS (3). (same as Biological Engineering [BIOL EN] 4350). Watershed evaluation using AVSWAT for hydrology, sediment yield, water quality; includes USLE, MUSLE, WEPP, Procedures for model calibration/sensitivity data analysis. Prerequisites: Biological Engineering [BIOL EN] 2180 or Civil Engineering [CV ENG] 3200 or instructor's consent.

CV ENG 4792: Analysis of Water-Resource Systems (3). Applies hydrology, hydraulic and sanitary engineering, and economics to water-resource design problems considering man and his environment. Uses methods of systems analysis. Prerequisite: instructor's consent.

CV ENG 4980: Civil Engineering Systems Design (3). Design of civil engineering systems. Prerequisite: senior standing in Civil Engineering at the University of Missouri-Columbia or written consent of Chairman.

CV ENG 4990: Undergraduate Research in Civil and Environmental Engineering (1-4). Independent investigation or project in Civil Engineering. Prerequisites: senior standing in Civil and Environmental Engineering and instructor's consent. May be repeated to 6 hours.

CV ENG 4995: Research in Civil & Environmental Engineering-Undergraduate Honors (1-3). Independent project, supervised by the honors advisor, to be presented as a formal written report. Prerequisite: participation in the Civil and Environmental Engineering Departmental Honors Program.

MIZZOU ENGINEERING
University of Missouri
engineering.missouri.edu

Department of Electrical and Computer Engineering

What is it?

COMPUTER ENGINEERS design hardware and computer systems and develop software. They have interests in applications that include artificial intelligence, computer design and architecture, and other areas related to the conceptual world of the computer system.

What can you do?

You can work in the computer industry, government or commerce, and you can choose a career path in design, development, production or manufacturing.

CONTACT:

Tami Beatty
349 Engineering Bldg. West
573-882-2648
beattyt@missouri.edu

AVERAGE SALARY OFFER: $56,000*

DEGREES:

- Bachelor of Science in Computer OR Electrical Engineering BS CE or BS EE
- Dual Degree: Bachelor of Science in Computer AND Electrical Engineering BS EE and CE
- Master of Science in Computer and Electrical Engineering MS ECE
- Doctoral Degree in Computer and Electrical Engineering PhD ECE

*2009 University of Missouri Destination Survey

TYPICAL COMPUTER ENGINEERING CURRICULUM

FIRST SEMESTER			SECOND SEMESTER		
FRESHMAN YEAR					
Chem 1320	Gen. Chemistry II w/Lab	3	CS 2050	Algorithm Desgn. and Prog. II	3
CS 1050	Algorithm Desgn. and Prog. I	3	ECE 1210	Introduction to Logic Systems	3
ECE 1000	Intro. to Elec. & Comp. Engr.	1	Engl 1000	Exposition and Argumentation	3
Math 1500	Analytical Geom. & Calc.	5	Math 1700	Calculus II	5
Constitutional req. (Soc./Behav. Science)		3	*Humanities/Fine Arts elective*		3
	TOTAL CREDIT HOURS	15		TOTAL CREDIT HOURS	17
SOPHOMORE YEAR					
ECE 2100	Circuit Theory	4	ECE 3220	Comp. for Embed. Syst.	3
ECE 3210	Microprocessor Engineering	4	ECE 3810	Circuit Theory II	4
Math 2300	Calculus III	3	Math 4100	Differential Equations	3
Physcs 2750	University Physics I	5	Physcs 2760	University Physcs. II	5
	TOTAL CREDIT HOURS	16		TOTAL CREDIT HOURS	15
JUNIOR YEAR					
ECE 3410	Electronic Circuits & Signals I	4	ECE 4250	VDHL and Progr. Logic Devices	4
ECE 3830	Signals and Linear Systems	3	ENGR 1200	Stats & Elem. Strength of Mats. or	
Stat 4710	Intro. to Math. Statistics	3	ENGR 2300	Engr. Thermodynamics or	
Math 2320	Discrete Math Structures	3	IMSE 2710	Engr. Economic Analysis	3
Humanities/Fine Arts elective		3	ECE 4000+	Technical elective	3
			ECE or CS 3000+ or 2000+ Math, Physcs, Chem., BioE, ChemE, Civil, IMSE, MAE		3
			Social/Behavorial Science elective		3
	TOTAL CREDIT HOURS	16		TOTAL CREDIT HOURS	16
SENIOR YEAR					
ECE 3110	Elect. Engr. Projects Lab	3	ECE 4970	Senior Capstone Design	3
ECE 4270	Microcomp. Arch. and Interfac.	4	ECE or CS 3000+ or 2000+ Math, Physics, Chem., BioE, ChemE, Civil, IMSE, MAE		3
ECE 4220	Real Time Embed. Syst. or				
CS 4520	Operating Systems	3	ECE or CS 3000+ or 2000+ Math, Physics,		
ECE 4000+	Technical elective	3	Chem., BioE, ChemE, Civil, IMSE, MAE		3
Social/Behavioral Sciences elective		3	*Free elective*		3
			Humanities/Fine Arts elective		3
	TOTAL CREDIT HOURS	16		TOTAL CREDIT HOURS	15

TOTAL CREDIT HOURS 126

MIZZOU ENGINEERING
University of Missouri
engineering.missouri.edu

Department of Electrical and Computer Engineering

What is it?

ELECTRICAL ENGINEERS are involved in electrical power generation, communication systems, instrumentation, circuit design and microprocessor design. Global energy problems and rapid advances in microelectronics ensure a constant demand for electrical engineers.

What can you do?

You can work in industry, government, consulting or commerce. Choose a career path in design, development, production, sales or service.

CONTACT:
Tami Beatty
349 Engineering Bldg. West
573-882-2648
beattyt@missouri.edu

AVERAGE SALARY OFFER: $56,000*

DEGREES:

- Bachelor of Science in Computer OR Electrical Engineering BS CE or BS EE
- Dual Degree: Bachelor of Science in Computer AND Electrical Engineering BS EE and CE
- Master of Science in Computer and Electrical Engineering MS ECE
- Doctoral Degree in Computer and Electrical Engineering PhD ECE

*2009 University of Missouri Destination Survey

TYPICAL ELECTRICAL ENGINEERING CURRICULUM

FIRST SEMESTER			SECOND SEMESTER		
FRESHMAN YEAR					
Chem 1320	Gen. Chemistry II w/Lab	3	ECE 1210	Intro. to Logic Systems	3
CS 1040	Intro. to Prob. Solv. & Prog. or		Engl 1000	Exposition and Argumentation	3
1050	Algorithm Desgn. and Prog. I	3	Math 1700	Calculus II	5
ECE 1000	Intro. to Elec. & Comp. Engr.	1	*Humanities/Fine Arts elective*		3
Math 1500	Analytical Geom. & Calc.	5	*Economics elective (Soc./Behav. Science)*		3
Constitutional elective (Soc./Behav. Science)		3			
	TOTAL CREDIT HOURS	15	TOTAL CREDIT HOURS		17
SOPHOMORE YEAR					
ECE 2100	Circuit Theory	4	ECE 3810	Circuit Theory II	4
ECE 3210	Microprocessor Engineering	4	Math 4100	Differential Equations	3
Math 2300	Calculus III	3	Physcs 2760	University Physcs. II	5
Physcs 2750	Universtiy Physics I	5	*Humanities/Fine Arts elective*		3
	TOTAL CREDIT HOURS	16		TOTAL CREDIT HOURS	15
JUNIOR YEAR					
ECE 3410	Electronic Circuits & Signals I	4	ECE 3610	Semiconductors and Devices	3
ECE 3510	Electromagnetic Fields	3	ENGR 1200	Stats & Elem. Strength of Mats. or	
ECE 3830	Signals and Linear Systems	3	2300	Engr. Thermodynamics or	
Stat 4710	Intro. to Math. Stats	3	IMSE 2710	Engr. Economic Analysis	3
Social/Behavioral Science elective		3	(2) ECE or CS 3000+ or 2000+ Math, Physcs, Chem., BioE, ChemE, Civil, IMSE, MAE		6
			Humanities/Fine Arts elective		3
	TOTAL CREDIT HOURS	16		TOTAL CREDIT HOURS	15
SENIOR YEAR					
ECE 3110	Elec. and Comp. Engr. Projects	3	ECE 4970	Senior Capstone Design	3
ECE 3000+ or 2000+ Math, Physcs, Chem., BioE, ChemE, Civil, IMSE, MAE		3	ENGR 1200	Stats & Elem. Strength of Mats. or	
(2) ECE 4000+ Technical Elective		6	2300	Engr. Thermodynamics or	
Free Elective		4	IMSE 2710	Engr. Economic Analysis	3
			ECE 3000+ or 2000+ Math, Physcs, Chem., BioE, ChemE, Civil, IMSE, MAE		3
			ECE 4000+ Sr. Lecture/Lab		4
			ECE 4000+ Tecnical Elective		3
	TOTAL CREDIT HOURS	16	TOTAL CREDIT HOURS		16

TOTAL CREDIT HOURS 126

ELECTRICAL AND COMPUTER ENGINEERING COURSES

ECE 1000: Introduction to Electrical and Computer Engineering (1). Introduction to department, college and campus computing facilities and software; overview of areas encompassed by electrical engineering; small-team lab/projects. Lectures help sessions, and lab sessions. Prerequisite: freshman status.

ECE 1001: Experimental Course (cr.arr.). For freshman-level students. Content and number of credit hours to be listed in Schedule of Courses.

ECE 1210: Introduction to Logic Systems (3).
Introduces basic tools, methods and procedures to design combinational and sequential digital circuits and systems. Topics include number systems, Boolean algebra, logic minimization, circuit design, memory elements, and finite state machine design. Graded on A-F basis only.

ECE 2001: Experimental Course (cr.arr.). For sophomore-level students. Content and number of credit hours to be listed in Schedule of Courses.

ECE 2100: Circuit Theory I (4). DC circuit analysis, inductors and capacitors, first order response, AC circuit analysis, single-phase AC power. Co-requisite: Mathematics [MATH] 2300. Graded on A/F basis only.

ECE 2110: Experimental Electrical Engineering I (3). Application of standard electronic test equipment to basic experimental tasks of measurement and characterization of electronic phenomena and devices. Prerequisites: Engineering [ENGINR] 2100 concurrently.

ECE 3110: Electrical and Computer Engineering Projects (3). Open-ended design projects which encourage innovative solutions to design and measurement problems. Students teams complete several projects from different areas. Both oral and written presentations emphasized. Prerequisites: Statistics [STAT] 4710 and at least two of three from the following: Electrical and Computer Engineering [ECE] 3210, 3410 and 3510. Restricted to Electrical and Computer Engineering [ECE] students only or instructor's consent. Graded on A/F basis only.

ECE 3210: Microprocessor Engineering (4).
Introduction to microprocessor architectures and programming; memory, memory management and cache organizations, bus configurations and timing implications; parallel I/O and serial communication interfaces. Prerequisite: Electrical and Computer Engineering [ECE] 1210 and Computer Science [CMP_SC] 1040 or 1050.

ECE 3220: Computing for Embedded Systems (3). Software/Hardware development for embedded systems, including memory, I/O and interrupts; an overview of C and C++, class structures in object oriented programming; software development with UML and testing and debugging strategies. Prerequisites: Electrical and Computer Engineering [ECE] 3210 and C++ or Java. Graded on A/F basis only.

ECE 3230: Algorithms and Software Design (3).
Covers basic algorithms including: arithmetic operations, sorting, string processing, parsing, hashing, and tree and graph manipulations. The C language and UNIX operating system are used as vehicles for illustration and practice in use of the algorithms and in the application of software design techniques. Prerequisite: Electrical and Computer Engineering [ECE] 2210.

ECE 3410: Electronic Circuits and Signals I (4).
Electron Devices, modeling and applications to basic electronic circuits, including RC amplifiers

and power supplies. Prerequisite: Electrical and Computer Engineering [ECE] 2110, 3810 concurrent.

ECE 3470: Introduction to Power Engineering (3). Real and reactive power in single and three-phase ac circuits; magnetic circuits and transformers; energy conversion, DC machines, induction and synchronous machines; power transmission and distribution. Co-requisite Electrical and Computer Engineering [ECE] 3810. Graded on A/F basis only.

ECE 3510: Electromagnetic Fields (3). Elements of vector analysis, transmission line theory, electrostatics, magnetostatics, time varying fields and plane waves. Prerequisite: Physics [PHYSCS] 2760, Mathematics [MATH] 4100. Graded on A/F basis only.

ECE 3610: Semiconductors and Devices (3).
Crystal structure; quantum aspects of energy, radiation and matter; quantum mechanics and energy bands in solids; electronic and optical properties of semiconductors; p-n junctions and diodes; bipolar and field-effect transistors. Prerequisites: Electrical and Computer Engineering [ECE] 3510.

ECE 3810: Circuit Theory II (4). Impulse and step responses, RLC circuits, classical differential equations solutions, complex plane stability, frequency and Bode Analysis, Resonance, Laplace transforms, two-port networks, mutual inductance and transformers. Prerequisites: Electrical and Computer Engineering [ECE] 2100 and Mathematics [MATH] 4100 concurrently. Graded on A/F basis only.

ECE 3830: Signals and Linear Systems (3).
Transform Analysis of Signals and Linear Systems. Laplace transforms, z-transforms, Fourier series and transforms. Prerequisite: Electrical and Computer Engineering [ECE] 3810.

ECE 4001: Topics in Electrical and Computer Engineering (3-4). Current and new technical developments in electrical engineering. Prerequisite: senior standing.

ECE 4020: Energy Systems and Resources (3). (same as Nuclear Science and Engineering [NU_ENG} 4315). Analysis of present energy usage in Missouri, USA and the world, evaluation of emerging energy technologies and trends for the future. Economics and environmental impact of the developed technologies. Prerequisite: Engineering [ENGINR] 2300.

ECE 4030: Introduction to Nuclear Reactor Engineering (3). (same as Nuclear Science and Engineering [NU_ENG] 4346). Engineering principles of nuclear power systems, primarily for the production of electrical energy. Prerequisites: Engineering [ENGINR] 1200, 2300.

ECE 4085: Problems in Electrical and Computer Engineering (2-4). Analytical or experimental problems pertaining to electric circuits, machines, fields or electronics. Prerequisites: 12 hours Electrical and Computer Engineering credit or instructor's consent.

ECE 4150: Solid State Area Laboratory (1).
Laboratory experiments involved with solid state theory and integrated circuit fabrication and testing. Prerequisites: Electrical and Computer Engineering [ECE] 4650 and 4670.

ECE 4170: Control Systems Laboratory (1). Experiments in computer process control and industrial automation; automated process modeling; control algorithm design; control simulation; direct digital real-time control; transducers; computer interfacing; industrial control mechanisms; Programmable Logic Controllers. Prerequisites: Electrical and Computer

Engineering [ECE] 4310, 3210, 3110.

ECE 4220: Real Time Embedded Computing (3). Embedded systems development with real time constraints including RTOS, task management and synchronization, real time scheduling algorithms, deadlocks, performance analysis and optimization, interfacing to external devices, and device drivers. Prerequisite: Electrical and Computer Engineering [ECE] 3220. Graded on A/F basis only.

ECE 4250: VHDL and Programmable Logic Devices (4). Design techniques including module definition, functional partitioning, hardware design language descriptions and microprogramming; design examples include arithmetic units, programmable controllers, and microprocessors. Prerequisites: Electrical and Computer Engineering [ECE] 3210.

ECE 4270: Computer Organization (4). Advanced computer architectures and programming; memory, memory management and cache organizations, parallel processing, graphical processor units for general programming. Prerequisite: Electrical and Computer Engineering [ECE] 3210.

ECE 4310: Feedback Control Systems (4). System modeling and time and frequency response, closed loop control, stability, continuous system design, introduction to discrete time control, software and hardware experiments on compensator design and PID control. Prerequisite: Electrical and Computer Engineering [ECE] 3810. Graded on A/F basis only.

ECE 4330: Introduction to Mechatronics and Robotic Vision (4). Covers 1) mechatronic systems; 2) the mathematical tools used to model industrial and mobile robots; and 3) vision sensors, their underlying models and algorithms that allow us to control and interact with robots. Prerequisites: Electrical and Computer Engineering [ECE] 3220 or 4220 or a C/ C++ languages.

ECE 4340: Building Intelligent Robots (4). (same as Computer Science [CMP_SC] 4730). Covers the design and development of intelligent machines, emphasizing topics related to sensor-based control of mobile robots. Includes mechanics and motor control, sensor characterization, reactive behaviors and control architectures. Prerequisites: junior standing and programming experience in one of the following programming languages: Basic , C, C++, or Java.

ECE 4350: Programmable Logic Controllers (4).
Hardware and software aspects of PLC's; computer/ PLC Communications; developing ladder logic programs; interfacing I/O devices, including sensors, to the PLC; labeling and documentation; utilizing analog capabilities; applications; developing Supervisory Control and Data Acquisitions (SCADA) applications. Prerequisite: junior standing or above.

ECE 4370: Automatic Control System Design (3).
Techniques for feedback system design and analysis; compensation using root locus and frequency-domain methods; state-variable design methods; techniques for nonlinear systems analysis and design; sample-data control systems. Prerequisite: Electrical and Computer Engineering [ECE] 4310.

ECE 4390: Computer Process Control (3).
Role of digital computer in process control; digital controller design; computer interfacing; transducers; programmable logic controllers; process modeling; introduction to robotics. Prerequisites: Electrical and Computer Engineering [ECE] 4310 and 3210.

ECE 4410: Power Electronics I (4). Power electronic device characteristics, important circuit and component concepts, loss mechanisms and thermal analysis, phase controlled rectifiers, dc-

dc converters, and dc-ac inverters. Includes laboratory projects. Prerequisites: Electrical and Computer Engineering [ECE] 3610 and 3410.

ECE 4430: Electronic Circuits and Signals II (3). Advanced study of electronic devices including frequency response of amplifiers, nonlinear effects in transistor amplifiers, oscillators, and feedback amplifiers. Prerequisites: Electrical and Computer Engineering [ECE] 3830 and 3410.

ECE 4450: Amplifier Analysis and Design (3).
Design of electronic networks with application to instrumentation, control and communications systems. Practical specifications and problems in design. Lectures and projects. Prerequisite: Electrical and Computer Engineering [ECE] 4430

ECE 4510: Pulsed Power Engineering (3). Concepts of energy generation and storage systems used in pulse power engineering, high power opening and closing switches, high voltage engineering, grounding and shielding, high voltage safety. Prerequisite: Electrical and Computer Engineering [ECE] 3510.

ECE 4530: Photonics (3). Introduction to the physical principles and optical materials used in diagnostics, optical communications, semiconductor and solid state lasers, optical fiber transmissions, optical detectors, optical signal processing. Prerequisite: Electrical and Computer Engineering [ECE] 3510.

ECE 4550: Introduction to Plasmas (3). (same as Nuclear Science and Engineering [NU_ENG] 4375). Equations of plasma physics, interaction of waves and plasmas; plasma sheaths and oscillations; measurements and applications. Prerequisites: Electrical and Computer Engineering [ECE] 4930.

ECE 4570: Lasers and Their Applications (3).
(same as Nuclear Engineering [NU_ENG] 4382). An introductory course in lasers. The course treats the subject from both a conceptual viewpoint and from the application of Maxwell's equations, to develop the optical theory for lasers. The course includes approximately 10 classroom hours of laboratory work with lasers. Prerequisites: Physics [PHYSCS] 2760 and Mathematics [MATH] 4110.

ECE 4580: Computational Neuroscience (4).(same as Biological Science [BIO_SC] 4580). Interdisciplinary course in biology and quantitative sciences with laboratory and modeling components. Explores basic computational and neurobiological concepts at the cellular and network level. Introduction to neuronal processing and experimental methods in neurobiology; modeling of neurons and neuron-networks. Prerequisite: Mathematics [MATH] 1500 or equivalent. Graded on A/F basis only.

ECE 4610: Physical Electronics (3). Introduction to physical principles of semiconductors and semiconductor devices; gas, solid state, and semiconductors lasers; electro-optics; plasma physics and gaseous electronics; materials interaction with electric and magnetic fields. Prerequisite: Electrical and Computer Engineering [ECE] 3510.

ECE 4620: Introduction to BioMEMS (3). Study of BioMEMS devices and applications. Topics cover BioMEMS including overview of microfabrication techniques, common bioMEMS material, microfluidic principles, microfluidic devices, drug delivery, biomedical microdevices for neural implants, patch-clamping and single cell based analysis systems, microelectroporation, DNA microarrays, Plymerase Chain Reaction and biopolymers, chemical and gas sensors and biosensors. Graded on A/F basis only.

ECE 4630: Introduction to Optical Electronics (3). Principles, devices and materials used to generate, modulate, and detect optical radiation. Review of important properties of light and semiconductors. Light-emitting diodes and lasers. Electro-optic modulation. Thermal and quantum detection. Emphasis on semiconductor-based devices and application to fiber-optical communications. Prerequisite: Electrical and Computer Engineering [ECE] 3610.

ECE 4640: MEMS Laboratory (4). The main objective of this course is to provide hands-on skills for the interdisciplinary Microelectromechanical Systems (MEMS). It puts emphasis on the practical aspects of design, fabrication, test, and characterization of micro/nano devices and systems. Prerequisites: Physics [PHYSCS] 2760, Chemistry [CHEM] 1320, or Electrical and Computer Engineering [ECE] 2100; instructor's consent.. Graded on A/F basis only.

ECE 4650: Semiconductor Device Theory (3).
Band theory, equilibrium and non-equilibrium semiconductor electronics, junction theory, p-n junction devices, bipolar and field effect transistors including SPICE simulation. Prerequisite:Electrical and Computer Engineering [ECE] 3610.

ECE 4655: Digital image Processing (3). (same as Computer Science [CMP_SC] 4650). This course provides fundamentals of digital image processing hardware and software including digital image acquisition, image display, image enhancement, image transforms and segmentation. Prerequisites: Statistics [STAT] 4710 and Computer Science [CMP_SC] 2050 or instructor's consent.

ECE 4670: Microelectronic Fabrication (4). Basic silicon integrated circuit fabrication processes, basic techniques of wafer processing, economics of fabrication and resulting devices properties, interdependence of process flow and device design. Accompanying laboratory. Prerequisite: Electrical and Computer Engineering [ECE] 3610.

ECE 4675: Digital Image Compression (3). (same as Computer Science [CMP_SC] 4670) This course provides basic concepts and theorems in information theory, discrete cosine transform, discrete wavelet transform, quantizer design, bit allocation, and rate-distortion analysis and practical coding and communication system design, (such as Huffman coding, arithmetic coding, variable length coding, motion estimation, JPEG.) Prerequisite: Statistics [STAT] 4710 or instructor's consent. Graded on A/F basis only.

ECE 4690: Design and Simulation of VLSI Circuits (4). Design of CMOS integrated circuits with emphasis on analog applications. Device models are developed for circuit simulation. Lecture and laboratory. Prerequisite: Electrical and Computer Engineering [ECE] 4670.

ECE 4710: Communications Systems (3).
Concepts of communication systems, signal analysis and power spectrum density, signal transmission and filtering, linear modulation, exponential modulation, sampling, baseband digital communication, modulated digital communication, spread spectrum communication. Prerequisites: Electrical and Computer Engineering [ECE] 3830.

ECE 4720: Introduction to Machine Learning and Pattern Recognition (3). (Same as Computer Science [CMP_SC] 4720) This course provides foundation knowledge to the basic methods in machine learning and pattern recognition (MLPR). MLPR addresses the problems of programming computers to optimize certain performance criteria by using example data or expert knowledge and it has wide applications. Prerequisites: Computer Science [CMP_SC] 2050 and Statistics [STAT] 4710 or instructors consent.

ECE 4730: Introduction to Wireless Communication System (3). Principles of wireless communication analysis and design. Digital communication basics, cellular radio, wireless PCS communications, multiple access techniques, channel coding and equalization, and standards of digital cellular/PCS systems.

ECE 4770: Electromechanical Conversion I (3).
Theory and applications of electric machinery. Steady state and transient performance analysis of AC and DC electrical machines with emphasis on internal electromagnetic phenomena. Fundamentals of electronic speed controls. Prerequisite: Electrical and Computer Engineering [ECE] 3470.

ECE 4830: Introduction to Digital Signal Processing (4). Concepts, analytical tools, design techniques used in computer processing of signals; signal representation, sampling, discrete-time systems analysis, recursive and non-recursive filters, design/ implementation, discrete Fourier transform. Prerequisites: Electrical and Computer Engineering [ECE] 2110, 2210, 3830.

ECE 4850: Image Processing (3). (same as Computer Science [CMP_SC] 4650). Fundamentals of digital image processing hardware and software including digital image acquisition, image display, image enhancement, image transforms and segmentation.

ECE 4870: Introduction to Computational Intelligence (3). (same as Computer Science [CMP_SC] 4770). Introduction to the concepts, models, and algorithms for the development of intelligent systems from the standpoint of the computational paradigms of neural networks, fuzzy set theory and fuzzy logic, evolutionary computation and swarm optimization. Prerequisite: some exposure to rigorous axiomatic mathematical development of a topic (as can be found in most senior/graduate level math or statistics courses) is needed to appreciate some of the development of the theory. Also, the ability to program (well) in some high level language is essential to preform the computer projects. Graded on A/F basis only.

ECE 4880: Micro/Nano Systems (3). Micro/nano systems including micromachining, material properties, micro-actuators, optical, RF, inertial/mechanical and acoustic M/NEMS and M/Nanofluidic systems. Prerequisite: Electrical and Computer Engineering [ECE] 3610 or instructor's consent. Graded on A/F basis only.

ECE 4910: Microwave Systems (3). Theory and applications of transmission systems with emphasis on transmission lines at low and high frequencies. Prerequisites: Electrical and Computer Engineering [ECE] 3510.

ECE 4920: Microwave Engineering (3). Wave equation, plane wave propagation, transmission line theory, Smith Chart analysis, impedance transformers, waveguides modes, basic antenna theory, impedance matching and tuning, basic microstrip and stripline circuits.

ECE 4930: Intermediate Electromagnetics (4). Course covers transmission lines, waveguides, microstrip electromagnetic circuits, and radiating systems. Prerequisites: Electrical and Computer Engineering [ECE] 3510.

ECE 4940: Antenna Theory, Design and Laboratory (4). Introduction to antenna theory, design and laboratory. Emphasis on engineering aspects of antenna systems, transmitting and receiving antenna parameters, various antennas. Prerequisites: Electrical and Computer Engineering [ECE] 3510.

ECE 4950: Microwave Principles (4). Maxwell's Equations, transmission lines, plane wave progagation and reflection, waveguides, resonant cavities, microwave devices and components,

radiation, radio wave propagation. Lecture and laboratory. Prerequisites: Electrical and Computer Engineering [ECE] 3510 and 3410.

ECE 4970: Senior Capstone Design (3). Group Design Projects. Design methodology, project management, development of specifications, examination of alternatives, preparation of proposal. Lectures on safety, ethics, professionalism, and economics. Oral and written reports. Not for graduate credit. Prerequisites: Electrical and Computer Engineering [ECE] 3110 and senior standing. Restricted to ECE students only or instructor's consent.

ECE 4980: Senior Capstone Design II (2). (same as Computer Science [CMP_SC] 4980). Completion of Electrical and Computer Engineering [ECE] 4970 design project. Design prototyping, testing, evaluation and preparation of documentation. Lectures on ethics, professionalism, safety, economic consideration. Oral and written reports. Not for graduate credit. Prerequisites: senior standing and Electrical and Computer Engineering [ECE] 4970.

ECE 4990: Undergraduate Research in Electrical Computer Engineering (1-3). Supervised independent study or project in electrical or computer engineering, culminating in a written report.. Prerequisites: Undergraduate Program Director's consent.

ECE 4995: Undergraduate Honors Research in Electrical Computer Engineering (1-3). Independent investigation or project in electrical or computer engineering to be presented as an undergraduate honors thesis. Prerequisites: Participation in the Electrical and Computer Engineering [ECE] Honors Program.

MIZZOU ENGINEERING engineering.missouri.edu

University of Missouri

Department of Computer Science

What is it?

COMPUTER SCIENTISTS are creators, researchers and developers who explore ways computers can help people and our planet and turn those ideas into practical applications.

What can you do?

You can work in almost every field imaginable, from human health to crop and animal production, mobile computing to national security, video game development to movie making.

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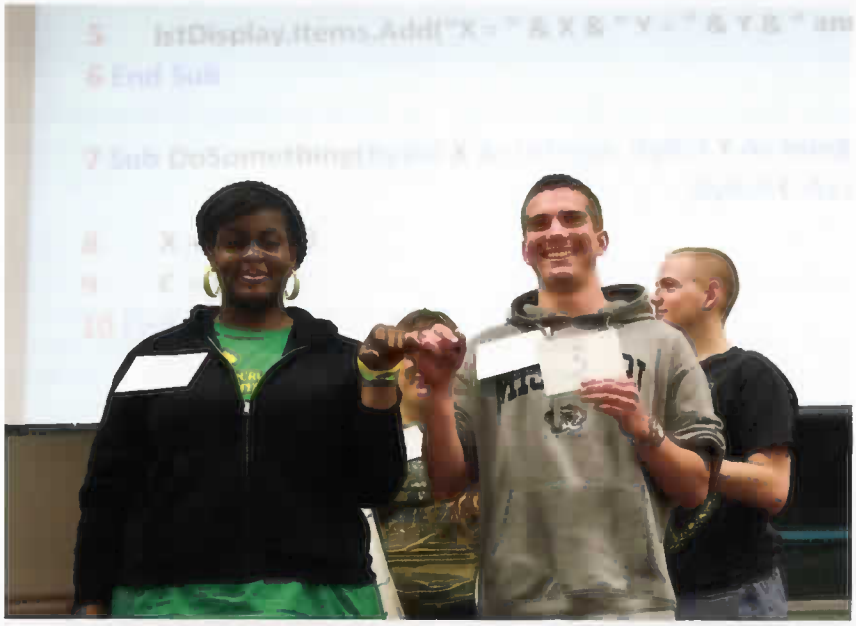

AVERAGE SALARY OFFER: $44,300*

DEGREES:

- Bachelor of Science in Computer Science BS CS
- Bachelor of Science in Information Technology BS IT
- Bachelor of Arts in Computer Science BA CS
- Dual Bachelor of Science in Computer Science and Bachelor of Science in Information Technology BS CSIT
- Master of Science in Computer Science MS CS
- Doctoral Degree in Computer Science PhD CS

*2009 University of Missouri Destination Survey

TYPICAL BS COMPUTER SCIENCE CURRICULUM

FIRST SEMESTER			SECOND SEMESTER		
FRESHMAN YEAR					
Comm 1200	Public Speaking	3	CS 1050	Algorithm Desgn. & Prog. I	3
CS 1000	Intro. to Computer Science	1	Eng 1000	Expo. & Argumentation	3
CS 1040	Intro. to Prob. Solv. & Prog.	3	Math 1700	Calculus II	5
Math 1500	Analytical Geom. & Calc.	5	*Social/Behavioral Science elective*		3
Constitutional elective (Soc./Behavioral Sci.)		3	*Non-science elective*		3
	TOTAL CREDIT HOURS	15		TOTAL CREDIT HOURS	17
SOPHOMORE YEAR					
Math 2300	Calculus III	3	CS 3330	Object Oriented Programming	3
CS 2050	Algorithm Design & Prog. II	3	CS 3270	Intro. to Digital Logic	3
Science Sequence		5	Math 2320	Discrete Mathematical Struc.	3
Humanities/Fine Arts electives		3	CS 3050	Design & Implmnt. of Algorithms	3
Non-science elective		3	*Science Sequence*		5
	TOTAL CREDIT HOURS	17		TOTAL CREDIT HOURS	17
JUNIOR YEAR					
CS 3280	Assemb. Lang. & Comp. Org.	3	CS 3380	Database Aps. and Info. Sys.	3
STAT 4710	Intro. to Math. Stats	3	CS 4050	Desgn. & Analsys. of Algorithms I	3
CS level 4000 elective		3	CS 4320	Software Engr. I (WI)	3
CS level 2000/3000 elective		3	*Science elective*		2
Social/Behavioral Science elective		3	*Technical elective*		3
			General elective		1
	TOTAL CREDIT HOURS	15		TOTAL CREDIT HOURS	15
SENIOR YEAR					
CS 4410	Theory of Computation I or		CS 4520	Op. Systems I	3
4430	Compilers I or		CS 4980	Senior Capstone Design II	2
4450	Prin. of Prog. Languages	3	CS	4410 or 4430 or 4450	3
CS 4850	Computer Networks I	3	*CS level 4000 elective*		3
CS 4970	Senior Capstone Design I (WI)	3	*Non-science elective*		3
Humanities/Fine Arts elective		3	*General elective*		1
CS level 4000 elective		3			
	TOTAL CREDIT HOURS	15	TOTAL CREDIT HOURS		15

TOTAL CREDIT HOURS 126

COMPUTER SCIENCE COURSES

CMP SC 1000: Introduction to Computer Science (1). This course introduces the Computer Science field, including the history of computers, career opportunities, and ethical/social issues. There will be lectures given by MU Computer Science faculty to discuss exciting fields as well as career advisement given by Computer Science industry representatives. Restricted to freshman/sophomore Computer Science [CMP_SC]/ Information Technology [INFOTC] majors.

CMP SC 1001: Topics in Computer Science (cr. arr.). Topic and credit may vary from semester to semester. May be repeated upon consent of department.

CMP SC 1010: Fundamentals of Personal Computing: Hardware, Software, and Communication (3). Introduction to the fundamentals of computers, especially personal computers. Basics of computer hardware, computer software and computer communications are presented. Learners will gain an understanding of how these basic components form a system for problem solving.

CMP SC 1020: Introduction to Computing (3).
Introduction to word processing, spreadsheets, and database software. Taught in classrooms equipped with microcomputers. May not be taken for credit after a computer science course numbered above 1001 or Accountancy [ACCTCY] 2258 has been completed. Does not fulfill a mathematical sciences requirement for Arts and Science students.

CMP SC 1040: Introduction to Problem Solving and Programming (3). An introduction to problem solving methods and programming concepts, providing experience in designing, developing, implementing, and testing programs. Cannot be taken for credit after Computer Science [CMP_SC] 1050.

CMP SC 1050: Algorithm Design and Programming I (3). This course provides experience in developing algorithms, designing, implementing programs. Topics include syntax/semantics, flow control, loops, recursion, I/O, arrays, strings and pointers. Prerequisites: Mathematics [MATH] 1100 and Computer Science [CMP_SC] 1040 (C- or better) or passing entrance exam. Math Reasoning Proficiency Course.

CMP SC 2001: Topics in Computer Science (cr. arr.). Topic and credit may vary from semester to semester. May be repeated upon consent of department. Prerequisite: departmental consent.

CMP SC 2050: Algorithm Design and Programming II (3). A study of fundamental techniques and algorithms for representing and manipulating data structures. Topics include data abstraction, recursion, stacks, queues, linked lists, trees, efficient methods of sorting and searching, and Big-O analysis. Prerequisite: Computer Science [CMP_SC] 1050.

CMP SC 2110: Programming in C (3). The primary goal of this course is for students to achieve proficiency in the C programming language. The course will teach students the syntax, semantics and skills in C. The students will work to develop advanced data structures/ algorithms, obtain an understanding of 'lower level' programming, become familiar with utilities and other resources necessary to build large-scale projects, debug sizable code, and understand a system level representation of executables produced. Prerequisite: Computer Science [CMP_SC] 2050.

CMP SC 2111: Production Languages (1-3). The study of the syntax, semantics, and applications of one programming language suitable for large scale scientific or commercial

projects, such as FORTRAN, COBOL, PL/1, C, or ADA. May be taken more than once for credit. Prerequisite: Computer Science [CMP_SC] 2050.

CMP SC 2830: Introduction to the Internet, WWW and Multimedia Systems (3). This course will attempt to provide a comprehensive understanding of the evolution, the technologies, and the tools of the Internet. In particular, issues pertaining to the World Wide Web and Multimedia (HTML, CGI, Web based applications) will be discussed in detail. Prerequisites: Computer Science [CMP_SC] 2050.

CMP SC 3001: Topics in Computer Science (cr.arr.). Current and new technical developments in computer science. For juniors and seniors. Prerequisite: departmental consent. May be repeated for 6 hours credit.

CMP SC 3050: Advanced Algorithm Design (3).
This class surveys fundamental algorithms and data structures that have wide practical applicability, including search trees and graph algorithms. Emphasis is placed on techniques for efficient implementation and good software development methodologies. Prerequisites: Computer Science [CMP_SC] 2050.

CMP SC 3270: Introduction to Digital Logic (3).
Basic tools, methods and procedures to design combinational and sequential digital circuits and systems, including number systems, boolean algebra, logic minimization, adder design, memory elements, and finite state machine design. Prerequisites: Computer Science [CMP_SC] 2050.

CMP SC 3280: Assembly Language and Computer Organization (3). Introduces microcontrollerbased systems, programming concepts, subroutines, bus control, input-output transfers, and interrupts. Prerequisite: Computer Science [CMP_SC] 3270. Graded on A/F basis only.

CMP SC 3330: Object Oriented Programming (3). This course focuses on object-oriented programming concepts: abstraction, polymorphism, encapsulation, inheritance, interfaces, abstract classes, files, streams, and object serialization. Topics such as GUI and event-driven programming are also tackled. Prerequisite: Computer Science [CMP SC] 2050.

CMP SC 3380: Database Applications and Information Systems (3). Covers fundamental topics of database management systems (DBMS) and database-enabled applications. Topics include a brief history of secondary storage and databases, data modeling, introductory SQL, an overview of current database trends, and current popular database systems. Prerequisite: Computer Science [CMP_SC] 2050. Graded on A/F basis only.

CMP SC 3530: UNIX Operating System (3). Introduction to the UNIX operating system and its interfaces including the file system, shell, editors, pipes and filters, input/output system, shell programming, program development including C, and document preparation. Prerequisite: Advanced C programming experience.

CMP SC 3940: Internship in Computer Science (1-3). Computer-related experience in business or industry jointly supervised by faculty and computer professionals. Students should apply one semester in advance for consent of the supervising professor. Prerequisite: Computer Science [CMP_SC] 2050. Graded on a S/U basis only.

CMP SC 4001: Topics in Computer Science (cr. arr.). Topic and credit may vary from semester to semester. May be repeated upon consent of department.

CMP SC 4050: Design and Analysis of Algorithms I (3). This course reviews and extends

earlier work with linked structures, sorting and searching algorithms, and recursion. Graph algorithms, string matching, combinatorial search, geometrical algorithms and related topics are also studied. Cannot be counted toward Computer Science MS/PHD. Prerequisite: Computer Science [CMP_SC] 2050 and Mathematics [MATH] 2320.

CMP SC 4060: String Algorithms (3). This course provides an introduction to algorithms that efficiently compute patterns in strings. Topics covered include basic properties of strings, data structures for processing strings, string decomposition, exact and approximate string matching algorithms. Prerequisite: Computer Science [CMP_SC] 4050. Graded on A/F basis only.

CMP SC 4085: Problems in Computer Science (1-6). Independent investigation or project in Computer Science. Prerequisite: senior standing in Computer Science. May be repeated to up 6 hours.

CMP SC 4270: Computer Architecture I (3).
Architectural features of high-performance computer systems including hierarchical and virtual memory, pipelining, vector processing and an introduction to multiple-processor systems. Prerequisites: Computer Science [CMP_SC] 3270.

CMP SC 4320: Software Engineering I (3). Overview of software life cycle, including topics in systems analysis and requirements specification, design, implementation testing and maintenance. Uses modeling techniques, project management, peer review, quality assurance, and system acquisition. Prerequisite: Computer Science [CMP_SC] 2050. Co-requisite: Computer Science [CMP_SC] 3380.

CMP SC 4330: Object Oriented Design I (3).
Building on a prior knowledge of program design and data structures, this course covers object-oriented design, including classes, objects, inheritance, polymorphism, and information hiding. Students will apply techniques using a modern object-oriented implementation language. Enrollment limited to undergraduate students only. Prerequisite: Computer Science [CMP_SC] 2050.

CMP SC 4380: Database Management Systems I (3). Fundamental concepts of current database systems with emphasis on the relational model. Topics include entity-relationship model, relational algebra, query by example, indexing, query optimization, normal forms, crash recovery, web-based database access, and case studies. Project work involves a modern DBMS, such as Oracle, using SQL. Prerequisite: Computer Science [CMP_SC] 3380.

CMP SC 4410: Theory of Computation I (3).
An introductory study of computation and formal languages by means of automata and related grammars. The theory and applications of finite automata, regular expressions, context free grammars, pushdown automata and Turing machines are examined. May not be counted toward Computer Science MS/PHD. Prerequisite: Mathematics [MATH] 2320.

CMP SC 4430: Compilers I (3). Introduction to the translation of programming languages by means of interpreters and compilers. Lexical analysis, syntax specification, parsing, error-recovery, syntax-directed translation, semantic analysis, symbol tables for block structured languages, and run-time storage organization. May not be counted toward Computer Science MS/PHD. Prerequisite: Mathematics [MATH] 2320.

CMP SC 4450: Principles of Programming Languages (3). An introduction to the structure, design and implementation of programming languages. Topics include syntax, semantics, data

types, control structures, parameter passing, run-time structures, and functional and logic programming. May not be counted toward Computer Science MS/PHD. Prerequisite: Computer Science [CMP_SC] 2050.

CMP SC 4520: Operating Systems I (3). Basic concepts, theories and implementation of modern operating systems including process and memory management, synchronization, CPU and disk scheduling, file systems, I/O systems, security and protection, and distributed operating systems. Cannot be counted toward Computer Science MS/PHD. Prerequisites: Computer Science [CMP_SC] 2050 and Mathematics [MATH] 1700.

CMP SC 4610: Computer Graphics I (3). Basic concepts and techniques of interactive computer graphics including hardware, software, data structures, mathematical manipulation of graphical objects, the user interface, and fundamental implementation algorithms. Prerequisites: Computer Science [CMP_SC] 2050 and either Mathematics [MATH] 1500 or both MATH 1300 and Mathematics [MATH] 1320.

CMP SC 4620: Physically Based Modeling and Animation (3). This course introduces students to physically based modeling and animation methodology for computer graphics and related fields such as computer vision, visualization, biomedical imaging and virtual reality. We will explore current research issues and will cover associated computational methods for simulating various visually interesting physical phenomena. This course should be appropriate for graduate students in all areas as well as advanced undergraduate students. Graded on A/F basis only. Prerequisites: Computer Science [CMP_SC] 4610, good knowledge of C or C++ programming, no physics background necessary.

CMP SC 4650: Digital Image Processing (3).
(same as Electrical and Computer Engineering [ECE] 4850). Fundamentals of digital image processing hardware and software including digital image acquisition, image display, image enhancement, image transforms and segmentation. Prerequisites: Computer Science [CMP_SC] 2050, Statistics [STAT] 4710 or instructor's consent.

CMP SC 4670: Digital Image Compression (3).
(same as Electrical and Computer Engineering [ECE] 4675) Covers digital image formation, information theory concepts, and fundamental lossless and lossy image compression techniques including bit plane encoding, predictive coding, transform coding, block truncation coding, vector quantization, subband coding and hierarchical coding. Prerequisite: Computer Science [CMP_SC] 2050.

CMP SC 4720: Introduction to Machine Learning and Pattern Recognition (3). (Same as Electrical Engineering [ECE] 4720) This course provides foundations and methods in machine learning and pattern recognition that address the problem of programming computers to optimize performance by learning from example data or expert knowledge. Prerequisite: Computer Science [CMP_SC] 2050 and Statistics [STAT] 4710 or instructor consent. Graded on A/F basis only.

CMP SC 4730: Building Intelligent Robots (4).
(same as Electrical and Computer Engineering [ECE] 4340). Covers the design and development of intelligent machines, emphasizing topics related to sensor-based control of mobile robots. Includes mechanics and motor control, sensor characterization, reactive behaviors and control architectures. Prerequisites: Electrical and Computer Engineering [ECE] 2210 or Computer Science [CMP_SC] 3270 and 2050 or instructor's consent.

CMP SC 4750: Artificial Intelligence I (3). Introduction to the concepts and theories of intelligent systems. Various approaches to creating intelligent systems, including symbolic and computational approaches, insight into the philosophical debates important to understanding AI. Prerequisite: at least junior standing, Computer Science [CMP_SC] 2050

CMP SC 4770: Introduction to Computational Intelligence (3). (same as Electrical and Computer Engineering [ECE] 4870). Introduction to the concepts, models and algorithms for the development of intelligent systems from the standpoint of the computational paradigms of neural networks, fuzzy set theory and fuzzy logic, evolutionary computation and swarm optimization.

CMP SC 4830: Science and Engineering of the World Wide Web (3). This course will study the science and engineering of the World Wide Web. We will study the languages, protocols, services and tools that enable the web. Emphasis will be placed on basics and technologies. Prerequisites: Computer Science [CMP_SC] 2830.

CMP SC 4850: Computer Networks I (3).
Introduction to concepts and terminology of data communications and computer networking. Basic protocols and standards, applications of networking, routing algorithms, congestion avoidance, long-haul and local networks. Prerequisite: Computer Science [CMP_SC] 3270 and Mathematics [MATH] 2320.

CMP SC 4860: Network Security (3). Principles and practice of cryptography, network security, and computer system security. It includes symmetric and asymmetric cryptography, authentication, security applications such as secure email, IP security, Web security, and system security issues such as intruders, viruses, worms, Trojan horses, and firewalls. Graded on A/F basis only. Prerequisite: Computer Science [CMP_SC] 4850.

CMP SC 4870: Wireless and Mobile Networks (3). Concepts and techniques in wireless and mobile networks: cellular concepts, wireless physical layer, wireless MAC protocol, mobility management, power management, wireless network security, wireless telecommunication system, wireless LAN, wireless add hoc networking, wireless personal area network. Prerequisite: Computer Science [CMP_SC] 4850. Graded on A/F basis only.

CMP SC 4970: Senior Capstone Design I (3).
Design projects emphasizing team work, communication skills, and prototyping. Covers professional ethics, intellectual property/patenting, knowledge of engineering literature, safety, economic and environmental impact of technology. Essays, oral and written reports. Prerequisites: Computer Science [CMP_SC] 4320 and senior standing.

CMP SC 4980: Senior Capstone Design II (2).
Course entails completion of Computer Science [CMP_SC] 4970 design project. Design prototyping, testing, evaluation, presentation, and preparation of documentation. Prerequisite: Computer Science [CMP_SC] 4970.

CMP SC 4990: Undergraduate Research in Computer Science (0-6). Independent investigation or project in Computer Science. Prerequisite: senior standing in Computer Science. May be repeated to 6 hours.

CMP SC 4995: Undergraduate Research in Computer Science - Honors (1-6). Independent investigation to be presented as an undergraduate honors thesis. Prerequisite: honors student in Computer Science.

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University of Missouri

Department of Computer Science

INFORMATION TECHNOLOGY PROGRAM (IT)

What is it?

People in INFORMATION TECHNOLOGY work on the development and dissemination of information through database applications, networking and various modes of presentation.

What can you do?

You can work in fields such as information systems, networking and mobile computing, game technology and entertainment – animation and modeling, audio and video production, and digital media.

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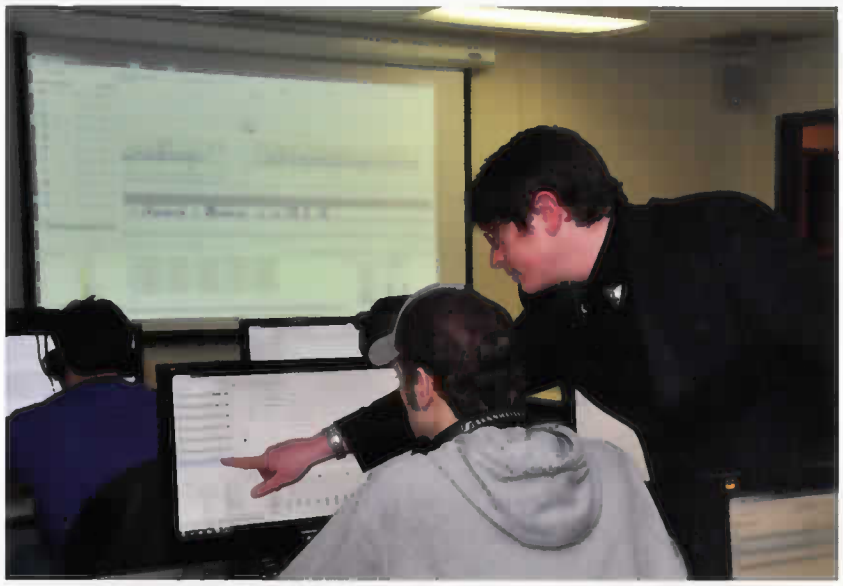


TYPICAL INFORMATION TECHNOLOGY CURRICULUM

FIRST SEMESTER			SECOND SEMESTER		
FRESHMAN YEAR					
CS 1000	Intro. to Computer Science	1	CS 1050	Algorithm Desgn. & Prog. I	3
CS 1040	Intro. to Prob. Solv. & Prog.	3	Eng 1000	Expo. & Argumentation	3
Math 1320	Elements of Calculus	3	Math 1300	Finite Math	3
Constitutional elective (Soc./Behavioral Sci.)		3	*INFO TC level 1000/2000 elective*		3
Social /Behavioral Science elective		3	*Humanities/Fine Arts elective*		3
General elective		2	*General elective*		1
	TOTAL CREDIT HOURS	15		TOTAL CREDIT HOURS	16
SOPHOMORE YEAR					
CS 2050	Algorithm Design & Prog. II	3	CS 2830	Intro. to Internet, WWW and Multimedia	3
STAT 2500	Into. to Probability and Stats.	3			
Science course		4	INFO TC 2610	Audio/Video I	3
Humanities/Fine Arts electives		3	*Minor course*		3
Minor Course		3	*INFO TC level 1000/2000 elective*		3
			Minor or general elective		3
	TOTAL CREDIT HOURS	16		TOTAL CREDIT HOURS	15
JUNIOR YEAR					
CS 3380	Database Aps. and Info. Sys.	3	INFO TC 2910	Cyber Security	3
INFO TC 2810	Fundamentals of Network Tech.	3	CS 4320	Software Engineering (WI)	3
Business course		3	*INFO TC level 3000/4000 elective*		3
Minor course		3	*Science with lab*		5
Social /Behavioral Science elective		3	*General elective*		2
General elective		2			
	TOTAL CREDIT HOURS	17		TOTAL CREDIT HOURS	16
SENIOR YEAR					
CS 4970	Senior Capstone I (WI)	3	CS 4980	Senior Capstone II	2
INFO TC level 1000/2000 elective		3	Minor course		3
INFO TC level 3000/4000 elective		3	*Humanities/Fine Arts elective*		3
Minor course		3	*INFO TC level 3000/4000 elective*		3
General elective		4	*INFO TC level 3000/4000 elective*		3
			General elective		1
TOTAL CREDIT HOURS		16		TOTAL CREDIT HOURS	15

TOTAL CREDIT HOURS 126

AVERAGE SALARY OFFER: $35,200*

DEGREES:

- Bachelor of Science in Information Technology BS IT
- Dual Bachelor of Science in Computer Science and Bachelor of Science in Information Technology BS CSIT

*2009 University of Missouri Destination Survey

INFORMATION TECHNOLOGY COURSES

INFOTC 1001: Topics in Information Technology (3). Topics may vary from semester to semester. May be repeated upon consent of department.

INFOTC 1610: Introduction to Entertainment Media (3). This course is an introduction to the basic fundamentals of entertainment products such as postproduction technology, camera and lighting technology, audio creation and mixing technology, and broadcast technology. Computer programs designed for visual special effects are used.

INFOTC 2001: Topics in Information Technology (3). Topics may vary from semester to semester. May be repeated upon consent of department. Graded on A/F basis only.

INFOTC 2600: Digital Multimedia (3). This course introduces broad views of concepts, software, hardware, and solutions in entertainment media applications. It will examine career options in fields such as information technology, news, film production and postproduction, website design, advertising, or communication.

INFOTC 2610: Audio/Video I (3). This is an introductory course on digital audio and video editing. Background presented in the course will include an overview of the techniques used in modern Non-Linear video editing, and understanding of block editing, and why it is essential when using modern digital technology. The course is hands-on with students at workstations, learning the software directly at the keyboard, and working on assignments in a lab context.

INFOTC 2620: Computer Modeling and Animation I (3). Introduction to the field of computer modeling and animation with an emphasis on tools. Learn programming methods for developing customized modeling and animation algorithms. Prerequisites: Computer Sciences [CMP SC] 1050, and 2050 concurrently. Graded on A/F basis only.

INFOTC 2810: Fundamentals of Network Technology (3). This course includes an overview of networking and the common wireless standards. Prerequisites: Computer Sciences [CMP SC] 1050. Graded on A/F basis only.

INFOTC 2910: Cyber Security (3). This course covers numerous platform-independent security topics including threats, problem ports and services, theory and practice of defense in security, intrusion detection, data security, securing remote access, user education and support, designing a secure network and security management. Prerequisites: Computer Sciences [CMP SC] 1050, Information Technology [INFOTC] 2810. Graded on A/F basis only.

INFOTC 3001: Topics in Information Technology (3). Topics may vary from semester to semester. May be repeated upon consent of department. Graded on A/F basis only.

INFOTC 3610: Audio/Video II (3). This course presents broad professional techniques for completing an off-line edit and the progression to online and finishing, adding depth to topics introduced in A/V
I. Students will gain experience in editing techniques involving dialogue, action, documentaries, music videos, and multi-camera projects. The course also introduces special effects, audio finishing, clip and media management, and use of various media formats. Prerequisites: Information Technology [INFOTC] 2610 and co-requisites Computer Sciences [CMP SC] 2050.

INFOTC 3620: Computer Modeling and Animation II (3). This course covers advanced methods for modeling and animation with an emphasis on computer science theory and virtual reality. Prerequisites: Information Technology [INFOTC] 2620 and Computer Science [CMP

SC] 2050. Graded on A/F basis only.

INFOTC 3630: Introduction to Game Design (3). This class will focus on the theory, design, and implementation of games. Students will learn about designing and implementing vital components for modern game engines, with respect to data structures, algorithms, content, development tools, and optimization strategies. In addition, students will use the Valve Source Engine (used to power Half-Life 2) to develop there own mod. The final project is a fully functional game. Prerequisite: Information Technology [INFOTC] 2620, Computer Science [CMP SC] 2050.

INFOTC 3640: Digital Effects (3). This course is an introduction to the fundamentals of digital motion picture effects technology. This course is designed for a student interested in pursuing a career in information technology, news, film production and film postproduction, website design, or communication. Prerequisites: Information Technology [INFOTC] 1610 or 2610.

INFOTC 3850: Computer System Administration (3). This course will cover network management tools, network maintenance, data management, remote access management, management tasks, responsibilities and ethics, required plans and policies, design of a well-managed network. Some work will be done in both Windows and Linux environments. Prerequisites: Computer Science [CMP SC] 2050, junior standing. Graded on A/F basis only.

INFOTC 4001: Topics in Information Technology (3). Topics may vary from semester to semester. May be repeated upon consent of department. Graded on A/F basis only.

INFOTC 4390: Database Administration (3).
This course is designed to give a firm foundation in Database Administrators' tasks. The primary goal is to give necessary knowledge and skills to setup, maintain and troubleshoot an Oracle database. This is an instructor-led course featuring lecture and hands-on exercises. Online demonstration and written practice sessions reinforce the concepts and skills introduced. The course defined objectives are designed to support preparation for the Oracle Certified Professional examination. Prerequisites: CMP SC 4380.

INFOTC 4630: Game Design II (3). This course explores 1) the manual and procedural development of static and dynamic game content, 2) programming for gameplay, interactivity, UI, game Artificial Intelligence, and 3) algorithms, ADTs, and research vital to game design. Prerequisite: Information Technology [INFOTC] 3630.

INFOTC 4640: Digital Effects II (3). This course builds on fundamentals of digital motion picture effects technology learned in Digital Effects I. Computer programs designed for digital visual special effects in film and broadcast are integrated throughout the course. Prerequisites: Information Technology [INFOTC] 3640.

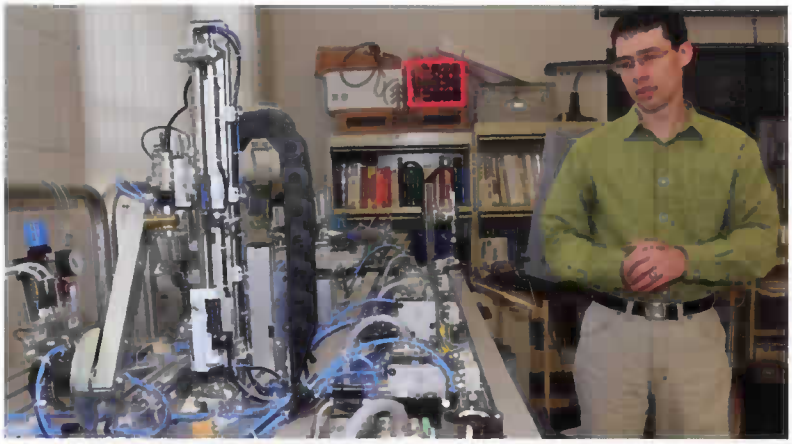
INFOTC 4650: Shader Programing (3). The focus of this course is modern computer graphics algorithms and programming, with an emphasis on games, shader languages, (GLSL and Cg) and Graphical Processor Units (GPUs). Prerequisites: Computer Science [CMP SC] 2050, Information Technology [INFOTC] 2620.

MIZZOU ENGINEERING
University of Missouri
engineering.missouri.edu

Department of Industrial and Manufacturing Systems Engineering

What is it?

INDUSTRIAL ENGINEERS combine basic engineering skills, optimization/statistical analysis, people skills, and business savvy to analyze, design, build, and manage systems to increase effectiveness and productivity – solving problems to make things work better.



What can you do?

Since the work involves designing integrated systems of people, machines and resources, you can work in manufacturing and service industries, including healthcare, logistics consulting, finance, government and more.

CONTACT:
Paula McDonald
E3437 Lafferre Hall
573-882-2691
mcdonaldp@missouri.edu

AVERAGE SALARY OFFER: $53,400*

DEGREES:

- Bachelor of Science in Industrial Engineering BS IE
- 5-year BS IE/MBA
- Master of Science in Industrial Engineering MS IE
- Doctoral Degree in Industrial Engineering PhD IE

*2009 University of Missouri Destination Survey

TYPICAL INDUSTRIAL ENGINEERING CURRICULUM

FIRST SEMESTER			SECOND SEMESTER		
FRESHMAN YEAR					
Math 1500	Analytical Geom. & Calc.	5	Math 1700	Calculus II	5
ENGR 1000	Introduction to Engineering	1	Chem 1310	General Chemistry I or	
ENGR 1100	Engineering Graphics	2	1320	General Chemistry II w/Lab	2 - 3
IMSE 1087	Undergraduate Seminar	0	CS 1040	Intro. to Prob. Solv. & Prog. or	
Humanities/Fine Arts elective		3	1050	Algorithm Design & Prog. I	3
Constitution Req. (Social/Behavioral Science)		3	IMSE 1087	Undergraduate Seminar	0
			IMSE 2030	Fund. of Syst. Dsgn. & Analysis	3
			Engl 1000	Exposition & Argumentation	3
	TOTAL CREDIT HOURS	14		TOTAL CREDIT HOURS	16-17
SOPHOMORE YEAR					
Math 2300	Calculus III	3	Math 4100	Differential Equations	3
Physics 2750	University Physics I	5	Physcs 2760	University Physics II	5
IMSE 1087	Undergraduate Seminar	0	ENGR 1200	Statics & Elem. Strength Mat.	3
IMSE 2110	Prob. & Stats for Engineers	3	IMSE 1087	Undergraduate Seminar	0
IMSE 2710	Engr. Economic Analysis	3	IMSE 2210	Linear Algebra for Engineers	3
Ecomomics requirement		3	IMSE 4110	Evaluation of Engr. Data	3
	TOTAL CREDIT HOURS	17		TOTAL CREDIT HOURS	17
JUNIOR YEAR					
IMSE 1087	Undergraduate Seminar	0	ENGR 2100	Circuit Theory	3
IMSE 3810	Ergonomics & Wkstation. Desgn.	3	IMSE 1087	Undergraduate Seminar	0
IMSE 4210	Linear Optimization	3	IMSE 4310	Int. Prod. Systems Design	3
IMSE 4230	Operations Research Models	3	IMSE 4350	Prod. & Operations Analysis	3
IMSE 4280	Systems Simulation	3	IMSE 4610	Engineering Quality Control	3
ENGR 2300	Thermodynamics		*Humanities/Fine Arts elective*		3
	TOTAL CREDIT HOURS	15	TOTAL CREDIT HOURS		15
SENIOR YEAR					
IMSE 1087	Undergraduate Seminar	0	IMSE 1087	Undergraduate Seminar	0
IMSE 4410	Mgmt. Info. Systems Design	3	IMSE 4980	Capstone Design II (WI)	3
IMSE 4550	Computer Aided Dsgn. & Mfg.	4	*IMSE elective*		3
IMSE 4970	Capstone Design I (WI)	1	*Technical elective*		3
IMSE elective		3	*Engr. elective*		3
Technical elective		3	*Social/Behavioral Science elective*		3
Humanities/Fine Arts elective		3			
	TOTAL CREDIT HOURS	17		TOTAL CREDIT HOURS	15

TOTAL CREDIT HOURS 126

INDUSTRIAL AND MANUFACTURING SYSTEMS ENGINEERING COURSES

IMSE 1000: Introduction to Industrial Engineering (1). Introduction to industrial engineering profession, the IMSE department, and the core topics of industrial engineering. Introduction to problem solving, ethics and industrial engineering design and analysis techniques.

IMSE 1010: Experimental Course (cr.arr.). For freshman-level students. Content and credit to be listed in the Schedule of Courses.

IMSE 1087: Undergraduate Seminar (0). Seminars are held monthly to provide a forum for departmental communication of upcoming opportunities (jobs, speakers, deadlines, etc.), speakers from industry to provide educational context, and student interaction. Required every semester of enrollment for graduation. Graded on S/U basis only.

IMSE 2030: Fundamentals of Systems Design and Analysis (3). Develop an understanding of a systems approach to the design and operation of modern industrial organizations: systems structure and function, system specification, structured problem solving and system design methodology.

IMSE 2110: Probability and Statistics for Engineers (3). Introduction to data analysis, probability concepts, random variables, parameter estimation and hypothesis testing. Prerequisite: Mathematics [MATH] 1500.

IMSE 2210: Linear Algebra for Engineers (3).
Study of quantitative methods necessary for analysis, modeling and design of optimal industrial systems. Prerequisite: Computer Science [CMP SC] 1001, 1040, 1050 and Mathematics [MATH] 1700.

IMSE 2410: Introduction to Information Technologies (1). A survey of current technologies and their use. Different technologies will be reviewed. Examples: web search strategies, common application tools, searching and sorting on the WWW, upcoming trends and directions in information technologies. This is a web-based self-study course with instructor's guidance.

IMSE 2710: Engineering Economic Analysis (3).
Fundamentals of engineering economic decision making. Includes time value of money, breakeven analysis, capital budgeting, replacement, after-tax analysis, inflation, risk, sensitivity analysis and multi-attribute analysis.

IMSE 2810: Performance Measurement and Ergonomics (3). Design of man-machine systems considering capabilities and limitations of the human component. Method of measuring human performance in man-machine systems; includes lab. Prerequisite: Industrial and Manufacturing Systems Engineering [IMSE] 2110.

IMSE 3001: Topics in Industrial and Manufacturing Systems Engineering (0-4). Current and new technical developments in industrial engineering. Prerequisite: instructor's consent. May be repeated to 6 hours.

IMSE 3030: Manufacturing and Supply Systems (3). Provide a structured approach for the design and optimization of a system throughout its lifecycle: techniques following the logical sequence of strategic analysis, system design, implementation, and monitoring. Prerequisite: Industrial and Manufacturing Systems Engineering [IMSE] 2030.

IMSE 3810: Ergonomics and Workstation Design (3). Ergonomics and human factors theories applied to the design of man-machine systems. Discussion of ergonomic methods for

measurement, assessment, and evaluation, with major topics including workstation design, environmental stresses, and workplace safety. Includes lab. Prerequisites: Engineering [ENGINR] 1200.

IMSE 4001: Topics in Industrial and Manufacturing Systems Engineering (3). Current and new technical developments in industrial engineering.

IMSE 4085: Problems in Industrial Engineering (1-4). Supervised investigation in industrial engineering presented in form of an engineering report.

IMSE 4110: Engineering Statistics (3). Understanding and application of statistical analysis techniques. Emphasis on hypothesis testing, regression analysis, analysis of variance (ANOVA) and design of experiments (DOE). Prerequisites: Grade of C- or better in Industrial and Manufacturing Systems Engineering [IMSE] 2110.

IMSE 4210: Linear Optimization (3). Theory and application of linear optimization. Prerequisite: grade of C- or better in Industrial and Manufacturing Systems Engineering [IMSE] 2210.

IMSE 4230: Operations Research Models (3).
Formulates probabilistic models and determines optimal control policies for queueing and inventory systems. Introduces Markov chains and dynamic programming. Prerequisites: grade of C- or better in Industrial and Manufacturing Systems Engineering [IMSE] 2110 and 2210.

IMSE 4280: Systems Simulation (3). Discrete-event stochastic systems modeling and experimentation using simulation software. Statistical design and analysis including distribution fitting and alternative comparison methodologies. Prerequisites: grade of C- or better in Industrial and Manufacturing Systems Engineering [IMSE] 4110, Computer Science [CMP_ SC] 1040 or 1050.

IMSE 4310: Integrated Production Systems Design (3). Design and operation of production systems, including lean production concepts, just-intime/kanban, facility layout and material flow issues. Prerequisites: Industrial and Manufacturing Systems Engineering [IMSE] 4210, 4280.

IMSE 4350: Production and Operations Analysis (3). Quantitative methods for forecasting, scheduling, and production control in manufacturing and service systems. Use of Enterprise Resource Planning (ERP) systems. Prerequisite: Industrial and Manufacturing Systems Engineering [IMSE] 4210 and 4230.

IMSE 4385: Lean Six Sigma Green Belt Project (1). Application of the Lean Six Sigma methodology in an industry-based project. Prerequisite: Industrial and Manufacturing Systems Engineering [IMSE] 4310

IMSE 4410: Management Information Systems Design (3). MIS concepts and management issues, HTML for web pages and eShop (front-office operations), back-office operations using relational databases, introduction to SQL. Prerequisite: Computer Science [CMP SC] 1040 or 1050 and junior standing required.

IMSE 4420: Web-Based Information Systems (3). Data models, design of databases using E-R, UML (Access/Oracle), web databases, web servers and interfaces (Visual Basic, JavaScript), E-commerce infrastructure (PDM, STEP, XML), data mining for management information and services. Prerequisites: Industrial and Manufacturing Systems Engineering [IMSE] 4410 and

instructor's consent.

IMSE 4550: Computer Aided Design and Manufacturing (4). Product realization process from design, process planning, to manufacturing. Includes CE, DFS/DFM, CAD, CAPP, CNC, and survey of manufacturing methods. Prerequisites: Junior Standing.

IMSE 4570: Computer Integrated Manufacturing Control (3). Implementation of computer integrated manufacturing (CIM) and automation at the shop floor level. Covers essential components of machine sensing and actuation (including programmable robots), information representation and processing, data communication and networking. Prerequisite: Junior Standing.

IMSE 4610: Engineering Quality Control (3).
Analysis of quality in manufacturing including control charts, sampling plans, process capability, experimental design; introduction to system reliability. Overview of Six Sigma and DMAIC methodology. Prerequisite: Industrial and Manufacturing Systems Engineering [IMSE] 4110.

IMSE 4750: Entrepreneurial Innovation Management: Enterprise Conception (3). (same as Management [MANGMT] 4750). Develop a new business and technology plan including marketing, finance, engineering, manufacturing, and production concepts in this joint College of Engineering and College of Business course. Prerequisite: sophomore standing.

IMSE 4755H: Entrepreneurial Innovation Management: Enterprise Conception-Honors (3).
Develop a new business and technology plan including marketing, finance, engineering, manufacturing, and production concepts in this joint College of Engineering and College of Business course. Prerequisite: sophomore standing. Honors eligibility required.

IMSE 4760: Entrepreneurial Innovation Management: Enterprise Design (3). (same as Management [MANGMT] 4760). Expand on Industrial Manufacturing and Systems Engineering [IMSE] 4750 business/technology plan into an operations plan; advertising facilities layout, selling and distribution channels, product designs, accounting procedures, manufacturing processes, and prototypes. Prerequisite: Industrial Manufacturing and Systems Engineering [IMSE] 4750.

IMSE 4765H: Entrepreneurial Innovation Management: Enterprise Design-Honors (3). (same as Management [MANGMT] 4765H). Expand on Industrial Manufacturing and Systems Engineering [

IMSE] 4755H business/technology plan into an operations plan; advertising facilities layout, selling and distribution channels, product designs, accounting procedures, manufacturing processes, and prototypes. Prerequisite: Industrial Manufacturing and Systems Engineering [IMSE] 4755H. Honors eligibility required.

IMSE 4770: Entrepreneurial Innovation Management: Enterprise Operations (3). (same as Management [MANGMT] 4770). Perform the day-to-day operations for an enterprise by managing all business processes including finance, manufacturing, sales and delivery. Prerequisite: Junior Standing

IMSE 4775H: Entrepreneurial Innovation Management: Enterprise Operations-Honors (3).
Perform the day-to-day operations for an enterprise by managing all business processes including finance, manufacturing, sales and delivery. Honors eligibility required. Prerequisite:

Junior Standing.

IMSE 4970: Capstone Design I (1). Overview of professional engineering issues such as ethics, team dynamics, communication, and project management. Includes team-based industrial assessments to develop skills in problem/opportunity identification. Prerequisite: Senior Standing.

IMSE 4980: Capstone Design II (3). Industry-based team design experience structured to integrate material presented throughout the Industrial and Manufacturing Systems Engineering [IMSE] curriculum. Must immediately follow Industrial and Manufacturing Systems Engineering [IMSE] 4970. Prerequisite: Industrial and Manufacturing Systems Engineering [IMSE] 3810, 4310, 4970.

IMSE 4990: Undergraduate Research in Industrial Engineering (0-6). Independent investigation or project in industrial engineering. May be repeated to 6 hours.

IMSE 4995: Undergraduate Research Industrial Engineering - Honors (0-6). Independent investigation or project in industrial engineering. Prerequisite: honors student in Industrial Engineering. May be repeated to 6 hours.

MIZZOU ENGINEERING engineering.missouri.edu

University of Missouri

Department of Mechanical and Aerospace Engineering

What is it?

MECHANICAL ENGINEERS are unique because they not only design, develop and produce devices for consumers but also for other engineers.

What can you do?

You can work in research and development, automotive, aerospace, heating and ventilation, power generation, energy conversion, machine design and controls.

CONTACT:

Shannon Kirk

E2411 Lafferre Hall

573-882-7506

kirksd@missouri.edu

AVERAGE SALARY OFFER: $52,300*

DEGREES:

- Bachelor of Science in Mechanical Engineering BS ME
- Master of Science in Mechanical and Aerospace Engineering MS MAE
- Doctoral Degree in Mechanical and Aerospace Engineering PhD MAE

*2009 University of Missouri Destination Survey

TYPICAL MECHANICAL ENGINEERING CURRICULUM

FIRST SEMESTER			SECOND SEMESTER		
FRESHMAN YEAR					
Chem 1320	Gen. Chemistry II w/Lab	3	ENGR 1110	Solid Model. for Engr. Design	1
ENGR 1100	Engineering Graphics	2	ENG 1000	Expo. & Argumentation	3
MAE 1000	Intro. to Mech. Engr.	1	Math 1700	Calculus II	5
Math 1500	Analytical Geom. & Calc.	5	Physcs. 2750	University Physics I	5
Const. Req. (Social/Behavioral Science)		3	*Social/Behavioral Science elective*		3
Advanced Stand. Cred. for Chem 1310		2			
	TOTAL CREDIT HOURS	16		TOTAL CREDIT HOURS	17
SOPHOMORE YEAR					
MAE 2100	Comp. Prog. & Softwr. Tools	2	MAE 2600	Dynamics	3
Math 2300	Calculus III	3	MAE 3100	Computational Meth. for Engr. Design	4
ENGR 1200	Stats & Elem. Strength of Mats.	3	Math 4100	Differential Equations	3
ENGR 2300	Thermodynamics	3	ENGR 2200	Interm. Strength of Materials	3
Physcs 2760	University Physics II	5	*Humanities/Fine Arts elective*		3
	TOTAL CREDIT HOURS	16		TOTAL CREDIT HOURS	16
JUNIOR YEAR					
ENGR 2100	Circuit Theory for Engr.	3	MAE 3600	System Dynamics	3
MAE 3200	Engr. Materials	4	MAE 3900	Mechanical Design I	3
MAE 3400	Fluid Mechanics	3	MAE 4300	Heat Transfer	3
STAT 4710	Intro. to Math. Stats or		MAE 4500	Manufacturing Methods	3
IMSE 2110	Prob. and Stats for Engrs.	3	*Humanities/Fine Arts elective*		3
Humanities/Fine Arts elective		3			
	TOTAL CREDIT HOURS	16	TOTAL CREDIT HOURS		15
SENIOR YEAR					
MAE 3800	Instrum. and Meas. Lab	3	MAE 4800	Therm. & Fluid Science Lab	3
IMSE 2710	Engr. Econ. Analysis	3	MAE 4980	Senior Capstone Design MAE	3
MAE 4900	Mechanical Design II	3	*Social/Behavioral Science elective*		3
MAE 4000+ electives		6	*Approved Technical Elective 3000+*		3
			MAE 4000+ elective		3
	TOTAL CREDIT HOURS	15		TOTAL CREDIT HOURS	15

TOTAL CREDIT HOURS 126

MECHANICAL AND AEROSPACE ENGINEERING COURSES

MAE 1000: Introduction to Mechanical Engineering (1). Introduction to the mechanical engineering profession, the Mechanical and Aerospace Engineering Department and curriculum, and the core disciplines of mechanical engineering. Introduction to engineering problem solving, ethics, and design. Restricted to engineering students only.

MAE 1001: Experimental Course (cr.arr.). Experimental course. For freshmen-level students. Content and credit hours to be listed in Schedule of Courses.

MAE 2001: Experimental Course (cr.arr.).
Experimental course. For sophomore-level students. Content and credit hours to be listed in Schedule of Courses.

MAE 2100: Programming and Software Tools (2). Introduction to the use of computers, programming, and software. Topics include MATLAB syntax and programming techniques, algorithm design, and programming with Excel spreadsheets. Prerequisite: Mathematics [MATH] 1500 concurrent. Restricted to Engineering Students Only.

MAE 2300: Thermodynamics (3). (same as Engineering [ENGINR] 2300). Fluid properties, work and heat, first law, second law, entropy, applications to vapor and ideal gas processes. Prerequisites: Physics [PHYSCS] 2750.

MAE 2600: Dynamics (3). Basic fundamentals of particle and rigid body dynamics; energy and momentum methods. Prerequisite: grade of C or better in Engineering [ENGINR] 1200. Restricted to MAE students only.

MAE 3100: Computational Methods for Engineering Design (4). Introduction to numerical methods for linear system analysis, curve-fitting, integration and differentiation, and optimization. The numerical methods are demonstrated through computer implementation and application to engineering design problems. Prerequisites: Mechanical and Aerospace Engineering [MAE] 2100; Math [MATH] 4100 concurrent. Restricted to MAE students only.

MAE 3200: Engineering Materials (4). The nature of the structure of engineering materials. The relationship of material structure to physical properties. Mechanical behavior of engineering materials. Prerequisites: Grade of C or better in Engineering [ENGINR] 2200 and Chemistry [CHEM] 1320. Restricted to MAE students only.

MAE 3400: Fluid Mechanics (3). A basic course in fluid mechanics. Topics include: fluid properties, hydrostatics, conservation laws, infinitesimal and finite control volume analysis, Navier-Stokes equations, dimensional analysis, internal and external flows. Prerequisites: Mechanical and Aerospace Engineering [MAE] 2600; Engineering [ENGINR] 2300 concurrent. Restricted to MAE students only.

MAE 3600: Dynamic Systems and Control (3).
Modeling and analysis of dynamic systems and introduction to feedback control. Topics include dynamic modeling and response of mechanical, electrical, fluid, and thermal systems; and feedback control systems analysis. Prerequisites: Mechanical and Aerospace Engineering [MAE] 2600; 3100; Engineering [ENGINR] 2100 concurrent. Restricted to MAE students only.

MAE 3800: Instrumentation and Measurements Laboratory (3). Design and reporting of experimental investigations. Topics include instrument design equations, sources of error, and calibration. Survey of instruments to measure: voltage, resistance, current, time, frequency,

displacement, velocity, acceleration, strain, force, and torque. Prerequisites: Engineering [ENGINR] 2100; 2200; Mechanical and Aerospace Engineering [MAE] 3600 concurrent. Restricted to MAE students only.

MAE 3900: Mechanical Design I (3). Kinematics of machinery, and introduction to finite element analysis. Topics include linkage analysis and design, cam design, and numerical stress analysis. The course involves a major design project. Prerequisites: Engineering [ENGINR] 2200 and Mechanical and Aerospace Engineering [MAE] 2600. May be repeated for credit. Graded on A/F basis only.

MAE 4001: Topics in Mechanical and Aerospace Engineering (3). Current and new technical developments in mechanical and aerospace engineering. Prerequisite: instructor's consent. Restricted to MAE students only.

MAE 4085: Problems in Mechanical and Aerospace Engineering (cr.arr.). Special design, experimental and analytical problems in mechanical and aerospace engineering.

MAE 4210: Aerospace Structures (3). Fundamentals of the mechanics and design issues of aerospace structures. Analysis of thin skins with stiffeners for external surfaces, bulkheads and frames for shape support, and fasteners for holding components together. Prerequisites: Grade of C or better in Engineering [ENGINR] 2200. Graded on A/F basis only.

MAE 4220: Materials Selection (3). Study of the physical and mechanical metallurgy of alloy systems of interest in engineering applications. Prerequisite: Mechanical and Aerospace Engineering [MAE] 3200. Restricted to MAE students only.

MAE 4230: Nanomaterials (3). The primary goal of this course is to introduce students into the new field of nanostructured materials. The emphasis of the course is to introduce the students into synthesis and characterization of nanomaterials, the behavior of such materials with nanoscale structures, and their technological applications. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3200 or equivalent.

MAE 4231: Transport Phenomena in Materials Processing (3). (same as Biological Engineering [BIOL EN] 4231). Applications of fluid flow, heat transfer, and mass transfer in steady-state and unsteady-state materials processing with applications to metals, polymers, and ceramics. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3200, 3400, 4300 (or equivalent courses; and Mathematics [MATH] 4100. Graded on A/F basis only.

MAE 4240: Diffraction Methods in Materials Science (3). Introduction to crystal structure and the use of x-rays and neutrons to study materials aspects including phase analysis, structure determination, residual stress and texture. Prerequisite: instructor's consent. Restricted to MAE students only.

MAE 4250: Composite Materials (3). A survey of composite materials used in engineering emphasizing fiber-reinforced composites but including laminate and particulate composites. Prerequisite: Mechanical and Aerospace Engineering [MAE] 3200. Restricted to MAE students only.

MAE 4260: Experimental Stress Analysis (3). The course introduces basic concepts of stress and strain using elasticity theory. Single point and full-field experimental methods for stress and strain measurement, such as strain gages and photoelastcity, are discussed. Application of experimental methods in transducer development and design of structures will be covered.

Prerequisite: senior standing.

MAE 4270: Nondestructive Evaluation of Materials (3). The role of nondestructive evaluation (NDE) in engineering is explored. Ultrasonic NDE is studied in detail. Labs are used to support the study of ultrasonic NDE. Other NDE techniques are surveyed. Prerequisite: Mechanical and Aerospace Engineering [MAE] 3200. Restricted to MAE students only.

MAE 4280: Introduction to Finite Element Methods (3). The application of matrix operations, energy concepts and structural mechanics to the development of the finite element method. Application of finite element method to beams, frames and trusses. Prerequisites: Engineering [ENGINR] 2200 and Mechanical and Aerospace Engineering [MAE] 3100. Restricted to MAE students only.

MAE 4290: Welding Engineering (3). Welding is the most common method of joining similar as well as dissimilar materials. This course thus introduces the basic science and engineering aspects of commonly used fusion and non-fusion welding processes. Stress analysis and failure to welded joints is also introduced to develop safe and durable welded structures. Prerequisites: senior standing.

MAE 4300: Heat Transfer (3). Fundamentals of conduction, convection and radiation. Use of nondimensional parameters. Theory and design of simple heat exchangers. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3400, grade of C or better in Engineering [ENGINR] 2300. Restricted to MAE students only.

MAE 4310: Intermediate Heat Transfer (3).
Advanced topics in conduction, convection, and radiation. Heat exchanges and their applications will also be analyzed. Prerequisite: Mechanical and Aerospace Engineering [MAE] 4300. Restricted to MAE students only.

MAE 4315: Multiphase Heat Transfer (3). Fundamentals and application of heat and mass transfer and fluid flow with phase change; melting and solidification, sublimation and vapor deposition, condensation, evaporation, nucleate and film boiling, two-phase flow. Prerequisites: MAE 4300. Graded on A/F basis only.

MAE 4320: Design of Thermal Systems (3).
Thermal systems are simulated by mathematical models (often on a digital computer), followed by optimization. Supporting topics include: economics, heat transfer, thermodynamics, and optimization. Prerequisite: Mechanical and Aerospace Engineering [MAE] 4300.

MAE 4340: Heating and Air Conditioning (3).
General principles of thermal science applied to the design of environmental control systems. Topics covered include heating and cooling load calculations, annual operating and life cycle cost estimating, duct and pipe sizing, and equipment selection. Prerequisites: Mechanical and Aerospace Engineering [MAE] 4300. Restricted to MAE students only.

MAE 4380: Intermediate Thermodynamics (3).
Topics from classical and statistical thermodynamics. Prerequisite: Engineering [ENGINR] 2300.

MAE 4390: Aerospace Propulsion (3). Analysis of aircraft engines and spacecraft propulsion systems. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3400.

MAE 4420: Intermediate Fluid Mechanics (3).

Topics in potential and viscous flow theory, and computational fluid dynamics. Prerequisite: Mechanical and Aerospace Engineering [MAE] 3400.

MAE 4430: Introduction to Computational Fluid Dynamics and Heat Transfer (3). Introduction to the principles and development of the finite difference approximations to the governing differential equations of viscous and inviscid fluid flow, as well as heat transfer. Introduction to discretization methods and the calculation of flow fields, convection, diffusion and conduction. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3400, 4300 and 4420.

MAE 4440: Aerodynamics (3). Presents fundamentals of wing and airfoil theory for incompressible flow, including fluid kinematics and dynamics, potential flow, flow about a body, thin-airfoil theory, and finite wing. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3100 and 3400.

MAE 4450: Gas Dynamics (3). One dimensional compressible flow with and without friction and heat transfer. Isentropic flow and shock phenomenon in nozzles and diffusers. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3400.

MAE 4500: Manufacturing Methods (3). Introduction to manufacturing processes with emphasis on those aspects most relevant to methods, problems in force analysis, and practicum and experimentation in machine tool applications. Prerequisite: Engineering [ENGINR] 1110; grade of C or better in Mechanical and Aerospace Engineering [MAE] 3200. Restricted to MAE students only.

MAE 4520: Manufacturing Process Analysis (3).
Methods and techniques used in process analysis, optimization and control. These include deterministic modeling (slab, upper bound and FEM), physical modeling techniques and statistical process control. Prerequisite: Mechanical and Aerospace Engineering [MAE] 4500.

MAE 4550: Integrated Production Systems (3).
(same as Industrial and Manufacturing Systems Engineering [IMSE] 4550).

MAE 4600: Advanced Mechanics of Materials (3).
(same as Civil Engineering [CV_ENG] 4600). Analysis of more complicated problems in stresses, strains. Prerequisite: Engineering [ENGINR] 2200.

MAE 4620: Aircraft Flight Mechanics (3). Analysis of aircraft flight dynamics and aircraft performance. Topics include airplane aerodynamics and propulsion, steady flight, flight performance, aircraft maneuvers, aircraft stability, and an introduction to flight controls Prerequisite: Mechanical and Aerospace Engineering [MAE] 3600. Graded on A/F basis only.

MAE 4630: Space Flight Mechanics (3). Analysis of spacecraft motion. Topics include orbital dynamics, spacecraft attitude dynamics, satellite trajectory design, and spacecraft control system design. Prerequisite: Mechanical and Aerospace Engineering [MAE] 3600. Restricted to MAE students only.

MAE 4650: Synthesis of Linkages (3). Type, number and dimensional synthesis of linkages to produce a given input-output motion and/or force. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3100.

MAE 4660: Vibration Analysis (3). (same as Civil Engineering [CV_ENG] 4660). Vibration theory and its application to mechanical systems. Topics include free and forced vibration analysis of single-and multi-degree of freedom systems. Prerequisite: Mechanical and

Aerospace Engineering [MAE] 2600 and Mathematics [MATH] 4100.

MAE 4670: Vehicle Dynamics (3). Analysis and prediction of the dynamic behavior of ground vehicles utilizing computer simulation. Mechanics of various suspension systems, tire-roadway interaction, vehicle aerodynamics, vehicle handling and steering characteristics. Special topics including nonholonomic constraint formulation and stability of motion. Prerequisite: Mechanical and Aerospace Engineering [MAE] 3600.

MAE 4680: Introduction to MEMS (3). The course will start with a survey of the widespread applications of MEMS sensors and actuators. Micro fabrication methods used in conventional semiconductor industry will be introduced. MEMS-specific process will be emphasized. Fundamental principles in electric circuits and mechanics will be reviewed. Special attention is on mechanical issues encountered in MEMS design and fabrication.

MAE 4710: Hydraulic Control System (3).
Analysis of hydraulic control components and systems. Topics include pumps, valves, actuators, and industrial and mobile control systems. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3400 and 3600. May be repeated for credit. Graded on A/F basis only.

MAE 4720: Modern Control (3). Analysis and design of control systems using state-space methods. Topics include controllability and observability, feedback control using pole-placement, state observers, optimal linear-quadratic feedback control, and optimal estimation. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3600. Graded on A/F basis only.

MAE 4730: Mechatronics (3). Design of systems which require the integration of mechanical and electronic components. Topics include microcontrollers, sensors, actuators, mechanical systems, real time control system programming, and modeling of electronic and mechanical systems. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3600.

MAE 4740: Digital Control (3). Design and analysis of control systems using discrete time methods will be the focus of this course. Multivariable as well as single input single output techniques will be considered for digital control system design and analysis. Co-requisite: Mechanical and Aerospace Engineering [MAE] 4700. Graded on A/F basis only.

MAE 4750: Classical Control (3). Study of feedback control design based on classical continuous-time methods. Topics include performance specifications, stability analysis, root locus compensator design, and frequency domain analysis and compensator design. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3600.

MAE 4800: Thermal and Fluid Science Laboratory (3). Continuation of Mechanical and Aerospace Engineering [MAE] 3800 with emphasis on: instruments to measure temperature, pressure fluid flow, fluid velocity, sound, and computer data acquisition. Prerequisite: Mechanical and Aerospace Engineering [MAE] 4300. Restricted to MAE students only.

MAE 4820: Experimental Methods in Fluid Flow and Heat Transfer (3). Laboratory experiments involving fundamental mechanisms and phenomena associated with fluid flow and heat transfer. Current experimental methods and techniques employed.
Prerequisites: Mechanical and Aerospace Engineering [MAE] 4800 and 4300.

MAE 4900: Mechanical Design II (3). Application of the fundamentals of stress analysis of structures and materials science to the design, durability, and selection of machine elements, such as fasteners, springs, shafts, and gears. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3900; grade of C or better in MAE 3200. Restricted to MAE students only.

MAE 4920: Advanced Computational Design (3).
Development and application of modern simulation-based design methodologies. Topics include structural optimization, multidisciplinary design methods, reliability-based design, non-deterministic methods, design sensitivity analysis, and finite elements in design. Prerequisite: Mechanical and Aerospace Engineering [MAE] 3100. May be repeated for credit. Graded on A/F basis only.

MAE 4930: Applied Mechanical Optimization (3).
Introduction to mathematical programming techniques and applications to the design of mechanical systems and components. Prerequisite: Mechanical and Aerospace Engineering [MAE] 3100. Restricted to MAE students only.

MAE 4940: Aircraft Design (3). Conceptual design of aircraft, from initial sizing and design layout to design analysis, optimization and trade studies. Fundamental theories for aircraft design including sizing, aerodynamic forces, airfoil selection, wing loading, configuration layout payloads, propulsion systems, landing gear, aerospace structures, and cost analysis. Prerequisites: Mechanical and Aerospace Engineering 3400, 3600 and 3900. Graded on A/F basis only.

MAE 4980: Senior Capstone Design (3). Senior design experience. Topics include reliability, safety, manufacturability, economic, and environmental constraints; design case studies; and industrial design projects. Prerequisites: Mechanical and Aerospace Engineering [MAE] 3600, 4500, 4900; Statistics [STAT] 4710 or Industrial and Manufacturing Systems Engineering [IMSE] 2110. Restricted to MAE students only.

MAE 4990: Undergraduate Research in Mechanical and Aerospace Engineering (0-6).
Independent investigation or project in Mechanical Engineering. Prerequisites: senior standing in Mechanical Engineering and instructor's consent.

MAE 4995: Undergraduate Honors Research Mechanical & Aerospace Engineering (cr.arr.).
Independent investigation to be presented as an undergraduate honors thesis. Prerequisite: Honors student in Mechanical and Aerospace Engineering