UMSL/Washington University Joint Undergraduate Engineering Program

General Information
The Joint Undergraduate Engineering Program of UMSL and Washington University was approved in 1993 by the University of Missouri and the Coordinating Board for Higher Education. The program is designed to offer course work beyond the pre-engineering courses at UMSL and the area community colleges. Pre-engineering and general education courses are offered at UMSL, and upper-level engineering courses are offered in the late afternoons, evenings and on Saturdays on the Washington University campus; this schedule permits students to co-op during the day at local engineering firms. Students will be admitted to the upper-division program only after they have completed an acceptable pre-engineering program. They can earn a bachelor of science in civil engineering (B.S.C.E.), a bachelor of science in electrical engineering (B.S.E.E.), or a bachelor of science in mechanical engineering (B.S.M.E.).

Mission Statement
The mission of the University of Missouri-St. Louis/Washington University Joint Undergraduate Engineering Program is to provide a high quality civil, mechanical, and electrical engineering education leading to a well-trained, sophisticated work force primarily for the St. Louis region. The program strives to excite and nurture the intellectual, technical, professional and personal development of the students through a partnership which provides a mechanism for Washington University to share its campus, resources and personnel with the UMSL students, many of whom are place-bound individuals. The Joint Program reflects the commitment of both institutions to work together to provide for the civil, mechanical and electrical engineering needs of the St. Louis community.

Program Educational Objectives
The University of Missouri-St. Louis/Washington University Joint Undergraduate Engineering Program aspires to make positive, substantive and lasting contributions to the lives of our students. The nontraditional and traditional students in the civil, mechanical and electrical engineering programs often have work experience in or related to engineering practice. The program seeks to impart an education that inspires the graduates to constantly share their knowledge with others, to continually improve their knowledge and understanding, and to persistently adapt to change in technology and world needs. Graduates of the program are expected to develop and use professional skills that facilitate their continued career growth well beyond their graduation and should be able to apply their comprehensive education within the civil, mechanical and electrical engineering profession or a related field. The objectives are to:

- Meet the needs of employers of civil, mechanical, and electrical engineers, with an emphasis on the St. Louis region.
- Meet the expectations of graduate schools that our alumni attend.

Student Outcomes
The student outcomes are the skills and knowledge expected of all students at the time of their graduation. Faculty members will assess these student outcomes in their classes every semester. The student outcomes for the Engineering Program are:

- An ability to apply knowledge of mathematics, science and engineering
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- An ability to function on multidisciplinary teams
- An ability to identify, formulate, and solve engineering problems
- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- A recognition of the need for, and an ability to engage in, lifelong learning
- A knowledge of contemporary issues
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

The B.S.C.E., the B.S.E.E., and the B.S.M.E. are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET), 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 – telephone: (410) 347-7700.

Admission
Normally admission is granted to persons who have completed the pre-engineering program with a minimum grade point average of 2.75 over all mathematics, chemistry, physics, and introductory engineering courses (statics and dynamics). Students with less than a 2.75 grade point average, but at least a C in all their science and math courses, may be admitted on a probationary basis. These students must pass an Engineering Math Workshop with a grade of B or better, and then pass J E MATH 3170 Engineering Mathematics in the first year with a C- or better, in order to continue in the program.

Fees
Students register on the UMSL campus and pay UMSL fees plus an engineering fee for engineering courses. Limits on enrollments are determined by the availability of resources.

Career Outlook
Engineering is one of the few careers in which the bachelor’s degree is a professional degree. Students earning a bachelor of science degree in one of the engineering disciplines are well qualified for entry-level engineering positions in a variety of businesses, industries, consulting firms, and government agencies. As society becomes increasingly dependent on technology, the outlook for all engineering disciplines becomes increasingly bright. Engineering careers typically rank at, or very near, the top of virtually any published rating of promising jobs for the 21st Century. Besides tackling challenging technical problems, roughly two-thirds of all engineers will have some level of management responsibility within ten years of receiving their bachelor’s degrees. Many practicing engineers will eventually continue their education by pursuing graduate
degrees on a part-time basis. Typical areas of graduate study include all advanced technical and scientific fields and management.

For Further Information

For information about enrolling in this program, please contact the UMSL/Washington University Joint Undergraduate Engineering Program at 314-516-6800.

Degree Requirements

• Bachelor of Science in Civil Engineering
• Bachelor of Science in Electrical Engineering
• Bachelor of Science in Mechanical Engineering

A program of 132 semester hours is required for the Bachelor of Science in Civil Engineering, a program of 122 semester hours is required for the Bachelor of Science in Electrical Engineering, and a program of 134 semester hours is required for the Bachelor of Science in Mechanical Engineering, as shown below:

• All majors must complete the University General Education requirements (http://bulletin.umsl.edu/generaleducationrequirements), the Pre-Engineering Requirements and the Core Engineering Requirements.
• All students must first complete J E MATH 3170, Engineering Mathematics, with a minimum grade of C-.
• Mechanical and Electrical Engineering majors must also complete J E ENGR 2300, Introduction to Electrical Networks with a minimum grade of C-.
• A minimum grade of C- is necessary to meet the prerequisite requirement for any course.

Pre-Engineering Requirements

Students seeking to major in engineering are first designated as ‘Undeclared with an interest in Engineering majors’ until they have completed Math 1800 Analytical Geometry & Calculus I. Upon successful completion of Math 1800 with a grade of C or better, students will be allowed to declare pre-engineering as their major. Math 1800 must be completed successfully within two attempts.

MATH 1800 Analytic Geometry And Calculus I 5
MATH 1900 Analytic Geometry And Calculus II 5
MATH 2000 Analytic Geometry And Calculus III 5
MATH 2020 Introduction To Differential Equations 3
CHEM 1111 Introductory Chemistry I 5
PHYSICS 2111 Physics: Mechanics And Heat 5
PHYSICS 2121 Physics: Electricity, Magnetism, And Optics 5
ENGR 2310 Statics 3
ENGR 2320 Dynamics 3
ENGL 1100 First-Year Writing 3
Total Hours 42

Civil engineering majors must also complete GEOL 1001A, General Geology as part of the pre-engineering requirements (3 Hours).

General Education Requirements

PHIL 2259 Engineering Ethics 3
PHIL 3380 Philosophy Of Science 3

Electrical Engineering Major Requirements

J CMP SC 1002 Introduction To Computing Tools: Matlab Skills 1
J E ENGR 2320 Introduction To Electronic Circuits 3
J E ENGR 2300 Introduction To Electrical Networks 3
J E ENGR 2330 Electrical And Electronic Circuits Laboratory 3

One additional Humanities course 1
HIST 1001 American Civilization To 1865 3
or HIST 1002 American Civilization 1865 To Present 3
or HIST 1004 The History Of Women In The United States 6
Two additional Social Science courses 1
Total Hours 18

1 One course must meet the Cultural Diversity requirement, and one course must meet the engineering Valuing Skill requirement. Humanities and social sciences electives must meet both the University of Missouri-St. Louis General Education Requirements and the Humanities and Social Sciences Requirements of the Joint Undergraduate Engineering Program. Check with your advisor for details.

Engineering Core Requirements

CMP SCI 1250 Introduction To Computing 3
J E COMM 2000 Engineering Studio I 1
J E MATH 3170 Engineering Mathematics 4
ENGL 3130 Technical Writing 3
Total Hours 11

Civil Engineering Major Requirements

J C ENGR 2160 Surveying 3
J C ENGR 3410 Structural Analysis 3
J C ENGR 3420 Structural Design 3
J C ENGR 3360 Civil Engineering Materials Lab 1
J C ENGR 3460 Transportation Engineering 3
J C ENGR 3760 Hydraulic Engineering 3
J C ENGR 4190 Soil Mechanics 3
J C ENGR 4200 Soil Exploration And Testing 1
J C ENGR 4600 Highway and Traffic Engineering 3
J C ENGR 4640 Foundation Engineering 3
J C ENGR 4670 Structure Design Projects 3
or J C ENGR 45 Water Hydrology and Hydraulic Design Project 3
J C ENGR 4730 Construction Operations And Management 3
J C ENGR 4740 Economic Decisions In Engineering 3
J C ENGR 4950 Fundamentals Of Engineering Review 1
J C ENGR 4990 Senior Civil Engineering Seminar 1
J M ENGR 1413 Introduction To Engineering Design: CAD 2
J M ENGR 2410 Mechanics Of Deformable Bodies 3
J M ENGR 3360 Material Science For J C ENGR 3
J M ENGR 3700 Fluid Mechanics 3
J M ENGR 3721 Fluid Mechanics Laboratory 1
MATH 1320 Applied Statistics I 3
Civil Engineering Electives 6
Total Hours 58
requirements, and electives. Civil, electrical, and mechanical engineering pre-engineering requirements, engineering core requirements, major least 48 hours of engineering topics semester hours, including all courses:

Each engineering student must complete a curriculum that contains at least 48 semester hours for courses in the engineering programs.

The number of semester hours assigned to each engineering course in the Joint Undergraduate Engineering Program is further divided into hours of engineering design, engineering science, and basic science content. Engineering topics is the sum of engineering science hours and engineering design hours. The following table shows the design hours and engineering science content as their equivalents in the UMSL/Washington University Joint Undergraduate Engineering Program. Transfer courses from other institutions do not necessarily have the same engineering science and engineering design content as their equivalents in the UMSL/Washington University Joint Undergraduate Engineering Program. Students who include transfer courses in their curricula should consult with their advisers to be sure that these requirements are met.

### Graduation Requirements

In addition to the requirements of the University of Missouri-St. Louis that apply to all candidates for undergraduate degrees, the student must earn a minimum of 19 credit hours in Joint Mechanical Engineering courses are required. Admission to the Joint Engineering program is required. A minimum of 18 credit hours in Joint Electrical Engineering courses are required. In accordance with the University’s Latin Honors policy (http://bulletin.umsl.edu/undergraduatestudy/#academicrecognitiontext), candidates graduating from the University of Missouri St. Louis/Washington University Join Undergraduate Engineering Program in the 2017-2018 Academic Year must meet the following GPA qualifications:

- Summa Cum Laude: 3.925
- Magna Cum Laude: 3.800
- Cum Laude: 3.523

### Minor in Electrical Engineering

Admission to the Joint Engineering program is required. A minimum of 18 credit hours in Joint Electrical Engineering courses are required.

**Required Courses:**

- J E ENGR 2300  Introduction To Electrical Networks  3
- J E ENGR 2330  Electrical And Electronic Circuits Laboratory  3

**Take three courses from the following list:**

- J E ENGR 2320Introduction To Electronic Circuits  3
- J E ENGR 2600Introduction To Digital Logic And Computer Design  3
- J E ENGR 3300Engineering Electro Magnetic Principles  3
- J E ENGR 3311Electronics Laboratory  3
- J E ENGR 3320Power, Energy And Polyphase Circuits  3
- J E ENGR 3511Signals And Systems  3
- J E ENGR 4350Electrical Energy Laboratory  3
- J E ENGR 4411Control Systems I  3

**At least one additional J E ENGR Course**

Total Hours: 18

### Minor in Mechanical Engineering

Admission to the Joint Engineering program is required. A minimum of 19 credit hours in Joint Mechanical Engineering and Engineering courses are required.

**Required Courses:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 2310</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 2320</td>
<td>Dynamics</td>
<td>3</td>
</tr>
</tbody>
</table>

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### Mechanical Engineering Major Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>J C ENGR 4950</td>
<td>Fundamentals Of Engineering Review</td>
<td>1</td>
</tr>
<tr>
<td>J CMP SC 1002</td>
<td>Introduction To Computing Tools: Matlab Skills</td>
<td>1</td>
</tr>
<tr>
<td>J E ENGR 2300</td>
<td>Introduction To Electrical Networks</td>
<td>3</td>
</tr>
<tr>
<td>J E ENGR 2340</td>
<td>Electrical Laboratory For Mechanical Engineers</td>
<td>1</td>
</tr>
<tr>
<td>J E MATH 3260</td>
<td>Probability And Statistics For Engineering</td>
<td>3</td>
</tr>
<tr>
<td>J M ENGR 1413</td>
<td>Introduction To Engineering Design: CAD</td>
<td>2</td>
</tr>
<tr>
<td>J M ENGR 1414</td>
<td>Introduction To Engineering Design: Project</td>
<td>2</td>
</tr>
<tr>
<td>J M ENGR 2110</td>
<td>Machine Shop, Fabrication, and Prototyping</td>
<td>3</td>
</tr>
<tr>
<td>J M ENGR 2410</td>
<td>Mechanics Of Deformable Bodies</td>
<td>3</td>
</tr>
<tr>
<td>J M ENGR 3110</td>
<td>Mechanical Design And Machine Elements</td>
<td>3</td>
</tr>
<tr>
<td>J M ENGR 3200</td>
<td>Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>J M ENGR 3250</td>
<td>Material Science For J M ENGR</td>
<td>4</td>
</tr>
<tr>
<td>J M ENGR 3700</td>
<td>Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>J M ENGR 3710</td>
<td>Principles Of Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>J M ENGR 3721</td>
<td>Fluid Mechanics Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>J M ENGR 3722</td>
<td>Heat Transfer Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>J M ENGR 4041</td>
<td>Current Topics In Engineering Design</td>
<td>1</td>
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<tr>
<td>J M ENGR 4120</td>
<td>Design of Thermal Systems</td>
<td>3</td>
</tr>
<tr>
<td>J M ENGR 4170</td>
<td>Dynamic Response Of Physical Systems</td>
<td>2</td>
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<td>J M ENGR 4180</td>
<td>Dynamic Response Laboratory</td>
<td>2</td>
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<tr>
<td>J M ENGR 4110</td>
<td>Mechanical Engineering Design Project</td>
<td>3</td>
</tr>
<tr>
<td>J M ENGR 4310/</td>
<td>Control Systems I</td>
<td>1</td>
</tr>
<tr>
<td>J E ENGR 4410</td>
<td>Control Systems I</td>
<td>3</td>
</tr>
<tr>
<td>Mechanical Engineering Electives</td>
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<td>12</td>
</tr>
</tbody>
</table>

Total Hours: 59

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### Latin Honors Requirements

In accordance with the University’s Latin Honors policy (http://bulletin.umsl.edu/undergraduatestudy/#academicrecognitiontext), candidates graduating from the University of Missouri St. Louis/Washington University Join Undergraduate Engineering Program in the 2017-2018 Academic Year must meet the following GPA qualifications:

- Summa Cum Laude: 3.925
- Magna Cum Laude: 3.800
- Cum Laude: 3.523

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### Mechanical Engineering Design and Engineering Science Requirements

The number of semester hours assigned to each engineering course in the Joint Undergraduate Engineering Program is further divided into hours of engineering design, engineering science, and basic science content. Each engineering student must complete a curriculum that contains at least 48 hours of engineering topics semester hours, including all courses: pre-engineering requirements, engineering core requirements, major requirements, and electives. Civil, electrical, and mechanical engineering majors should consult with their advisers to select electives at the 3000 and 4000 level that include sufficient engineering design and engineering science content to produce the required totals.
J M ENGR 2410 Mechanics Of Deformable Bodies 3

Choose at least one laboratory course from the following: 1-4
J M ENGR 3250 Material Science For J M ENGR
J M ENGR 372 Fluid Mechanics Laboratory
J M ENGR 372 Heat Transfer Laboratory
J M ENGR 418 Dynamic Response Laboratory
Select nine additional credit hours in J M ENGR numbered 3000-4999 9

Total Hours 19-22

Minor in Civil Engineering
Admission to the Joint Engineering program is required. A minimum of 18 credit hours in Joint Civil Engineering courses and Engineering courses are required.

Required Courses
ENGR 2310 Statics 3
J M ENGR 2410 Mechanics Of Deformable Bodies 3
J M ENGR 3700 Fluid Mechanics 3
Take at least three courses from one of the tracks below: 9

Structures
J C ENGR 216 Surveying
J M ENGR 336 Material Science For J C ENGR
J C ENGR 341 Structural Analysis
J C ENGR 342 Structural Design
J C ENGR 463 Design Of Steel Structures
J C ENGR 466 Advanced Design Of Concrete Structures

Water Resources/Environmental
J C ENGR 352 Water and Wastewater Treatment
J C ENGR 376 Hydraulic Engineering
J C ENGR 483 Fundamentals of Surface Water Hydrology and Environmental Engineering
J C ENGR 474 Economic Decisions In Engineering

Transportation
J C ENGR 216 Surveying
J C ENGR 346 Transportation Engineering
J C ENGR 460 Highway and Traffic Engineering

Geotechnical
GEOL 1001A General Geology Lecture
J C ENGR 216 Surveying
J M ENGR 336 Material Science For J C ENGR
J C ENGR 419 Soil Mechanics
J C ENGR 464 Foundation Engineering
J C ENGR 474 Economic Decisions In Engineering

Construction Management
J C ENGR 216 Surveying
J C ENGR 472 Legal Aspects Of Construction
J C ENGR 473 Construction Operations And Management
J C ENGR 474 Economic Decisions In Engineering

Total Hours 18

Sample Four Year Plans
BS Electrical Engineering (p. 4)  BS Civil Engineering (p. 4)
BS Mechanical Engineering (p. 5)

Electrical Engineering

First Year
Fall Hours Spring Hours
MATH 1800 5 HIST 1001 or 1002 3
CHEM 1111 5 MATH 1900 5
ENGL 1100 3 EXPLORE – Humanities & Fine Arts
ENGR 1010 1 EXPLORE – Social Sciences 3

Second Year
Fall Hours Spring Hours Summer Hours
PHIL 2259 3 PHIL 3380 3 ENGR 2320 3
PHYSICS 2111 5 PHYSICS 2112 5
MATH 2000 5 ENGR 2310 3
EXPLORE – Social Sciences 3 MATH 2020 3

Third Year
Fall Hours Spring Hours Summer Hours
J E ENGR 2300 3 J E ENGR 3300 3 J E ENGR 3510 3
J C ENGR 1002 1 J E ENGR 2320 3
CMP SC 1250 3 J E ENGR 2320 3
ENGL 3130 3 J M ENGR 3200 3
J E MATH 3170 4
J E COMM 2000 1

Fourth Year
Fall Hours Spring Hours
J E ENGR 4410 3 J E ENGR Elective 6
J E ENGR elective 3 J E ENGR 4300 3
J E ENGR 2600 3 J E ENGR 3320 3
J E ENGR 3310 3

Fifth Year
Fall Hours
J E ENGR Elective 3
MATH 1320 3
J E ENGR 4980 3

Total Hours: 124

PLEASE NOTE: This plan is an example of what a four year plan could look like for a typical student. Placement exam scores in math as well as the completion of coursework may change the plan. It should not be used in the place of regular academic advising appointments. All students are encouraged to meet with their advisor each semester. All requirements are subject to change.

Civil Engineering

First Year
Fall Hours Spring Hours
MATH 1800 5 HIST 1001 or 1002 3
CHEM 1111 5 GEOL 1001A 4
ENGL 1100 3 MATH 1900 5
PLEASE NOTE: This plan is an example of what a four year plan could look like for a typical student. Placement exam scores in math as well as the completion of coursework may change the plan. It should not be used in the place of regular academic advising appointments. All students are encouraged to meet with their advisor each semester. All requirements are subject to change.

Engineering Courses

**ENGR 1010 Introduction to Engineering:** 1 semester hour
This course, required of all new Freshman with an Interest in Engineering, is designed to assist students in their transition to the university experience and to UMSL by giving students the knowledge and tools needed to succeed as scholars. Students will learn about faculty expectations, support services, and student life, as well as engineering.

**ENGR 2310 Statics:** 3 semester hours
Prerequisites: MATH 1900 and PHYSICS 2111. Statics of particles and rigid bodies. Equivalent systems of forces. Distributed forces; centroids. Applications to trusses, frames, machines, beams, and cables. Friction. Moments of inertia. Principle of virtual work and applications.

**ENGR 2320 Dynamics:** 3 semester hours

**Joint Civil Engineering Courses**

**J C ENGR 2160 Surveying:** 3 semester hours
Horizontal and vertical control surveys, including traverses, triangulation, trilateration, and leveling; basic adjustments of observations; geologic data; coordinate systems. Basic route surveying, including horizontal and vertical curves.
J C ENGR 3360 Civil Engineering Materials Lab: 1 semester hour

J C ENGR 3410 Structural Analysis: 3 semester hours

J C ENGR 3420 Structural Design: 3 semester hours
Prerequisites: J M ENGR 3250, J C ENGR 3410. Fundamentals of structural design in steel, reinforced concrete, and timber. Familiarization with the sources of various design codes and practice in interpreting them. Computer graphics applications.

J C ENGR 3460 Transportation Engineering: 3 semester hours
Fundamental treatment of the planning, engineering, design, and procedural aspects of multimodal transportation are covered. Intermodal freight and urban transportation planning processes and overview of environmental, energy, and economic issues are discussed.

J C ENGR 3520 Water and Wastewater Treatment: 3 semester hours
Prerequisites: J M ENGR 3700 (may be taken concurrently) or permission of instructor. Application of the basic principles of chemistry, microbiology, and fluid mechanics to the analysis of environmental problems, especially those involving control of water and land contamination. Properties of municipal and industrial wastewater, solid waste, and hazardous waste. Estimation of assimilative capacity and other characteristics of receiving waters. Introduction to unit processes and unit operations used in the treatment of municipal and industrial wastewater. Design of processes and facilities used for treating drinking water, wastewater, and sludge disposal. Waste minimization and recycling in both industrial and municipal settings.

J C ENGR 3760 Hydraulic Engineering: 3 semester hours
Prerequisites: J M ENGR 3700. The principles of open channel flow will be discussed and illustrated with practical examples. Methods for channel design, storm sewer, culvert and bridge analysis will be presented using the concepts of gradually-varied, steady flow. A design project using computerized analysis and design is used to implement concepts in a large practical application.

J C ENGR 4000 Independent Study: 1-6 semester hours
Prerequisites: Junior standing and consent of faculty advisor. Independent investigation of a civil engineering topic of special interest to a student performed under the direction of a faculty member.

J C ENGR 4190 Soil Mechanics: 3 semester hours

J C ENGR 4200 Soil Exploration and Testing: 1 semester hour
Prerequisite: J C ENGR 4190 (may be taken concurrently). Soil exploration; in-situ soil testing, laboratory testing of soil; processing of test data using a microcomputer; statistical analysis of test data; use of test results in the decision-making process.

J C ENGR 4600 Highway and Traffic Engineering: 3 semester hours

J C ENGR 4630 Design of Steel Structures: 3 semester hours
Prerequisites: J C ENGR 3410, J C ENGR 3420. Behavior and design of steel frames by “allowable stress” and “maximum strength” based on deterministic and LRFD (Load-resistance factor design) methods. Design of beams, columns, beam-columns, plate girders, connections, multistory frames, and bridge girders. Torsional design of steel structures. Plastic analysis and design of steel structures. Miscellaneous topics in structural steel construction and design.

J C ENGR 4640 Foundation Engineering: 3 semester hours
Prerequisites: J C ENGR 3420, J C ENGR 4190, J C ENGR 4200. Principal problems in design and construction of foundations for bridges and buildings. Bearing capacity of deep and shallow foundations; pressure on retaining walls and shallow foundations; pressure on retaining walls and slope stability; modern developments in piling, cofferdams, open caissons, pneumatic caissons.

J C ENGR 4660 Advanced Design of Concrete Structures: 3 semester hours
Prerequisites: J M ENGR 3250, J C ENGR 3410, J C ENGR 3420. Flexural behavior and design, strength and deformation of rectangular and nonrectangular sections, shear strength, beam-columns, long columns, slab systems, design of frames, and footings will be covered.

J C ENGR 4670 Structure Design Projects: 3 semester hours
Prerequisite: Permission of instructor. Students carry out the complete design of typical and unusual building and bridge structures. Use of the computer as a design tool is emphasized. Projects are conducted in cooperation with production engineers.

J C ENGR 4720 Legal Aspects of Construction: 3 semester hours
Prerequisite: Junior standing or permission of instructor. A survey of the legal problems of the construction manager. Including but limited to, liability in the areas of contracts, agency, torts, insurance, bad judgement and oversight.

J C ENGR 4730 Construction Operations and Management: 3 semester hours
Prerequisite: Junior standing. The construction industry, its development, components, and organization. Contracting methods. Applications and limitations. Selection of equipment using production analysis and economics. Field engineering, including form design, shoring, embankment design. Purchasing and change orders. Safety and claims.

J C ENGR 4740 Economic Decisions in Engineering: 3 semester hours
Prerequisite: Junior standing. Principles of economics involved in engineering decisions. Decisions between alternatives based on the efficient allocation of resources. Topics include the time element in economics, analytical techniques for economy studies, and taxes.
Joint Electrical Engineering Courses

**J E ENGR 2300 Introduction to Electrical Networks:** 3 semester hours
Elements, sources, and interconnects. Ohm's and Kirchhoff's laws, superposition and Thévenin's theorem; the resistive circuit, transient analysis, sinusoidal analysis, and frequency response.

**J E ENGR 2320 Introduction to Electronic Circuits:** 3 semester hours
Prerequisites: J E ENGR 2300. Introduction to contemporary electronic devices and their circuit applications. Terminal characteristics of active semiconductor devices. Incremental and D-C models of junction diodes, bipolar transistor (BJTs), and metal-oxide semiconductor field effect transistors (MOSFETs) are developed and used to design single-and multi-stage amplifiers. Models of the BJT and MOSFET in cutoff and saturation regions are used to design digital circuits.

**J E ENGR 2330 Electrical and Electronic Circuits Laboratory:** 3 semester hours
Prerequisites: J E ENGR 2300. Lectures and laboratory exercises related to sophomore topics in introductory networks and basic electronics.

**J E ENGR 2340 Electrical Laboratory for Mechanical Engineers:** 1 semester hour
Prerequisites: J E ENGR 2300. Laboratory in introductory electrical circuits and devices of relevance to mechanical engineers.

**J E ENGR 2600 Introduction to Digital Logic and Computer Design:** 3 semester hours
Prerequisite: J CMP SC 1260. Digital computers and digital information-processing system; Boolean algebra, principles and methodology of logical design; machine language programming; register transfer logic; microprocessor hardware, software, and interfacing; fundamental of digital circuits and systems; computer organization and control; memory systems; arithmetic unit design. Occasional laboratory exercises.

**J E ENGR 3300 Engineering Electro Magnetic Principles:** 3 semester hours
Electromagnetic theory as applied to electrical engineering; vector calculus; electrostatics and magnetostatics; Maxwell's equations, including Poynting's theorem and boundary conditions; uniform plane-wave propagation; transmission lines-TEM modes, including treatment of general, lossless line, and pulse propagation; introduction to guided waves; introduction to radiation and scattering concepts.

**J E ENGR 3310 Electronics Laboratory:** 3 semester hours
Prerequisites: J E ENGR 2300, J E ENGR 2330. Laboratory exercises for juniors covering topics in computer-aided measurements, computer simulation, and electronic circuits.

**J E ENGR 3320 Power, Energy and Polyphase Circuits:** 3 semester hours
Prerequisite: J E ENGR 2300. Fundamental concepts of power and energy; electrical measurements; physical and electrical arrangement of electric power systems; polyphase circuit theory and calculations; principle elements of electrical systems such as transformers, rotating machines, control, and protective devices, their description and characteristics; elements of industrial power system design.

Joint Computer Science Courses

**J CMP SC 1002 Introduction To Computing Tools: Matlab Skills:** 1 semester hour
This course is aimed at the acquisition of MATLAB skills through hands-on familiarization and practice. Students practice the array, vector, and meshgrid representations, programming and plotting, and apply these skills to solve numerical problems and generate reports. (J CMP SC 1002 and CMP SCI 1250 can substitute for J CMP SC 1360).
J E ENGR 3360 Principles of Electronic Devices: 3 semester hours
Introduction to the solid-state physics of electronic materials and devices, including semiconductors, metals, insulators, diodes and transistors, Crystals growth technology and fundamental properties of crystals. Electronic properties and band structure of electronic materials, and electron transport in semiconductor materials. Fabrication of pn junction diodes, metal-semiconductor junctions, and tranistors and integrated circuit chips. Fundamental electrical properties of rectifying diodes and light-emitting diodes, bipolar transistors and field effect transistors. Device physics of diodes and transistors, large-signal electrical behavior and high-frequency properties.

J E ENGR 3370 Electronic Devices and Circuits: 3 semester hours

J E ENGR 3510 Signals and Systems: 3 semester hours
Prerequisites: J E ENGR 2300 and J E MATH 3170. Elementary concepts of continuous-time and discrete-time signals and systems. Linear time-invariant (LTI) systems, impulse response, convolution, Fourier series, Fourier transforms, and frequency-domain analysis of LTI systems. Laplace transforms, Z-transforms, and rational function descriptions of LTI systems. Principles of sampling and modulation. Students participate weekly in recitation sections to develop oral communications skills using class materials.

J E ENGR 3620 Computer Architecture: 3 semester hours
Prerequisite: J E ENGR 2600. Study of interaction and design philosophy of hardware and software for digital computer systems: Machine organization, data structures, I/O considerations. Comparison of minicomputer architectures.

J E ENGR 4000 Independent Study: 1-3 semester hours
Prerequisites: Senior in Good Standing. Opportunities to acquire experience outside the classroom setting and to work closely with individual members of the faculty. A final report must be submitted to the department. Open as a senior elective only. Hours and credit to be arranged. Credit variable, maximum credit per semester 3 hours. Maximum program total credit 3 hours.

J E ENGR 4050 Reliability and Quality Control: 3 semester hours
Prerequisites: J E MATH 3260 or MATH 1320. An integrated analysis of reliability and quality control function in manufacturing. Statistical process control, analysis, reliability prediction, design, testing, failure analysis and prevention, maintainability, availability, and safety are discussed and related. Qualitative and quantitative aspects of statistical quality control and reliability are introduced in the context of manufacturing.

J E ENGR 4340 Solid State Power Circuits and Applications: 3 semester hours
Prerequisite: J E ENGR 2320, J E ENGR 3510. Study of the strategies and applications of power control using solid-state semiconductor devices. Survey of generic power electronic converters. Applications to power supplies, motor drives, and consumer electronics. Introduction to power diodes, thyristors, and MOSFETs.

J E ENGR 4350 Electrical Energy Laboratory: 3 semester hours
Prerequisites: J E ENGR 2330, J E ENGR 3510, J E MATH 3170. Study of the solid-state physics of electronic materials and devices, including semiconductors, metals, insulators, diodes and transistors, Crystals growth technology and fundamental properties of crystals. Electronic properties and band structure of electronic materials, and electron transport in semiconductor materials. Fabrication of pn-junction diodes, metal-semiconductor junctions, and transistors and integrated circuit chips. Fundamental electrical properties of rectifying diodes and light-emitting diodes, bipolar transistors and field effect transistors. Device physics of diodes and transistors, large-signal electrical behavior and high-frequency properties.

J E ENGR 4360 Energy Alternatives: 3 semester hours
Prerequisites: J E ENGR 2300, or J M ENGR 3200. This course introduces engineering analyses of the human uses of energy. Both non-renewable (e.g., oil, natural gas, coal, nuclear) and sustainable (e.g., hydropower, solar, wind, biomass) resources are covered. Topics include the engineer's role in harvesting, production, storage, conversion, delivery, and uses of energy. Students will learn system analysis, design, integration, optimization, and operational aspects of selected resources delivery systems, and end uses. Technical content will include site selection, conversion and delivery efficiency calculations, engineering economic analyses, control systems, and energy resource systematic classification. Measure will consist of a mix of homework, quizzes, tests, class participation, and projects.

J E ENGR 4410 Control Systems I: 3 semester hours

J E ENGR 4520 Power Systems Analysis: 3 semester hours
Prerequisite: J E ENGR 3320. Introduction to the modeling and elements of power systems; machines, lines, and loads; load flow methods and applications; short circuit analysis using symmetrical components on symmetrical and unsymmetrical faults; methods of economic operation of power systems and contingency; state estimators, stability, and introduction of the independent system operator.

J E ENGR 4710 Communications Theory and Systems: 3 semester hours
Prerequisites: J E ENGR 3510 and J E MATH 3260. Introduction to the concepts of transmission of information via communication channels. Amplitude and angle modulation for the transmission of continuous-time signals. Analog-to-digital conversion and pulse code modulation. Transmission of digital data. Introduction to random signals and noise and their effects on communication. Optimum detection systems in the presence of noise. Elementary information theory. Overview of various communication technologies such as radio, television, telephone networks, data communication, satellites, optical fiber, and cellular radio.

J E ENGR 4720 Internet Communications: 3 semester hours
This course will introduce and cover the architecture, protocols, security, and quality of service (QoS) of Internet Communications. Starting with the design principles and architecture of the Internet, communication applications such as Voice over IP (VoIP), video conferencing, and presence and instant messaging will be covered. Protocols developed by the Internet Engineering Task Force (IETF) including IP, TCP, UDP, DNS, SIP, XMPP, and ENUM will be studied. Latest areas of research including the Service Oriented Architecture (SOA) and peer-to-peer (P2P) architectures for Internet Communications will be covered.
An introduction to engineering design in the context of mechanical engineering. Students learn the fundamentals of spatial reasoning and graphical representation. Freehand sketching, including pictorial and orthographic views, are applied to the design process. Computer modeling techniques provide accuracy, analysis, and visualization tools necessary for the design of devices and machines. Topics include recognition of need, specification formulation, concept generation, concept selection, embodiment, and detail design. Includes an introduction to several classes of machine elements such as bearings, gears, belts, and springs. Underlying analytical model of the machine elements are presented along with guidelines about designing and choosing such elements for practical applications. A case study from industry will emphasize how the steps of the design process were done as well as the rational for choosing particular machine elements.

**J M ENGR 3200 Thermodynamics: 3 semester hours**
Prerequisites: MATH 1900, CHEM 1111 and PHYSICS 2111. Classical thermodynamics; thermodynamic properties; work and heat; first and second laws. Entropy, irreversibility, availability. Application to engineering systems.
J M ENGR 3250 Material Science for J M ENGR: 4 semester hours
Prerequisites: CHEM 1111. Introduces the chemistry and physics of engineering materials. Emphasis on atomic and molecular interpretation of physical and chemical properties, the relationships between physical and chemical properties, and performance of an engineering material.

J M ENGR 3360 Material Science For J C ENGR: 3 semester hours
Same as J M ENGR 3250, but without the lab. Prerequisite: CHEM 1111. Introduces the chemistry and physics of engineering materials. Emphasis on atomic and molecular interpretation of physical and chemical properties, the relationships between physical and chemical properties, and performance of an engineering material.

J M ENGR 3700 Fluid Mechanics: 3 semester hours

J M ENGR 3710 Principles of Heat Transfer: 3 semester hours

J M ENGR 3721 Fluid Mechanics Laboratory: 1 semester hour
Prerequisites: J M ENGR 3700. Physical laboratory exercises focusing on fluid properties and flow phenomena covered in J M ENGR 3700. Calibration and use of a variety of equipment: acquisition, processing, and analysis of data by manual as well as automated methods.

J M ENGR 3722 Heat Transfer Laboratory: 1 semester hour
Prerequisites: J M ENGR 3721 and J M ENGR 3710. Physical laboratory exercises, including some numerical simulations and computational exercises, focusing on heat-transfer phenomena covered in J M ENGR 3710. Calibration and use of variety of laboratory instrumentation; acquisition, processing, and analysis of data by manual as well as automated methods; training in formal report writing.

J M ENGR 3750 Fluid Control and Power Systems Theory and Practice: 3 semester hours
Prerequisite: J M ENGR 3700. Topics to be covered include: design of hydraulic and pneumatic control and power systems using advanced concepts and analytical tools; analysis of fluid flow through small orifices and between parallel and inclined planes; theory of spool and flapper valves; physical configuration of practical components: pumps, motors, fluid lines and valves, accumulators and storage devices; integration of components into practical systems, development of realistic performance diagrams using MATLAB Simulink; application of performanc diagrams in design and analysis of fluid power systems.

J M ENGR 4000 Independent Study: 3 semester hours
Prerequisites: Junior standing and consent of faculty advisor. Independent investigation of a mechanical engineering topic of special interest to a student performed under the direction of a faculty member.

J M ENGR 4041 Current Topics in Engineering Design: 1 semester hour
Case studies of engineering failures, class discussion & short written papers are used to illustrate and stress the importance of engineering teamwork, ethics, and professional standards within the mechanical engineering discipline. Working in teams students develop and present a case study on a topic of their choice. Guest lecturers introduce contemporary topics such as product liability, environmental regulations, green design, appropriate technologies, and concurrent engineering.

J M ENGR 4110 Mechanical Engineering Design Project: 4 semester hours
Prerequisites: J M ENGR 3221. Feasibility study of an open-ended, original design or a creative redesign of a mechanical component or system requiring the application of engineering science principles. Feasibility is subject to economic, safety, legal, environmental, ethical, aesthetic, and other constraints in a competitive manufacturing environment. Project teams perform the detailed design and optimization of the concept developed in the feasibility study. Presentations and reports with manufacturing drawings and prototypes are completed by each team.

J M ENGR 4120 Design of Thermal Systems: 3 semester hours
Prerequisites: J M ENGR 3221. Analysis and design of advanced thermofluid systems. Student teams participate in the design process which could involve research, design formulation, codes, standards, engineering economics, a design project report, and formal presentations. Topics include: thermal-fluid systems and components, such as power, heating, and refrigeration systems, pumps, fans, compressors, combustors, turbines, nozzles, coils, heat exchangers and piping.

J M ENGR 4170 Dynamic Response of Physical Systems: 2 semester hours

J M ENGR 4180 Dynamic Response Laboratory: 1 semester hour
Prerequisites: J M ENGR 4170 and J M ENGR 4180 must be taken during the same semester. Laboratory problems focusing on materials covered in J M ENGR 4170.

J M ENGR 4250 Material Selection in Engineering Design: 3 semester hours
Prerequisites: Senior standing. Analysis of the scientific bases of material behavior in the light of research contributions of the last 20 years. Development of a rational approach to the selection of materials to meet a wide range of design requirements for conventional and advanced applications. Although emphasis will be placed on mechanical properties, other properties of interest in design will be discussed, e.g., acoustical, optical and thermal.

J M ENGR 4310 Control Systems I: 3 semester hours
J M ENGR 4630 Nanotechnology: Concepts and Applications: 3 semester hours

J M ENGR 4700 Sustainable Environmental Building Systems: 3 semester hours
Sustainable design of building lighting and HVAC systems considering performance, life-cycle cost and downstream environmental impact. Criteria, codes and standards for comfort, air quality, noise/vibration and illumination. Life cycle and other investment methods to integrate energy consumption/conservation, utility rates, initial cost, system/component longevity, maintenance cost and building productivity. Direct and secondary contributions to acid rain, global warming and ozone depletion.

J M ENGR 4810 HVAC Analysis and Design I: 3 semester hours

J M ENGR 4820 HVAC Analysis and Design II: 3 semester hours
Prerequisites: Senior standing. Energy calculations to estimate the quantity of energy needed to heat and cool building structures. Fundamentals of incompressible flow, basics of centrifugal pump performance, and design procedures for water piping systems. Space air diffuser design to assure that temperatures, humidities, and air velocities within occupied spaces are acceptable. Air duct design and fan analysis for optimally distributing air through building air duct systems. Performance analysis of refrigeration systems, including the effects of pressure losses and heat transfer. Direct contact heat and mass transfer.

J M ENGR 4900 Engineering Project Management: 3 semester hours
Basic fundamentals and advanced concepts of engineering project management applicable to projects and programs, both large and small. Project management skills, techniques, systems, software and application of management science principles will be covered and related to research, engineering, architectural, and construction projects from initial evaluations through approval, design, procurement, construction and startup.