

An introduction to the concept of project management as a tool for the management of engineering endeavors. Students will be introduced to concepts and methods of management, such as motivating, directing, planning and controlling. An emphasis will be placed on the management of technology and scientific ventures, and the challenges these projects offer. Concepts such as organizational design, the strategic context of projects, project leadership, project evaluation, and stakeholder management will be discussed. Specific tools for the management of projects, including, but not limited to, software packages will be demonstrated and used. The course is designed to promote the development of student competency in the oral presentation of technical information.

**Prerequisite(s)/Course Notes:**

Junior class standing or above.

- **ENGG 111 - Electromagnetic Waves and Transmission**
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**Semester Hours: 3**

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Fall

Study of waves in transmission line networks including impedance properties and power transfer. Electromagnetic waves in waveguides and uniform media, including their reflection, refraction and transmission. Communication and radar systems design involving antennas and propagation. Optimum design methods for maximum power transfer.

**Prerequisite(s)/Course Notes:**

ENGG **104**, MATH **144**.

- **ENGG 112 - Engineering Drawing**
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Fall, Spring

Engineering graphics, descriptive geometry, graphical mathematics, sketching and orthographic projection are presented within the framework of the design process. Introduction to, and extensive use of, computer-aided drafting (CAD) software, such as AutoCAD.

**Prerequisite(s)/Course Notes:**

High school trigonometry. No liberal arts credit. (Formerly ENGG 1.)

- **ENGG 113 - Engineering Thermodynamics**
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**Semester Hours: 3**

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Spring

Fundamental concepts of thermodynamics, including open and closed systems, properties of thermodynamic fluids, First and Second Laws of Thermodynamics.

**Prerequisite(s)/Course Notes:**

**PHYS 011A.** Corequisite: **MATH 072.**

- **ENGG 114 - Heat Transfer**
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**Semester Hours: 3**

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Fall

Fundamental principles of heat transfer. Topics include steady and transient conduction, free and forced convection, radiation between surfaces, boiling, and design of heat exchangers and equipment using fins.

**Prerequisite(s)/Course Notes:**

**ENGG 115, MATH 131.**

- **ENGG 115 - Fluid Mechanics**
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**Semester Hours: 3**

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Spring

Introduction to fluid mechanics (statics and dynamics). Topics include fluid hydrostatics, stability, buoyancy, conservation of mass, momentum, and energy (both control volume and differential forms), dimensional analysis, inviscid and viscous flows, internal and external flows, and boundary layer theory.

**Prerequisite(s)/Course Notes:**

**ENGG 025, ENGG 026, MATH 073, MATH 131.**

- **ENGG 116 - Compressible Flow**
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**Semester Hours: 3**

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Periodically

One-dimensional compressible flow, normal and oblique shocks; two-dimensional and nonsteady flow by method of characteristics. Flow with friction and heat transfer. Design of nozzles, diffusers and gas pipeline systems.

**Prerequisite(s)/Course Notes:**

**ENGG 115.**

- **ENGG 117 - Environmental Unit Processes and Operations**
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**Semester Hours: 3**

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Periodically

Theory and design of the physical, chemical, and biological unit operations of filtration, sedimentation, coagulation, flocculation, adsorption, ion exchange, disinfection, gas transfer, biological degradation, and sludge handling as applied to water and wastewater treatment.

**Prerequisite(s)/Course Notes:**

ENGG 047 or permission of instructor.

- **ENGG 118 - Fundamentals of Biomaterials**
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**Semester Hours:** 3

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Spring

Biomaterials play important roles in tissue engineering, regenerative medicine, nanotechnology, and development of medical devices interacting with the biological system. This course will provide a detailed analysis of the mechanical, chemical, and bio-physiological properties and behavior of the different types of biomaterials. Upon successful completion, students should be able to select and justify appropriate materials for the design and engineering of biomedical implants.

**Prerequisite(s)/Course Notes:**

**CHEM 003A.** (Formerly ENGG 197E, *Special Topics: Fundamentals of Biomaterials.*)

- **ENGG 119 - Industrial Engineering Methods**
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Periodically

Operation and process analysis. Measurement and evaluation of worker-production systems including time study, work measurement, and predetermined measurement systems. Workplace design. Concepts in Human Factors Engineering and Ergonomics. Systems engineering including the implementation of total quality management systems.

**Prerequisite(s)/Course Notes:**

(Formerly *Methods Engineering.*)

- **ENGG 120 - Transportation Engineering I**
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**Semester Hours:** 3

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Spring

An introduction to the principles and methods used by engineers and planners in the planning, design, and operation of transportation systems. Vehicular flow models, highway capacity, traffic control, urban transportation planning, and environmental impact of transportation systems will be covered. Software tools for the design and analysis of such systems will be introduced.

**Prerequisite(s)/Course Notes:**

ENGG **026**. May not be taken on a Pass/D+/D/Fail basis.

- **ENGG 128 - Human Computer Interaction / Human Factors**
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**Semester Hours:** 3.0

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This course introduces fundamental concepts and theories that help students understand how learning human physiological and psychological strengths and limitations can lead to better design, more effective learning, friendlier human computer interactions for safer environments.

This course considers the following topics, an introduction to human factors, research methods, design and evaluation methods, human sensory systems, cognition, decision making, stress and workload, safety and human error, principles of human computer interaction, sketch design and prototyping, handless interaction.

**Prerequisite(s)/Course Notes:**

Same as CSC 128 and CSC 228

- **ENGG 129 - Mechanical Vibrations**
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**Semester Hours:** 3

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Periodically

Properties of mechanical vibrations. Natural frequencies of systems having one or multiple degrees of freedom, forced vibrations with or without damping, vibration isolation and reduction, transient phenomena and application to design.

**Prerequisite(s)/Course Notes:**

ENGG 026, MATH 131.

- **ENGG 130 - Modeling, Analysis and Control of Dynamic Systems**
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**Semester Hours:** 4

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Fall

Dynamic system investigation process; physical and mathematical modeling of mechanical, electrical, electromechanical, fluid, thermal, and multidisciplinary engineering systems. Dynamic system response. Time-domain and frequency domain analysis; transfer-function, block diagram, and state-space model representations; linearization of components and models; control system design: stability and performance; feedback and feedforward control; root-locus and frequency response analysis and design techniques; proportional, integral, and derivative (PID) control modes. There is extensive use of MATLAB/Simulink and relevant MATLAB Toolboxes. There are 10 studio hardware/software sessions integrated into the course. (3 hrs lecture, 2 hrs lab)

**Prerequisite(s)/Course Notes:**

ENGG 026, 030. Corequisite: MATH 131. (Formerly *Modeling and Analysis of Dynamic Systems*.)

- **ENGG 131 - Advanced Strength of Materials**
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**Semester Hours:** 3

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Periodically

Curved beams, theories of failure, shear center, elastic stability, beam columns, comparison of designs based upon elementary and advanced methods of analysis, beams on elastic foundations, energy methods, thin plates and shells, and selected topics.

**Prerequisite(s)/Course Notes:**

ENGG 028, MATH 131.

- **ENGG 132 - Structural Analysis I**
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**Semester Hours: 3**

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Fall

Stability and determinacy, analysis of trusses, analytical and graphical methods, determination of forces in determinant structures, influence lines, approximate analysis of structures, displacement of structure by angle changes and energy methods.

**Prerequisite(s)/Course Notes:**

ENGG 028.

- **ENGG 134 - Structural Analysis II**
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**Semester Hours: 3**

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Periodically

Indeterminate structural analysis by force and displacement methods, moment distribution, flexibility and stiffness influence, methods of analysis, structural analysis by computer programs and plastic design.

**Prerequisite(s)/Course Notes:**

ENGG 132.

- **ENGG 135 - Design of Reinforced Concrete Structures**
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**Semester Hours: 4**

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Periodically

Fundamental concepts of structural design applied to reinforced concrete structures; limit state design methodology; properties of concrete and steel reinforcement; behavior of structural members subject to flexure, shear, axial loads, and combined actions; strength design of beams, slabs, columns, and footings; serviceability requirements; and design of structural systems for buildings.

**Prerequisite(s)/Course Notes:**

**ENGG 132.** (Formerly *Structural Design.*)

- **ENGG 136 - Hydraulic Engineering and Water Resources**
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**Semester Hours: 3**

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Periodically

Introduction to hydrology. Population and water demand projections, design of water transport systems. Applications of principles of fluid mechanics to typical civil engineering systems; pipe networks, pumping stations, open channel flow and measuring devices.

**Prerequisite(s)/Course Notes:**

Corequisite: ENGG **115.**

- **ENGG 137 - Design of Steel Structures**
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**Semester Hours: 3**

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Fall

Fundamental concepts of structural design applied to steel structures; limit state design methodology; properties of structural steel; structural framing systems; analysis and design of

tension members, compression members, beams, beam-columns, and connections; design of structural systems for buildings.

**Prerequisite(s)/Course Notes:**

**ENGG 132.**

- **ENGG 138 - Propulsion**
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**Semester Hours: 3**

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Periodically

Applications of principles of thermodynamics, gas dynamics and combustion to the design of air breathing and rocket motors. Thermodynamics of combustion, gas flows with chemical reactions, jet propulsion power plants, design of liquid and solid propellant chemical rockets.

**Prerequisite(s)/Course Notes:**

ENGG 116. Corequisite: ENGG 116.

- **ENGG 139 - Thermal Engineering**
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**Semester Hours: 3**

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Fall

Synthesis of fundamental principles of thermodynamic fluid mechanics and heat transfer for the design and analysis of systems to produce power or refrigeration. Topics include combustion, vapor power cycles, gas turbine power plants, internal combustion engines, refrigeration cycles and air-conditioning systems.

**Prerequisite(s)/Course Notes:**

ENGG 113.

- **ENGG 140 - Aircraft Performance**
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**Semester Hours: 3**

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Periodically

Examination of performance characteristics of aircraft as a function of propulsion system (turbojet, turbofan, turboprop, piston prop). Optimal conditions for cruise, turning, climb, takeoff and landing. Calculations of best range speed, fuel consumption, and time for maneuvers.

**Prerequisite(s)/Course Notes:**

ENGG 026, MATH 131.

- **ENGG 141 - Mechanical Analysis and Design**
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**Semester Hours: 4**

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Fall

Mechanical design emphasizing complementary efforts of synthesis and analysis; engineering material selection for mechanical design; machine static and dynamic load determination with MatLab/Simulink; impact loading; applied stress analysis involving complex stress fields including thick-walled cylinders and curved members; deflection and stiffness considerations including energy methods, Castigliano's Theorem, and column buckling; design for static strength: combined stress theories of failure and stress concentration; design for fatigue strength: multi-axial fatigue failure theories; design criteria for combined static and dynamic duties. Mechanical components: shafts, gears, rolling-element bearings, screws and fasteners, springs, clutches and brakes. Introduction to lubrication theory: types of lubrication, fluid friction, hydrostatic and hydrodynamic theories of lubrication, externally-pressurized bearings, squeeze-film bearings, wedge-film thrust bearings, journal bearings, and bearing materials.

**Prerequisite(s)/Course Notes:**

ENGG 026, 028. (Formerly *Mechanical Analysis and Design I.*)

- **ENGG 142 - Mechatronic System Design**

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**Semester Hours: 4**

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Spring

Mechatronics is multidisciplinary, model-based systems engineering. It is the synergistic combination of mechanical engineering, electronics, control engineering, and computer systems, all integrated through the design process from the start of the design process. Topics covered include: mechatronic system design fundamentals; power transmission fundamentals; servo-system design: kinematics and dynamics of mechanical systems, trajectory planning for mechanical systems, electromechanical and fluid-power actuators, mechatronic system sensors, control system design; system integration: system-level modeling, system-level performance and tradeoffs. There is extensive use of MatLab Simulink and relevant MatLab Toolboxes.

**Prerequisite(s)/Course Notes:**

**ENGG 130, 141.** (Formerly *Mechanical Analysis and Design II.*)

- **ENGG 143A - Civil Engineering Design A**

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**Semester Hours: 3**

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Fall, Spring

Integration of physical principles with mathematical analysis and/or experimental techniques as basis for an individually required design project in engineering science. The course is designed to promote the development of student competency in the oral presentation of technical information.

**Prerequisite(s)/Course Notes:**

ENGG 028 or permission of instructor and senior standing in Engineering Science or Civil Engineering. No liberal arts credit. (Formerly *Independent Engineering Design A.*)

- **ENGG 143B - Electrical Engineering Design**

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**Semester Hours:** 3

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Fall

Integration of physical principles with mathematical analysis and/or experimental techniques as a basis for an individually required design project in electrical engineering.

**Prerequisite(s)/Course Notes:**

Senior standing in Electrical Engineering or Computer Engineering. No liberal arts credit.

- **ENGG 143C - Civil Engineering Design C**

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**Semester Hours:** 3.0

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Integration of physical principles with mathematical analysis and/or experimental techniques as a basis for an individually required design project in civil engineering.

**Prerequisite(s)/Course Notes:**

Senior standing in Civil Engineering.

- **ENGG 143D - Design of Multidisciplinary Engineering Systems**

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**Semester Hours:** 3

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Fall

This course provides a meaningful culminating experience that introduces students to the multidisciplinary aspects of design, incorporating electronics and computer control within mechanical systems. The design process (i.e., need definition and evaluation; synthesis including development of alternative concepts; analysis including physical and mathematical modeling, simulation, and optimization; and detailed design) is learned through an engineering case study of

an actual multidisciplinary product. The students, working in small teams, simultaneously apply the design process in the context of an open-ended engineering problem. Professional development in areas of leadership, team dynamics, interpersonal relationships, technical communications, and project management is emphasized. Oral presentations are required and the course is writing intensive. 2 hours lecture, 2 hours lab.

**Prerequisite(s)/Course Notes:**

**ENGG 142** or permission of instructor. No liberal arts credit. (Formerly *Mechanical Engineering Design*.)

- **ENGG 143E - Aircraft Design**
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## **ENGG 143E - Aircraft Design**

**Semester Hours:** 3

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Periodically

Design of an aircraft meeting the specifications of payload, range, cruising speed and runway length. Project follows accepted design procedure in calculating the design characteristics: fuselage, wing planform and shape, engine specifications. Analysis of the designed aircraft's performance is calculated. The course is designed to promote the development of student competency in the oral presentation of technical information.

**Prerequisite(s)/Course Notes:**

**ENGG 140**. Corequisites: **ENGG 145, 146**. No liberal arts credit.

- **ENGG 143F - Heating, Ventilation and Air-conditioning (HVAC) Design**
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**Semester Hours:** 3

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Spring

Design of heating, ventilating, and air-conditioning spaces for residential and/or nonresidential applications. Considerations include cooling and heating load calculations, duct and pipe sizing, life-cycle costs, system configuration selection, equipment selection, and professional codes and standards.

**Prerequisite(s)/Course Notes:**

Senior standing in mechanical engineering. No liberal arts credit.

- **ENGG 143G - Independent Engineering Design B**
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**Semester Hours:** 3

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Fall, Spring

Integration of physical principles with mathematical analysis and/or experimental techniques as basis for an individually required design project in engineering science. The course is designed to promote the development of student competency in the oral presentation of technical information.

**Prerequisite(s)/Course Notes:**

Senior standing in Engineering Science and Bioengineering. No liberal arts credit

- **ENGG 143J - Electrical and Computer Engineering Design**
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**Semester Hours:** 2

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Fall, Spring

Integration of physical principles with mathematical analysis and/or experimental techniques as a basis for an individually required design project in electrical engineering. The course is designed to promote the development of student competency in the oral presentation of technical information.

**Prerequisite(s)/Course Notes:**

Senior standing in Electrical Engineering or Computer Engineering. May not be taken on a Pass/D+/D/Fail basis. No liberal arts credit. (Formerly ENGG 143B.)

- **ENGG 143K - Electrical and Computer Engineering Design**
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**Semester Hours: 1**

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Fall, Spring

Integration of physical principles with mathematical analysis and/or experimental techniques as a basis for an individually required design project in electrical engineering. The course is designed to promote the development of student competency in the oral presentation of technical information.

**Prerequisite(s)/Course Notes:**

Senior standing in Electrical Engineering or Computer Engineering. May not be taken on a Pass/D+/D/Fail basis. No liberal arts credit. (Formerly ENGG 143B.)

- **ENGG 145 - Aerodynamics**
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**Semester Hours: 3**

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Periodically

Development of potential flow theory, concepts of circulation and lift. Classical airfoil theory and finite wing theory. Viscous drag and lift-induced drag. Flow control and high lift devices for wings. Effects of compressibility at high subsonic Mach numbers.

**Prerequisite(s)/Course Notes:**

**ENGG 115.** Prerequisite or corequisite: **MATH 143** or **ENGG 150.**

- **ENGG 146 - Aircraft Stability**
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Periodically

Analysis of static stability contributions of major aircraft surfaces, including wings, tails, and fuselages, as well as the control surfaces on wings and tails. Development of aircraft equations of motion and stability derivatives.

**Prerequisite(s)/Course Notes:**

**ENGG 028, MATH 131.** (Formerly *Aircraft Structures*.)

- **ENGG 147 - Soil Mechanics and Foundations**
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**Semester Hours: 3**

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Periodically

Fundamentals of soil behavior and its use as a construction material; engineering geology of soils and rocks; soil properties and classification; effective stress principle, consolidation, and settlement; shear strength and limit analysis; relationship of soils to foundation design.

**Prerequisite(s)/Course Notes:**

**ENGG 028.**

- **ENGG 148 - Design of Foundations**
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**Semester Hours: 3**

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Spring

Design of spread footings, combined footings and mat foundations; Rankine lateral earth pressures, and design of retaining walls, sheet piles, and braced cuts. Drilled piers and caissons. Slope stability analysis, and overview of foundation design in weak soils.

**Prerequisite(s)/Course Notes:**

**ENGG 028, 115, 147.**

- **ENGG 150 - (MA) Engineering Mathematics I**

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**Semester Hours: 3**

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Fall, Spring

Systems of linear equations, row operations, Gauss Jordan reduction, matrix algebra, inversion, determinants, eigenvalues and eigenvectors, solutions of linear ODEs, algebra of the complex plane, polar representation and DeMoivre's theorem, the complex exponential and logarithmic functions, Fourier Series, the solution of the heat and wave equations by Fourier Series, Bessel functions and applications.

**Prerequisite(s)/Course Notes:**

MATH **073** or higher. Same as MATH **143**. (Formerly MATH 143 & 144.)

- **ENGG 151 - Independent Projects in Engineering Design — Electrical Engineering I**

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**Semester Hours: 1**

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Fall, Spring

Selections assigned by the instructor for oral and written reports.

**Prerequisite(s)/Course Notes:**

Prerequisite: Senior standing in Electrical Engineering or permission of department. Hours arranged on an individual basis. (Formerly Electrical Engineering I.)

- **ENGG 153 - Advanced Computer Architecture**

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**Semester Hours: 3**

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Fall

Study of computer architecture from classical to advanced perspectives. Explores architectural characteristics of modern computer systems such as performance, instruction sets, assemblers, datapaths, pipelining, caching, memory management, I/O considerations, and multiprocessing. Same as CSC **153**.

**Prerequisite(s)/Course Notes:**

CSC **110** or ENGG **036**.

- **ENGG 154 - Advanced Computer Architecture Laboratory**
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**Semester Hours:** 1

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Spring

Experiments provide laboratory experience in the designs and operations of different types of computer architecture, memory architectures, I/O and bus subsystems, special purpose architectures, parallel processing, and distributed systems. Explore hardware and software issues and tradeoffs in the design, implementation, and simulation of working computer systems.

**Prerequisite(s)/Course Notes:**

CSC **153** or ENGG **153** and CSC **110A** or ENGG **032B** with permission of instructor. Same as CSC **154**. No liberal arts credit.

- **ENGG 156 - Independent Projects in Engineering Design — Industrial Systems**

**Engineering and Operations Research I**

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**Semester Hours:** 3

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Fall, Spring

Selections assigned by the instructor for oral and written reports. The course is designed to promote the development of student competency in the oral presentation of technical information.

**Prerequisite(s)/Course Notes:**

Prerequisite: Senior standing in Industrial Engineering or permission of department. Hours arranged on an individual basis. (Formerly *Industrial Systems Engineering and Operations Research I.*)

- **ENGG 157 - Independent Projects in Engineering Design — Industrial Systems**

**Engineering and Operations Research II**

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**Semester Hours: 1**

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**Fall, Spring**

**Selections assigned by the instructor for oral and written reports.**

**Prerequisite(s)/Course Notes:**

**Prerequisite: Senior standing in Industrial Engineering or permission of department.**

**Prerequisite or Corequisite: ENGG 156. Hours arranged on individual basis.**

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- **ENGG 158 - Independent Study**
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**Semester Hours: 2**

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Fall, Spring

Independent design or experimental work in an area of interest. The course is designed to promote the development of student competency in the oral presentation of technical information.

**Prerequisite(s)/Course Notes:**

Senior standing or permission of department.

- **ENGG 159 - Engineering Ergonomics**
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**Semester Hours: 3**

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Periodically

The field of engineering ergonomics focuses on how people interact with tools, navigate workspaces, and carry out physical tasks. In this course, we will study the capabilities and limitations of the musculoskeletal system and apply this understanding to the design and evaluation of the tools, spaces, and tasks that individuals encounter in their work. Topics

covered will include the structure and function of the musculoskeletal system; the evaluation of mechanical work capacity; and occupational biomechanical models; as well as task, workplace, and tool design intended to minimize worker injury. The class will also begin to explore the mechanical principles behind the design of objects for ease of use and minimization of use errors.

**Prerequisite(s)/Course Notes:**

ENGG **025**. May not be taken on a Pass/D+/D/Fail basis.

- **ENGG 160A - Measurements and Instrumentation Laboratory**
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**Semester Hours: 1**

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Fall

Introduction to measurement theory and techniques. Topics include measurement systems terminology (accuracy, precision, resolution, uncertainty, regression), digitization, data acquisition with LabView graphical programming, calibration and response of dynamic systems, bridge circuits, probability and statistics, and signal analysis.

**Prerequisite(s)/Course Notes:**

ENGG **030**. Corequisite: **MATH 131**. No liberal arts credit.

- **ENGG 162 - Civil Engineering Materials and Structures Lab**
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**Semester Hours: 1**

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Once a Year

Experimental investigation of the properties of materials used in civil engineering, including structural materials and modern construction materials. Experimental investigation of the behavior of structural elements subjected to various loading conditions.

**Prerequisite(s)/Course Notes:**