ENGINEERING (ENGRG)

ENGRG 5000 Engineering Communications 3 Credits
Emphasizes methods of communication in the engineering workplace, including the development and writing of proposals, technical manuals, design reports, and business presentations. Effective teamwork communication strategies for virtual and co-located project teams will be addressed.
Components: Class

ENGRG 5030 Linear Algebra 3 Credits
This course is an online introductory course in linear algebra. This foundation course is designed to prepare a student for study in the Master of Science in Engineering program. Matrices, systems of equations, determinants, eigenvalues, eigenvectors, vector spaces, linear transformations, and diagnolization. This course is not appropriate for students seeking a MS or MA degree in mathematics.
Components: Class
Prereqs/Coreqs: P. MATH 2740 with a grade of "C" or better

ENGRG 6050 Applied Statistics 3 Credits
This course is an online introductory course in statistics. This foundation course is designed to prepare a student for study in the Master of Science in Engineering program or the Master of Science in Project Management program. This course will cover basic concepts of probability, discrete and continuous random variables, confidence intervals, hypothesis testing, and applications of statistics including simple linear regression, multiple regression, basic design of experiments and ANOVA. This course is not appropriate for students seeking a MS or MA degree in mathematics.
Components: Class
Prereqs/Coreqs: P. MATH 2740 with a grade of "C" or better

ENGRG 6150 Reinforced Concrete Structures 3 Credits
This is a graduate level class on advanced design of RC members that aims to introduce advanced analysis and design skills for special reinforced concrete elements, which are beyond the scope of common undergraduate reinforced concrete design courses, yet essential for professional practitioner. Topics will include analysis of doubly reinforced RC sections and sections of irregular shapes with application of the strain compatibility approach, design for the combined shear and torsion stresses, full analysis, design, and detailing of continuous RC beams including deflection calculation, analysis and design of two-way slabs, slender columns, footings under eccentric load, and introduction to prestressed concrete.
Components: Class
Prereqs/Coreqs: P. Introduction to Structural Engineering course (equivalent to CIVILENG 3140)

ENGRG 6230 Structural Steel Design with LRFD 3 Credits
The purpose of this course is to introduce students to the design of steel structures by the load and resistance factor design (LRFD) method. The newest steel specification requires a strength method (like LRFD) to be used. The allowable stress method (ASD) has been renamed the allowable strength method, and is based on many of the principles of LRFD design. A general overview of the new ASD method will be given, but the focus of the class will be on designing structures with LRFD. Students will learn to design tension and compression members, beams and beam-columns, and connections. A low-rise steel office building will be designed throughout the semester as a group design project. P. CIVILENG 3100 - Structural Mechanics (or equivalent) is required. Familiarity with a structural analysis program (e.g., RISA-2D, STAAD, etc.) will be beneficial but not required.
Components: Class

ENGRG 6560 Computational Fluid Dynamics 3 Credits
Introduction to computational fluid dynamics (CFD) with an emphasis on a commercial software package. Concepts of consistency, stability, convergence, scheme order, and turbulence modeling from the practitioner's viewpoint are covered. Simulations of steady and unsteady flows, compressible and incompressible flows, forced and natural convection heat transfer, and conduction in solids are performed.
Components: Laboratory, Class
Prereqs/Coreqs: P. Undergraduate course in Fluid Dynamics (equivalent to ME 3300); Undergraduate course in Computational Methods (equivalent to ME 3430) or similar, or approval of the instructor

ENGRG 6750 Computational Methods in Engineering 3 Credits
Use of digital computers to solve equations encountered in mechanical engineering problems. Numerical integration and differentiation, solution of linear and nonlinear equations, ordinary and partial differential equations (finite element and finite difference methods), systems of equations (matrix equations). Programming using MATLAB. How to choose the proper numerical method, and pitfalls that lead to bad solutions.
Components: Laboratory, Class
Prereqs/Coreqs: P. MATH 3630 and (MECHENG 3430 or COMPUTER 1430 or ENGRPHYS 3240)

ENGRG 6820 Advanced Manufacturing Processes 3 Credits
Additive manufacturing (AM) also known as 3D printing, comprises manufacturing technologies in which 3D objects are fabricated layer-by-layer using digital files. It has grown from being just a prototyping platform to product manufacturing technologies for end-use parts. It is redefining how products are made. Products once thought to be impossible are now made. Product development lead times are also shorter thanks to the technologies. This course seeks to introduce students to the fundamentals AM processes and materials. Its unique benefits and applications as well as challenges and opportunities will be discussed. Topics on laser welding, friction stir welding, electro-chemical, electrical discharge machining, and wire cutting will also be discussed.
Components: Class
Prereqs/Coreqs: P. Undergraduate Manufacturing Processes course (equivalent to ME 3230)

ENGRG 7030 Simulation Modeling of Engineering Systems 3 Credits
This introductory course is applied simulation taught at the graduate level. It is also a system analysis course. Students learn how to analyze systems and how to represent them in the simulation model. Students are expected to bring topics and problems to class and to contribute in significant discussion about the material. This is a hands-on course. Students are taught simulation theory through practice in developing more and more complex models. The course includes a range of simulation styles including: basic manual simulation (rolling dice, random number tables); simple automated simulation (use of general purpose software like BASIC, spreadsheets, macros); traditional simulation (coded programs with tabular results); real time monitoring (graphic displays during simulation); and state-of-the-art object oriented software (including two and three dimensional animation). P. A calculus-based statistics course is required. No prior knowledge of simulation is required, nor is any computer programming experience. Basic familiarity with computing in general is needed (files, folders, basic editing operations, etc.), but nothing advanced. A fundamental understanding of probability and statistics is needed.
Components: Class

ENGRG 7070 Optimization with Engineering Applications 3 Credits
Students will be able to solve a variety of optimization problems using optimization software or the optimization routines available in spreadsheets. Linear, non-linear, and discrete problems will be solved. Students will learn the theory of improving search methods, which are the basis for all optimization algorithms. An emphasis will be placed on the need for the modeler to examine the practicality of program results. Also, students will perform a Life Cycle Analysis, which is an optimization procedure that minimizes the impacts on the environment.
Components: Class

ENGRG 7220 Dynamics of Structures 3 Credits
Dynamic analysis of structures using simplified single-degree-of-freedom models, model analysis and static condensation. Assumptions used in numeric analysis methods will be explored in order to better understand the output from computer analysis. Application of dynamic analysis as implemented in the International Building Code. P. GENENG 2230 - Engineering Mechanics - Dynamics. Recommended: MATH 3230 - Linear Algebra, MATH 3630 - Differential Equations, CIVILENG 3100 - Structural Mechanics (or equivalent for all courses listed).
Components: Class

ENGRG 7260 Advanced Shallow Foundation Design with LRFD Applications 3 Credits
This course is designed to fully prepare a student with only an introductory course in soil mechanics to: analyze the bearing capacity of shallow foundations; to design shallow foundations to meeting bearing capacity and settlement requirements; to design reinforced concrete shallow foundations; and to apply Load and Resistance Factor Design (LRFD) principles to the design and analysis of shallow foundations. P. CIVILENG 3730 - Geotechnical Engineering (or an equivalent course in soil mechanics).
Components: Class

ENGRG 7270 Advanced Deep Foundation Design with LRFD Applications 3 Credits
This course is designed to fully prepare a student with a course in deep foundations to: analyze the bearing capacity of deep foundations; to design deep foundations to meet bearing capacity and settlement requirements; to design reinforced concrete deep foundations (drilled shafts); and to apply Load and Resistance Factor Design (LRFD) principles to the design and analysis of deep foundations.
Components: Class
Prereqs/Coreqs: P. ENGRG 7260

ENGRG 7280 Geosynthetics Engineering 3 Credits
This course is designed to fully prepare a student with only an introductory course in soil mechanics to recognize, design, and analyze the geosynthetic alternatives to traditional civil engineering project features such as: subsurface drainage systems; beddings and filters for erosion control systems; erosion control systems; temporary runoff and sediment control; roadways and pavement systems; embankments on soft foundations; stability of steep slopes; retaining walls and abutments; and landfill final cover and base liner systems. P. CIVILENG 3730 Geotechnical Engineering I (a course in soil mechanics) and CIVILENG 3300 Fluid Mechanics, or equivalents of both of these courses.
Components: Class

ENGRG 7290 Earth Retaining Structures: Design, Analysis and LRFD 3 Credits
This course is designed to fully prepare a student with only an introductory course in soil mechanics to recognize, design, and analyze concrete retaining walls, MSE walls, cantilever and anchored sheetpile walls, braced excavations, and cofferdams using conventional and Load and Resistance Factor Design (LRFD) concepts.
Components: Class
Prereqs/Coreqs: P. CIVILENG 3730 and ENGRG 7280

ENGRG 7310 Control Systems Engineering I 3 Credits
Classical control systems, frequency domain. Laplace transformation and transfer functions of linear electrical, mechanical, and electromechanical systems. Time response and pole-zero analysis. Stability and error analysis of feedback systems. Control systems design via root locus techniques.
Components: Class

ENGRG 7320 Control Systems Engineering II 3 Credits
Classical and modern control systems, frequency and time domain. Design via frequency response techniques. Modeling in state-space. Signal-flow graphs of state equations. Stability and errors in state space. Controllability and observability. Control systems design via state space.
Components: Class
Prereqs/Coreqs: P. ENGRG 7310

ENGRG 7340 Digital Control Systems 3 Credits
Digital Controller Design in time and frequency domain. State space modeling, controllability, observability, stability, minimal realization, pole placement and observer design. P. A BS degree in Engineering, with some background in Automatic Control Area.
Components: Class
Prereqs/Coreqs: P. ENGRG 7310 and ENGRG 7320

ENGRG 7510 Design of Experiments 3 Credits
This course on Design of Experiments (DOE) provides experiences in planning, conducting, and analyzing statistically designed experiments. The methods of DOE may be applied to design or improve products and processes. Analysis of variance (ANOVA), test of hypothesis, confidence interval estimation, response surface methods, and other statistical methods are applied in this course to set values for design, process, or control factors so that one or more responses will be optimized, even when noise factors are present in the system. This course is designed to teach the nuts and bolts of DOE as simply as possible. P. MATH 4030 or ENGRG 6050, or consent of instructor.
Components: Class

ENGRG 7520 Design for Manufacturability 3 Credits
A major portion of the costs and in turn the profitability of manufacturing organizations are affected by the quality of the design of their products. Building quality into the design will call upon engineers to systematically design a product and/or process so that it can be produced with lowest costs, rapid response time, and meet customers' expectations. This will require the integration of design, manufacturing, management, and economic principles. The course will address this overall integration and focus on the design for manufacturing aspects so as to provide faster time to market, productive utilization of equipment, faster delivery, improved quality, reduced cost, and effective continuous improvement. Students will be able to systematically design a product and/or process so that it can be produced with lowest costs, rapid response time, and meet customers' expectations. In doing so, they will be able to identify opportunity for design, address technical considerations of design manufacturing, and make a business decision on feasibility of design.
Components: Class

ENGRG 7530 Design for Usability 3 Credits
This course explores the ergonomic aspects of usability within the product design, work design, and manufacturing or service environment. Ergonomic principles which apply to the design of physical work as well as the tools and products of production will be investigated. The impact of cognitive demands of the user will be investigated for applicability to the design of products and processes. The macroergonomic aspects of the built environment necessary for inclusive design will be discussed with respect to minimize operational error and maximize safety for a wide range of expected users.
Components: Class

ENGRG 7540 Advanced Finite Element Method 3 Credits
Introduces the finite element method. Emphasizes beam and frame analysis, plane strain, axisymmetric, and three-dimensional stress analysis. Includes dynamic analysis and field problems, such as heat transfer. Utilizes readily available finite element computer programs to solve stress analysis, heat transfer, thermal stresses, etc. P. BS in Engineering or related field.
Components: Class

ENGRG 7550 Product Design and Development 3 Credits
This course examines the front end of the product development process. Topics include: organization and management issues associated with the product development process; the identification of customer needs and the translation of these needs into product performance specifications; methodologies for the generation and selection of concepts; developing the product architecture with emphasis on creating interfaces, prototyping and design for manufacturing.
Components: Class

ENGRG 7560 Sustainability in Engineering Design and Manufacturing 3 Credits
This course explores the engineering management systems and design frameworks necessary to understand the interrelated issues of environmental quality, sustainability principles, engineering best practices, and emerging manufacturing technologies.The engineering viewpoint of sustainability starts with the systems engineering life-cycle process and includes the systems design evaluation processes for producibility, maintainability, disposability, and life-cycle costing. Key supporting engineering management processes include trade-off studies and risk-based decision making.
Components: Class

ENGRG 7800 Engineering Management 3 Credits
Introduce the student to fundamental concepts of management and management theories. Discuss timely topics and issues of business ethics including environmental, safety, and product liability. The student will gain an understanding of differences between engineering and management roles with specific application to motivating, and managing technical personnel. The student will develop an understanding and application of the specific tools of engineering management including basic forecasting, planning, scheduling and decision-making models.
Components: Class

ENGRG 7810 Advanced Production and Operations Analysis 3 Credits
Tools and techniques associated with planning and controlling in the production environment including forecasting, aggregate planning, master production scheduling, materials requirement planning, and shop floor control. Integrated aspects of manufacturing resource planning and enterprise resource planning as well as the effects of just-in-time management and theory of constraints.
Components: Class

ENGRG 7820 Quality Engineering and Management 3 Credits
This course provides practical tools for planning and completing quality improvement projects. The first part of the course deals with an introduction to quality management philosophies, tools, and approaches. The second part (about 70%) of the course is devoted to the Six-Sigma (SS) philosophy, roadmap, tools, and techniques of planning and executing quality improvement projects. The course concludes with the application of the Design for Six Sigma (DFSS) approach to design or improve products and processes. P. MATH 4030 or ENGRG 6050, or consent of instructor.
Components: Class

ENGRG 7830 Advanced Cost and Value Analysis 3 Credits
Introduction to the concepts of value within the manufacturing environment. Investigation of various methods of increasing value and defining value are considered. Emphasis is on creating value for the customer through application of sound economic analysis and manufacturing methods improvements. Value Engineering including function analysis. Value Stream Mapping and 5S applications are studied in the context of Lean Manufacturing methods.
Components: Class

ENGRG 7840 Systems Engineering Management 3 Credits
New technologies and time constraints need to meet the challenges of satisfying customer needs such as performance, quality, and over-all cost effectiveness. This sets up a framework for effective system engineering and management of complex systems. The systems engineering effort needs to integrate a wide variety of key design disciplines, apply robust design methods and tools in a manner as to achieve system engineering objectives, assess and control through design reviews, evaluations, feedback and corrective action. The management issues pertaining to the application of systems engineering to various projects is equally important. Principles of System Engineering Management Plan (SEMP), organizational aspects of Systems Engineering such as functional, product line, and matrix structures, and interfaces between the customer, the producer, and suppliers are some key topics that need to be addressed as part of Systems Engineering Management.
Components: Class

ENGRG 7850 Taguchi Method of Designing Experiments 3 Credits
This course will provide experience in applying Taguchi Methods for designing robust products and processes. Taguchi Methods may be considered as "cookbook" approaches to designing and analyzing industrial experiments. Students will learn to plan a project and develop strategies for experiments. Definition of controllable factors, noise factors, responses, and quality characteristics (both dynamic and static) in a project will be discussed. Applications of orthogonal arrays, signal-to-noise ratio, mean-squared deviation, loss function, ANOVA, and related topics will be covered.
Components: Class
Prereqs/Coreqs: P. MATH 4030 or MATH 6030 or ENGRG 6050, or consent of instructor

ENGRG 7860 Continuous Improvement With Lean Principles 3 Credits
Development and applications of lean techniques including an overview of the Toyota Production System. Lean principles including stability, standardization, just-in-time, jidoka and involvement. Examples from manufacturing, service and office settings. Specific techniques which support continuous improvement including five S, standardized work, production leveling, kanban systems, value stream mapping, poka-yoke, and A3 reporting. Methods for creating and sustaining a culture of continuous improvement.
Components: Class

ENGRG 7930 Special Topics in Engineering 1-3 Credits
Various engineering topics will be explored. Topics vary.
Components: Class

ENGRG 7980 Independent Study in Engineering 1-3 Credits
Students registering for independent study must submit, at or before registration, a description and timetable for completion, signed by both the instructor supervising the independent study and the student. The project must be above and beyond the student's traditional employment requirements. This is to be a graduate level experience, conducted with graduate rigor and culminating in a document of professional quality. The maximum allowable Independent Study credits will be four (4) within the Master of Science in Engineering program and a maximum of three (3) may be taken at any one time.
Components: Independent Study