ENGINEERING (EN)

EN 101 Introduction to Engineering 2(2-0)
Fall, Spring.
Introduction to engineering curriculum and careers. Problem solving and creativity. Spreadsheets, word processing and other computer skills.
Prerequisite: None.
Corequisite: None.
Registration Information: None.

EN 103 Problem Solving for Engineers 3(2-2)
Fall, Spring.
Writing computer programs to solve real-world problems in engineering and science.
Prerequisite: MATH 120.
Corequisite: None.
Registration Information: None.

EN 107 Engineering Graphics 2(1-2)
Fall, Spring.
Introduction to the preparation of engineering drawings using freehand sketching and computer graphics software.
Prerequisite: None.
Corequisite: None.
Registration Information: None.

EN 109 Introduction to Sustainability 2(2-0)
Fall.
Interdisciplinary foundation for sustainability including systems theory, humans and the environments, and the social and economic dimensions of sustainability.
Prerequisite: None.
Corequisite: None.
Registration Information: None.

EN 211 Engineering Mechanics I 3(3-0)
Fall.
Introduction to the relationship between forces and moments acting on an object that is in equilibrium (statics).
Prerequisite: MATH 207 and PHYS 221.
Corequisite: None.
Registration Information: None.

EN 212 Engineering Mechanics II 3(3-0)
Spring.
Introduction to the relationship between forces and moments acting on rigid objects and the motion of objects (dynamics).
Prerequisite: EN 211.
Corequisite: None.
Registration Information: None.

EN 215 Introduction to Industrial and Systems Engineering 3(3-0)
Fall.
Engineering viewpoints of the principles of organization for production and the operations applicable to accomplishing organizational responsibilities.
Prerequisite: None.
Corequisite: None.
Registration Information: None.

EN 231 Circuit Analysis I 4(4-0)
Fall.
Circuit concepts, conventions and network equations. Initial conditions and classical methods of obtaining transient and steady-state solutions.
Prerequisite: EN 231L and MATH 207 and PHYS 222.
Corequisite: None.
Registration Information: None.

EN 231L Circuit Analysis I Lab 1(0-2)
Fall.
Observation and analysis of electrical circuits involving resistance, inductance and capacitance.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 231 strongly recommended as corequisite.

EN 232 Circuit Analysis II 4(4-0)
As Needed.
Continuation of EN 231 including waveform synthesis, network theorems, Fourier series, pole-zero diagrams and two-port network theory. Introduction to Laplace transforms.
Prerequisite: EN 231.
Corequisite: None.
Registration Information: None.

EN 260 Basic Electronics 3(3-0)
Spring.
Characteristics, operation, and basic circuits of solid-state devices. Operational amplifiers with typical applications are also introduced.
Prerequisite: EN 231.
Corequisite: None.
Registration Information: None.

EN 263 Electromechanical Devices 3(3-0)
As Needed.
DC and AC motors and generators, transformers, stepper motors, servomotors and various sensors: theory, device characteristics, applications and controls.
Prerequisite: EN 103 and EN 212 and EN 231 and EN 260.
Corequisite: None.
Registration Information: None.

EN 275 Stochastic Systems 4(4-0)
Fall.
Noncalculus probability modeling and statistical analysis of systems containing elements of uncertainty.
Prerequisite: MATH 101.
Corequisite: None.
Registration Information: None.

EN 286 Group Dynamics for Teams 3(3-0)
Spring.
Group Dynamics applied to teams. Team development, basic team processes, conflict management, decision making, leadership, problem solving, and impacts of diversity and culture on teams.
Prerequisite: None.
Corequisite: None.
Registration Information: None.

EN 291 Special Topics (1-5 V)
As Needed.
Selected topics in engineering.
Prerequisite: None.
Corequisite: None.
Registration Information: Repeatable (99).

EN 292 Research (1-6 V)
As Needed.
Research closely supervised by a faculty member with regular meetings.
Prerequisite: None.
Corequisite: None.
Registration Information: Repeatable (99).

EN 295 Independent Study (1-5 V)
As Needed.
Intensive study directed by a faculty member.
Prerequisite: None.
Corequisite: None.
Registration Information: Repeatable (99).

EN 296 Cooperative Education Placement (1-5 V)
Fall, Spring.
Work experience under direction of a field supervisor and a faculty member.
Prerequisite: None.
Corequisite: None.
Registration Information: Freshman or sophomore standing. Repeatable (99).

EN 298 Internship (1-6 V)
As Needed.
Field work in a company or organization, with written reports.
Prerequisite: None.
Corequisite: None.
Registration Information: Repeatable (99).

EN 301 Fluid Mechanics 4(4-0)
As Needed.
Introduction to the relationship between the forces applied to a fluid, the motion of the fluid, and the mechanical properties of the fluid.
Prerequisite: EN 212.
Corequisite: None.
Registration Information: None.

EN 321 Thermodynamics 3(3-0)
Fall.
Introduction to energy equations and flows, entropy, kinetic theory and statistical mechanics, second law of thermodynamics, heat engines and heat transfer.
Prerequisite: PHYS 221.
Corequisite: None.
Registration Information: None.

EN 324 Materials Science and Engineering 3(3-0)
Spring.
Fundamentals of chemical structure and atomic bonding, material properties, deformations under force, stress-strain relationships, selection of materials.
Prerequisite: PHYS 221.
Corequisite: None.
Registration Information: High school chemistry required as prerequisite. EN 324L strongly recommended as corequisite.

EN 324L Materials Science and Engineering Lab 1(0-2)
Spring.
Measurements of material properties and stress-strain relationships.
Prerequisite: EN 211.
Corequisite: None.
Registration Information: EN 324 strongly recommended as corequisite.

EN 343 Engineering Economy 3(3-0)
Fall.
Modeling, analysis and decision making involving time value of money, depreciation, income taxes and replacement analysis.
Prerequisite: MATH 120.
Corequisite: None.
Registration Information: None.

EN 351 Heat Transfer 3(3-0)
As Needed.
Steady and unsteady conduction of heat. Convection heat transfer in boundary layer and duct flows. Forced and free convection. Thermal radiation.
Prerequisite: EN 321.
Corequisite: None.
Registration Information: None.

EN 360 Control Systems I 2(2-0)
As Needed.
Linear analog control systems theory is introduced. Open and closed-loop systems are examined, and performance characteristics are analyzed.
Prerequisite: EN 260 and MATH 337.
Corequisite: None.
Registration Information: EN 360L strongly recommended as corequisite.

EN 360L Control Systems I Lab 1(0-2)
Fall.
Control Systems I Lab.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 360 strongly recommended as corequisite.

EN 361 Digital Electronics 3(3-0)
Spring.
Introduction to digital technology emphasizing practical microprocessors. Number systems and codes, truth tables, Boolean functions, combinational and sequential logic, registers, counters, memory devices & microprocessors.
Prerequisite: EN 260.
Corequisite: None.
Registration Information: EN 361L strongly recommended as corequisite.

EN 361L Digital Electronics Lab 1(0-2)
Spring.
Digital Electronics Lab.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 361 strongly recommended as corequisite.

EN 362 Introduction to Mechatronics 2(2-0)
Fall.
Elements of a mechatronics system: signal conditioning, sensors, actuators, microcontrollers, and software.
Prerequisite: EN 263.
Corequisite: None.
Registration Information: EN 362L strongly recommended as corequisite.

EN 362L Mechatronics Lab 1(0-2)
Fall.
Mechatronics Lab.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 362 strongly recommended as corequisite.

EN 363 Virtual Machine Design 2(2-0)
Spring.
Computer aided design of machines including mechanical components: shaft systems, power transmission, and motion generation.
Prerequisite: EN 324.
Corequisite: None.
Registration Information: EN 363L strongly recommended as corequisite.

EN 363L Virtual Machine Design Lab 1(0-2)
Spring.
Virtual Machine Design Lab.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 363 strongly recommended as corequisite.

EN 375 Stochastic Systems Engineering 3(3-0)
Fall.
Probability modeling and statistical analysis of engineering systems containing elements of uncertainty.
Prerequisite: MATH 126.
Corequisite: None.
Registration Information: None.

EN 405 Advanced Programming 3(3-0)
As Needed.
Crafting efficient computer programs to solve large-scale engineering problems. Object oriented programming, data structures and algorithms, algorithmic complexity analysis.
Prerequisite: EN 103.
Corequisite: None.
Registration Information: May take equivalent of EN 103.

EN 420 Simulation Experiments 4(3-2)
Spring.
Design and statistical analysis of experiments using discrete event simulation models.
Prerequisite: EN 375.
Corequisite: None.
Registration Information: None.

EN 430 Project Planning and Control 3(3-0)
Fall.
Engineering project management including project selection, organization, planning, and budgeting. Project evaluation, tracking and control, and scheduling and resource allocation, including PERT and CPM.
Prerequisite: EN 375.
Corequisite: None.
Registration Information: None.

EN 435 Microprocessor Control Systems 3(2-2)
As Needed.
Components of a microprocessor control system, digital processing, survey of state-of-the-art micro-processor control systems.
Prerequisite: EN 360.
Corequisite: None.
Registration Information: None.

EN 439 Time and Motion Studies 2(1-2)
Fall.
Principles and techniques of methods analysis and work measurement, human performance in human-machine systems.
Prerequisite: EN 215 and EN 375.
Corequisite: None.
Registration Information: None.

EN 440 Safety Engineering 3(3-0)
Spring.
Occupational safety & health in different industrial environments. Theories of accident causation, government regulation, hazards, equipment, & safety administration.
Prerequisite: EN 343 and EN 439.
Corequisite: None.
Registration Information: None.

EN 441 Engineering of Manufacturing Processes 3(3-0)
Spring.
Materials and processes for manufacturing including machining, casting, and forming processes: design, modeling and control.
Prerequisite: EN 212.
Corequisite: None.
Registration Information: EN 441L strongly recommended as corequisite.

EN 441L Engineering & Manufacturing Proc Lab 1(0-2)
Spring.
Engineering & Manufacturing Proc Lab.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 441 strongly recommended as corequisite.

EN 442 Manufacturing Processes II 3(3-0)
As Needed.
Materials and processes for manufacturing including sheet metal forming, welding, machining and advanced manufacturing processes.
Prerequisite: EN 342.
Corequisite: None.
Registration Information: None.

EN 443 Quality Control and Reliability 3(3-0)
Spring.
Principles/methods of quality control/improvement. Quality management: design & implementation, problem solving techniques, quality improvement tools, etc. Statistical quality control: charts, evaluation, sampling, etc.
Prerequisite: EN 275 or EN 375.
Corequisite: None.
Registration Information: None.

EN 460 Control Systems II 2(2-0)
Spring.
Advanced control systems analysis, including microprocessor-based control systems analysis, A/D and D/A converters, Z transforms, and stepper motors.
Prerequisite: EN 360.
Corequisite: None.
Registration Information: EN 460L strongly recommended as corequisite.

EN 460L Control Systems II Lab 1(0-2)
Spring.
Control Systems II Lab.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 460 strongly recommended as corequisite.

EN 462 Industrial Robotics 2(2-0)
Spring.
Basic robotics principles; robot interfacing; robot controls and programming. Laboratory exercises use various robots to meet specific industrial tasks.
Prerequisite: EN 460 and EN 473.
Corequisite: None.
Registration Information: EN 462L strongly recommended as corequisite.

EN 462L Industrial Robotics Lab 1(0-2)
Spring.
Industrial Robotics Lab.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 462 strongly recommended as corequisite.

EN 471 Operations Research 3(3-0)
Fall.
Techniques for analysis and solution of problems in industrial and management systems. Linear programming, duality theory, sensitivity analysis, and network analysis techniques.
Prerequisite: MATH 207 and MATH 224.
Corequisite: None.
Registration Information: None.

EN 473 Computer Integrated Manufacturing 2(2-0)
Fall.
Engineering design, modeling and applications in production: automation, flowlines, robotics, numerical control, and computer usage in manufacturing.
Prerequisite: EN 103 and EN 231 and EN 231L and EN 441 and MATH 207.
Corequisite: None.
Registration Information: EN 473L strongly recommended as corequisite.

EN 473L Computer Integrated Mfg Lab 1(0-2)
Fall.
Computer Integrated Mfg Lab.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 473 strongly recommended as corequisite.

EN 475 Facility Planning and Design 3(3-0)
Fall.
Application of industrial and systems engineering techniques to problems related to an organization's physical resources. Facilities planning and plant layout, material handling, site selection and facilities location.
Prerequisite: EN 439 and EN 471.
Corequisite: None.
Registration Information: None.

EN 477 Operations Planning and Control 3(3-0)
Spring.
Techniques for analysis and management of manufacturing operations and production with emphasis on inventory systems and forecasting.
Prerequisite: EN 471.
Corequisite: None.
Registration Information: None.

EN 486 Senior Seminar 2(2-0)
Fall.
Steps in the engineering design process including creativity, technical analysis, and presentations. Prepare for senior project.
Prerequisite: None.
Corequisite: None.
Registration Information: Permission of instructor.

EN 487 Engineering Design 3(3-0)
Spring.
Application of engineering principles to a design project.
Prerequisite: EN 486.
Corequisite: None.
Registration Information: None.

EN 488 Industrial Engineering Design 3(3-0)
Spring.
Application of engineering principles to a design project.
Prerequisite: EN 486.
Corequisite: None.
Registration Information: None.

EN 489 Senior Capstone in Sustainability 1(1-0)
Spring.
Application of knowledge gained in the sustainability minor to a project in sustainability.
Prerequisite: CHEM 125 and EN 109.
Corequisite: None.
Registration Information: None.

EN 491 Special Topics (1-5 V)
As Needed.
Special Topics.
Prerequisite: None.
Corequisite: None.
Registration Information: Junior standing. Repeatable (99).

EN 492 Research (1-6 V)
As Needed.
Faculty directed research project.
Prerequisite: None.
Corequisite: None.
Registration Information: Junior or senior standing. Repeatable (99).

EN 495 Independent Study (1-5 V)
As Needed.
Independent Study.
Prerequisite: None.
Corequisite: None.
Registration Information: Junior standing. Repeatable (99).

EN 496 Cooperative Education Placement (1-5 V)
Fall, Spring.
Work experience under the direction of a field supervisor and a faculty member.
Prerequisite: None.
Corequisite: None.
Registration Information: Junior or senior standing. Repeatable (99).

EN 498 Internship (1-6 V)
As Needed.
Field work in a company or organization, with written reports.
Prerequisite: None.
Corequisite: None.
Registration Information: Junior or senior standing. Repeatable (99).

EN 503 Ergonomics 3(3-0)
Spring.
Theory/practice of human performance measurement & factors engineering. Study of human sensory/perceptive/mental/psychomotor applied to the design of human-machine systems for performance/effectiveness/productivity/safety.
Prerequisite: EN 540.
Corequisite: None.
Registration Information: None.

EN 504 Scheduling and Sequencing 3(3-0)
Spring.
Theory of deterministic scheduling and sequencing with stochastic extensions. An introduction to the complexity of computations in systems varying from single machine to job shop.
Prerequisite: EN 571.
Corequisite: None.
Registration Information: None.

EN 505 Advanced Programming 3(3-0)
As Needed.
Crafting efficient computer programs to solve large-scale engineering problems. Object oriented programming, data structures and algorithms, algorithmic complexity analysis.
Prerequisite: EN 103.
Corequisite: None.
Registration Information: May take equivalent of EN 103.

EN 507 Virtual Reality 3(3-0)
Fall.
Principles, practical aspects, and applications of virtual reality systems and components such as 3D interfaces, displays (3D, visual, haptic, auditory), position tracking, and virtual environments.
Prerequisite: None.
Corequisite: None.
Registration Information: None.

EN 511 Structural Engineering 3(3-0)
Fall.
Design and analysis of wood, steel and concrete structures in railroad application.
Prerequisite: EN 211 and EN 212.
Corequisite: None.
Registration Information: None.

EN 513 Artificial Intelligence 3(3-0)
Spring.
Topics in artificial intelligence including predicate calculus, search strategies, and machine learning with applications.
Prerequisite: None.
Corequisite: None.
Registration Information: None.

EN 520 Simulation Experiments 4(3-2)
Spring.
Design and statistical analysis of experiments using discrete event simulation models.
Prerequisite: EN 375.
Corequisite: None.
Registration Information: None.

EN 525 Modeling & Simulation 3(3-0)
As Needed.
Analysis and evaluation of real systems by using modern simulation methods such as System Dynamics and Multi-Agent-Based Modeling in engineering and business.
Prerequisite: BSAD 265 or EN 375.
Corequisite: None.
Registration Information: A college course on inferential statistics.

EN 528 Systems Theory & Applications 3(3-0)
As Needed.
A detailed description of different perspectives to analyze and understand the value of the systems perspective in addressing complex systems problems faced by managers in technology-based enterprises.
Prerequisite: MGMT 201.
Corequisite: None.
Registration Information: None.

EN 530 Project Planning and Control 3(3-0)
Spring.
Engineering project management including project selection, organization, planning, and budgeting. Project evaluation, tracking and control, and scheduling and resource allocation, including PERT and CPM.
Prerequisite: None.
Corequisite: None.
Registration Information: None.

EN 531 Railroad Power Systems 3(3-0)
As Needed.
Comprehensive analysis and design of electric power systems for railroads including power supplies, AC/DC and linear motors, third rails, catenaries, and substations/distribution systems.
Prerequisite: EN 231 and EN 231L and EN 263 and EN 360.
Corequisite: None.
Registration Information: None.

EN 539 Time and Motion Studies 2(1-2)
Fall.
Principles and techniques of methods analysis and work measurement, human performance in human-machine systems. Introduction to research in selected topics.
Prerequisite: None.
Corequisite: EN 375.
Registration Information: None.

EN 540 Safety Engineering 3(3-0)
Spring.
Occupational safety and health. Theories of accident causation, governmental regulation, protective equipment, hazard analysis, safety programs design and administration. Introduction to research in selected topics.
Prerequisite: EN 375.
Corequisite: None.
Registration Information: None.

EN 541 Engineering of Manufacturing Processes 3(3-0)
Spring.
Materials and processes for manufacturing including machining, casting, and forming processes: design, modeling and control. Introduction to research in selected topics.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 541L strongly recommended as corequisite. Permission of instructor.

EN 541L Engineering & Manufacturing Proc Lab 1(0-2)
Spring.
Engineering & Manufacturing Proc Lab.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 541 strongly recommended as corequisite.

EN 543 Quality Control and Reliability 3(3-0)
Spring.
Design and implementation of quality programs, quality improvement tools, control charts, process capability evaluation, acceptance sampling procedures. Introduction to research in selected topics.
Prerequisite: EN 275 or EN 375.
Corequisite: None.
Registration Information: None.

EN 544 Advanced Engineering Economics 3(3-0)
Spring.
Advanced topics in engineering economy featuring income tax consideration, treatment of inflation, risk and uncertainty models, cost-effectiveness concepts, and project comparison methods.
Prerequisite: EN 343.
Corequisite: None.
Registration Information: Permission of instructor.

EN 551 Fleet Management 3(3-0)
As Needed.
Fleet management business and economics, risk analysis, information systems, vehicle planning and control, productivity, safety, and environmental compliance.
Prerequisite: EN 343 and EN 375 and EN 471 and EN 530 and EN 577.
Corequisite: None.
Registration Information: None.

EN 552 Vehicle Dynamics 3(3-0)
As Needed.
Fundamental dynamic considerations in designing ground vehicles and vehicle control systems. Rail systems as an example of modeling dynamic systems at various levels of abstraction.
Prerequisite: EN 211 and EN 212 and EN 231 and EN 263.
Corequisite: None.
Registration Information: None.

EN 556 (MATH 556) Design & Analysis of Experiments 3(3-0)
Summer.
Foundations of experimental design, outline efficient methods to implement experiments, develop statistical methods to sort signal from noise, and analyze information derived from the experiment.
Prerequisite: MATH 256 and MATH 356.
Corequisite: None.
Registration Information: None.

EN 560 Control Systems II 2(2-0)
Spring.
Advanced control systems analysis, including microprocessor-based control systems analysis, A/D and D/A convertors, Z transforms, and stepper motors. Introduction to research in selected topics.
Prerequisite: EN 360 and EN 361.
Corequisite: None.
Registration Information: EN 560L strongly recommended as corequisite.

EN 560L Control Systems II Lab 1(0-2)
Spring.
Control Systems II Lab.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 560 strongly recommended as corequisite.

EN 561 Advanced Controls 3(3-0)
Fall.
State-spaced based analysis/design of linear control systems are introduced in both continuous- and discrete-time domains. Nonlinear systems and the linearization method are covered.
Prerequisite: EN 360.
Corequisite: None.
Registration Information: None.

EN 562 Industrial Robotics 2(2-0)
Spring.
Basic robotics principles; robot interfacing; robot controls and programming. Laboratory exercises use various robots to meet specific industrial tasks. Introduction to research in selected topics.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 562L strongly recommended as corequisite. Permission of instructor.

EN 562L Industrial Robotics Lab 1(0-2)
Spring.
Industrial Robotics Lab.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 562 strongly recommended as corequisite.

EN 563 Intelligent Robotics 3(3-0)
Spring.
Theoretical and practical aspects of advanced robotic topics such as trajectory generation, path planning and control, decision logic, advanced sensors, autonomous mobile robots, and humanoids.
Prerequisite: None.
Corequisite: None.
Registration Information: Graduate standing.

EN 565 Stochastic Systems Engineering 3(3-0)
As Needed.
Analysis and design of systems containing elements of uncertainty in demand and performance capability. Time varying measures and approximations are emphasized. Additional work required of graduate students.
Prerequisite: MATH 256 and MATH 356.
Corequisite: None.
Registration Information: None.

EN 571 Operations Research 3(3-0)
Fall.
Techniques for analysis and solution of problems in industrial and management systems. Linear programming, duality theory, sensitivity analysis, and network analysis techniques.
Prerequisite: MATH 224.
Corequisite: None.
Registration Information: Graduate standing.

EN 573 Computer Integrated Manufacturing 2(2-0)
Fall.
Ingineering design, modeling and applications for production automation, flowlines, robotics, numerical control, and computer usage in manufacturing. Introduction to research in selected topics.
Prerequisite: EN 541.
Corequisite: None.
Registration Information: EN 573L strongly recommended as corequisite.

EN 573L Computer Integrated Mfg Lab 1(0-2)
Fall.
Computer Integrated Mfg Lab.
Prerequisite: None.
Corequisite: None.
Registration Information: EN 573 strongly recommended as corequisite.

EN 575 Facilities Planning and Design 3(3-0)
Fall.
Application of industrial and systems engineering techniques to problems related to an organization's physical resources. Facilities planning, plant layout, material handling, site selection and location.
Prerequisite: None.
Corequisite: EN 571.
Registration Information: None.

EN 577 Operations Planning and Control 3(3-0)
Spring.
Techniques for analysis and management of manufacturing operations and production with emphasis on inventory systems and forecasting.
Prerequisite: EN 571.
Corequisite: None.
Registration Information: Permission of instructor.

EN 578 Decision Making under Uncertainty 3(3-0)
As Needed.
A broad introduction to algorithms for decision making under uncertainty covering a wide variety of topics related to decision making, introducing the underlying mathematical problem formulations and their algorithms.
Prerequisites: BSAD 265 or EN 565.
Corequisites: None.
Registration Information: A college course on inferential statistics.

EN 585 Program Capstone 3(3-0)
As Needed.
Program Capstone for students finishing the Master in Engineering Management.
Prerequisite: None.
Corequisite: None.
Registration Information: 12 credit hours (Master in Engineering Management core courses) and graduate standing.

EN 588 Graduate Projects 3(3-0)
As Needed.
Application of graduate industrial engineering principles to a capstone design project.
Prerequisite: EN 520 and EN 571 and EN 575 and EN 577.
Corequisite: None.
Registration Information: Repeatable (99).

EN 590 Special Projects (1-3 V)
As Needed.
Individual project selected, outlined and pursued by student.
Prerequisite: None.
Corequisite: None.
Registration Information: Graduate standing. Approval of advisor. Repeatable (99).

EN 591 Special Topics (1-3 V)
Spring.
Selected topics in industrial and systems engineering. Heuristic design, reliability, industrial ergonomics, multi-criteria decision analysis, analytical facility location and site selection models. Not every topic offered each year.
Prerequisite: None.
Corequisite: None.
Registration Information: Permission of instructor. Repeatable (99).

EN 593 Graduate Seminar 2(2-0)
Fall.
Seminar for students entering the systems engineering program. Philosophical, methodological and ethical issues in systems engineering are discussed.
Prerequisite: None.
Corequisite: None.
Registration Information: Permission of instructor.

EN 595 Independent Study (1-5 V)
As Needed.
Independent Study.
Prerequisite: None.
Corequisite: None.
Registration Information: Graduate standing. Repeatable (99).

EN 598 Internship (1-6 V)
As Needed.
Field work in a company or organization, with written reports.
Prerequisite: None.
Corequisite: None.
Registration Information: Repeatable (99).

EN 599 Thesis Research (1-9 V)
Fall, Spring.
Preparation of thesis to meet degree requirements. Arranged with major advisor.
Prerequisite: None.
Corequisite: None.
Registration Information: Graduate standing. Approval of advisor. Repeatable (6).