

# ENGINEERING TECHNOLOGY (ENT)

## ENT 100 THE AGE OF ENERGY

3, 3/0

Energy needs of society and the drive to use renewable energy sources and more efficient forms of transportation; technological, societal, ethical, and economic impact of societies' energy needs; impact on quality of life issues; hands-on student team projects focusing on solar, wind, hydro; increased efficiency topics such as hybrid/electrical vehicles and house lighting. Offered occasionally.

## ENT 101 TECHNICAL DRAWING

3, 0/0

Survey of projection theory, multi-view projection, spatial relationships, and visualization of point, lines, planes and solids; size and shape description through sketching, and computer-aided drawing; standards and conventions, auxiliary views, revolutions, tolerance, dimensions, geometric tolerances, and pictorials. Offered occasionally.

## ENT 102 INTRODUCTION TO EQUATION-SOLVING SOFTWARE

1, 1/0

Use of current industry-standard computer software programs that allow users to enter and manipulate mathematical equations; perform calculations; and analyze, plot, and document data. These engineering software programs are invaluable tools to technology majors, who combine engineering principles with mathematics to describe physical phenomena. Offered fall only.

## ENT 104 ESSENTIALS OF ELECTRICAL ENGINEERING TECHNOLOGY

3, 2/3

Introduction to the field of Electrical Engineering Technology for majors and non-majors; Introduction to basic electricity, mathematical modeling of circuits, circuit breadboards, electrical instrumentation, computer analysis/circuit simulation and technical reporting. Emphasizes projects, project management and the need for teamwork by conducting projects in the areas of design, simulation and test. Required of all freshmen electrical engineering technology majors. Junior-transfer students will substitute a technical-elective course for ENT104. Offered fall only.

## ENT 202 INTRODUCTION TO ENGINEERING ECONOMICS AND PROJECT MANAGEMENT

1, 1/0

Prepares students to estimate, plan, and manage projects. Provides exposure to techniques to better prepare students for problems seen in industry. Offered fall only.

## ENT 213 COMPUTER METHODS FOR TECHNOLOGISTS

3, 3/0

Co-requisite: MAT 162 or MAT 127. The applications of commercial software for solving technical problems and performing office functions, including entering and manipulating mathematical functions and equations, analyzing and graphing data, performing symbolic and numerical calculations, and scheduling and managing project. Focuses on the analysis and solution of problems in engineering and technology. Offered every semester.

## ENT 221 NANOSCALE SCIENCE, ENGINEERING, AND IMPLICATIONS

3, 3/0

Prerequisites: MAT 162 or MAT 127, PHY 107 or PHY 111, CHE 101 or CHE 111. Overview of the nanoscale world that pervades our lives; fundamental concepts in materials properties and structure; dynamics in the nanoscale that include atomic interactions and energy kinetics; nanoengineering utilized in fabrication and characterization technologies; social implications of nanoscale materials and technology, including ethical, legal, and environmental impacts. Offered occasionally.

## ENT 295 INDEPENDENT PROJECT

1-3, .25/.75

Prerequisite: Instructor permission. Scholarship or creative work conducted under the supervision of a faculty member. Offered Occasionally.

## ENT 300 MATHEMATICS APPLICATIONS IN ENGINEERING TECHNOLOGY

3, 3/0

Prerequisite: MAT 127 or MAT 162. Application of algebra, analytic geometry, calculus and ordinary differential equations to problem solving in engineering technology. Introduction to first and second-order differential equations including methods of Laplace transforms, numerical solutions of ordinary differential equations, eigenvalues, eigenvectors, probability, and partial derivatives. Offered every semester.

## ENT 301 MECHANICS I

3, 2/3

Prerequisites: MAT 126 or MAT 161 and PHY 107 or PHY 111 or equivalent. Basic principles and applications of statics; equilibrium of rigid bodies, freebody diagrams, friction, centroids, moments of inertia, trusses, frames and machines, and equilibrium of particles. Offered every semester.

### ENT 302 MECHANICS II

3, 2/3

Prerequisites: ENT 300 or MAT 315. Principles of dynamics applied to the forces on and motion of rigid bodies and particles; kinematics, kinetics, and energy and momentum methods for both particles and rigid bodies; introduction to mechanical vibration included. Offered every semester.

### ENT 303 KINEMATICS

3, 2/3

Prerequisite: ENT 302. Relative motion of machine parts; graphical and analytical techniques presented for position, velocity and acceleration analysis of linkages, chains, rolling bodies, gears and miscellaneous. Offered spring only.

### ENT 311 THERMODYNAMICS

3, 2/3

Prerequisite: ENT 301. Basic principles of classical thermodynamics and their applications to various engineering technology areas; technical applications of heat-power systems, refrigeration systems, combustion and psychometrics, and HVAC systems. Offered fall only.

### ENT 312 FLUID MECHANICS

3, 2/3

Prerequisite: ENT 311. Introduction to the basic phenomena and principles of fluid flow; fluid properties, fluid statics, conservation of mass, and energy; study of the basic fluid mechanics concepts to the analysis of pipe and duct flow; measurement of fluid properties, pressures, velocities, and forces. Offered spring only.

### ENT 314 SOLID MODELING

3, 2/3

Prerequisites: TEC 101, ENT 301. Three-Dimensional (3D) parts and assembly creation; defining high-level features like cuts and holes in addition to low-level geometry; using parametric modeling; 3D solid modeling; analyzing solid models with finite element technique for stress and heat testing; applying solid models on rapid prototyping machines. Offered every semester.

### ENT 321 ANALYSIS OF MANUFACTURING PROCESSES

3, 2/3

Prerequisites: TEC 201 or ENT 201 and MAT 126 or MAT 161 (or equivalent). Quantitative analysis of materials processing and manufacturing; casting processes; stress-strain relationships; bulk deformation; sheet metal forming; powder metallurgy; machining and joining processes; surface modifications and nontraditional manufacturing processes. Offered occasionally.

### ENT 330 ELECTRICAL CIRCUITS ANALYSIS I

3, 2/3

Corequisite: PHY 108 (or PHY 112). Direct Current (DC) electric circuit concepts; basic circuits elements and their characteristics; analysis of series and parallel circuits; modeling and analysis of DC circuits with multiple sources; electrical instrumentation and computer analysis tools used in performing laboratory experiments. Required for all electrical engineering technology majors. Offered every fall semester.

### ENT 331 ELECTRICAL CIRCUITS AND DEVICES

3, 3/2

Prerequisites: PHY 107 or PHY 111 or equivalent. Introduction to electrical circuit concepts, both DC and AC; analysis of series and parallel circuits; use of superposition theorem to analyze electric circuits with multiple sources; electrical instrumentation and computer analysis tools used in performing laboratory experiments. Required for non-electrical engineering technology majors. Credit is issued for either ENT 331 or ENT 330, but not for both. Offered every semester.

### ENT 332 ELECTRICAL CIRCUITS ANALYSIS II

3, 3/2

Prerequisites: ENT 330 or equivalent. Alternating Current (AC) electric circuit concepts; waveform analysis; analysis of series and parallel AC circuits; electrical instrumentation and computer analysis tools used in performing laboratory experiments. Required for all electrical engineering technology majors. Offered every spring semester.

### ENT 335 INDUSTRIAL ELECTRONICS

3, 2/3

Prerequisite: ENT 331. Essential industrial machines and automation topics, such as discrete and analog process control, switches and sensors, control systems, industrial controls, LabView, programmable logic controllers, and data acquisition. Laboratory exercises provide practical applications of the industrial electronics that engineering technology graduates are likely to encounter. Offered fall only.

### ENT 340 BUILDING INFORMATION MODELING (BIM) USING REVIT MEP

3, 3/2

Prerequisites: ENT332 or ENT331, or instructor permission. Building Information Modeling software facilitates users to design a building and its elements, such as mechanical, electrical, and plumbing (MEP) systems in 3D and involves drawing techniques for 3D parametric solid modeling of MEP systems of buildings, enabling coordination and change management in design documentation extensively used in industry. Offered every spring semester.

### ENT 341 ELECTRONICS

3, 3/2

Prerequisite: ENT 330. Corequisite: ENT 332. Introductory analysis of electronic circuits, with emphasis on semiconductor devices. Offered spring only.

### ENT 342 ADVANCED CIRCUIT ANALYSIS

3, 3/0

Prerequisites: ENT 300 and ENT 332. Signal analysis, circuit parameter, time domain circuit, steady state and transient solution, Laplace transforms and applications, topics in frequency domain, network functions, theorems, sinusoidal steady state analysis from pole-zero plots. Introduction to network synthesis. Offered spring only.

### ENT 345 DIGITAL SYSTEMS

3, 2/3

Corequisite: ENT 341. Digital logic systems are a major part of modern electrical technology including applications in computers, manufacturing and the communication revolution currently taking place. This is an introductory level course required for all Electrical Engineering Technology majors. Offered spring only.

### ENT 346 MICROCONTROLLERS

3, 2/3

Prerequisite: ENT 345 and CIS 151. This course introduces the theory and application of microprocessors and microcontrollers and develops proficiency in programming Assembly and C languages, interfacing, as well as prototyping and troubleshooting. Offered fall only.

### ENT 350 ELECTRICAL CODES AND STANDARDS

3, 3/0

Prerequisites: ENT 332, or ENT 331 or equivalent. Electrical codes and standards are the strict set of rules and represent the established set of standards and practices that must be followed during design, operation and maintenance of electrical installations, what redundancies need to be in place, and what methods and protocols must be followed. Offered occasionally.

### ENT 351 ANALOG CIRCUITS ANALYSIS

3, 2/3

Prerequisites ENT 341 and ENT 342. Analyze, troubleshoot, and design foundational circuits employing operational amplifiers (op amp) and other electronic devices; establish proficiency with electronic circuit computer analysis tools and electronic instrumentation. Required for Electrical Engineering Technology, Electronics majors. Offered every fall semester.

### ENT 360 SMART BUILDINGS AND ENERGY EFFICIENCY

3, 2/3

Prerequisites: ENT 345 or instructor permission. Control techniques of various building systems, including but not limited to heating, ventilation, lighting, elevators, security, and energy management. Energy efficiency along with metering, integration of renewables, distributed generation, computational analytics, and service considerations. Offered occasionally.

### ENT 361 PROGRAMMABLE LOGIC CONTROLLERS (PLCs)

3, 2/3

Prerequisite: ENT 331 or TEC 314 or equivalent. A comprehensive treatment of programmable logic controllers (PLCs). Prior knowledge of PLCs is not required. Familiarity with the DOS or MS Windows operating systems is helpful. The standard PLC programming languages are examined: ladder logic, sequential function charts, function block diagrams, instruction lists, structured text, and high-level languages such as Basic, Pascal and C. Numerous laboratory exercises with four PLC brands give students broad exposure to programming, troubleshooting, networking, and PLC system design and startup. Offered occasionally.

### ENT 365 MANUFACTURING SYSTEMS DESIGN

3, 3/0

Prerequisite: ENT 321. Introduction of product development; production control; requirements and selection of machines/labor; material handling equipment selection; storage and warehousing; computer-aided plant layout; site selection and location; facility location analysis and its impact on manufacturing. Offered occasionally.

### ENT 371 ELECTRIC MACHINES

3, 2/3

Prerequisite: ENT 332. DC and AC machines and transformers are studied as an integral part of electric power systems. Single and three-phase induction and synchronous machines, DC motors and fractional horsepower motors, including stepper motors. Solid-state motor control; computer tools for study of motor performance. Laboratory experiments illustrate motor performance and measurement techniques. Offered fall semester.

### ENT 392 MATERIAL SELECTION AND DESIGN FOR MANUFACTURING

3, 2/3

Prerequisites: ENT 301, ENT 321, and TEC 311. Introduction to materials properties for design of structures and components, design/selection/failure of materials, and selection of ferrous/nonferrous/ceramics and polymeric materials. Offered occasionally.

### ENT 401 STRESS ANALYSIS

3, 2/3

Prerequisites: ENT 300 or MAT 315. Techniques used to predict stress and strain caused by loads or other effects in structural members and machine elements; use of analytical, numerical and experimental methods. Offered fall only.

### ENT 402 SHOCK AND VIBRATION ANALYSIS

3, 2/3

Prerequisites: ENG 302, ENT 401 and junior or senior status. Theoretical, analytical, and experimental methods used in the analysis of shock and vibration in machine elements and structures; free and forced vibration of one and multidegree of freedom systems with introduction to lumped parameter systems and continuous systems; familiarity with instrumentation and experimental techniques developed by performing hands-on laboratory experiments. Offered spring only.

### ENT 404 DESIGN OF AUTOMATED MANUFACTURING SYSTEMS

3, 2/3

Prerequisites: ENT 361 and ENT 392. Design for automation; mechanization of parts handling; automated manufacturing and assembly; numerical control and CAD/CAM; industrial robots and implementation, machine vision, microprocessors, principles of lean manufacturing, computer integrated manufacturing, and automated factory. Offered occasionally.

### ENT 411 HEAT TRANSFER

3, 2/3

Prerequisite: ENT 312. Heat transfer and its application to various engineering technology areas; extension of thermodynamics and fluid flow analysis. Topics include conduction, convection, radiation, and current areas. Offered fall only.

### ENT 414 MANUFACTURING ANALYSIS

3, 3/0

Prerequisite: Upper-division status in ENT or TEC. Analysis of product design and development, economic analysis, break-even analysis, life cycle approach, capacity planning, manufacturing operations economy, allocation of resources, human factors, machines and maintenance, quality control and assurance, measurement of productivity and its effects on manufacturing economics. Offered occasionally.

**ENT 420 PROFESSIONAL EXPERIENCE IN MECHANICAL ENGINEERING TECHNOLOGY**

1, 1/0

Corequisites/Prerequisites: ENT 411, ENT 421, ENT 335. Prerequisites: ENT 401, ENT 331, ENT 311, ENT 312, ENT 301, ENT 302, TEC 311 and TEC 201. Exposure to professional engineering design concepts/methodologies; MET portfolio development and evaluation of MET subject matter necessary for the senior design project; senior design project proposal development. Required for mechanical engineering technology program. Offered fall only.

**ENT 421 MACHINE DESIGN I**

3, 2/3

Prerequisites: ENT 303 and ENT 401. Techniques used to design and specify machine elements, i.e., shafts, springs, fasteners, belts, clutches, brakes, chains, bearings, gears, cams, etc. Offered fall only.

**ENT 422 MACHINE DESIGN II**

3, 2/3; IN23, RE23

Prerequisite: ENT 420. Advanced topics in machine design. Students design a major project involving preliminary analysis, working drawings, fabrication, and testing of a prototype. Required for mechanical engineering technology majors. Offered spring only.

**ENT 433 MICROPROCESSOR APPLICATIONS AND ROBOTICS**

3, 3/2

Prerequisite: ENT 346. Theoretical and practical background of the technology used in the application of microprocessors. Programming hardware, interfacing, and application of microprocessors. The elements of robotics with emphasis on the construction and programming of robots. Offered occasionally.

**ENT 441 COMMUNICATION TRANSMISSION TECHNOLOGY**

3, 2/3

Prerequisite: ENT 332 and senior status. Introduction to the development and technology of digital, RF, microwave and optical fiber communications including transmission line types and characteristics, components, measurement of reflections, power, impedance, and wavelength. Signal structure and protocols used in data communications; computer analysis and design of digital and carrier communication circuits. Offered fall only.

**ENT 442 RF AND MICROWAVE COMMUNICATIONS**

3, 2/3

Prerequisite: ENT 441. Introduction to wireless communication technology. Free-space and near-earth propagation effects, including RF safety, multipath, and antennas are covered. Receiver and transmitter design, components, and performance. Emphasis on digital representation of signals and transmission of digital data, types of modulation and channel capacity; systems and applications. Offered spring only.

**ENT 445 POWER ELECTRONICS**

3, 3/0

Prerequisites: ENT 332, ENT 341 (could be taken as corequisite). The operation of modern, high-power electronic devices as applied to controls, electric machines, and power systems; power diodes, silicon-controlled rectifiers, thyristors, BJTs, MOSFETs, and IGBTs; applications to rectifiers, inverters, controlled rectifiers, AC voltage control, DC step-up and step-down systems, high-voltage DC (HVDC), and flexible AC transmission systems (FACTS); perform laboratory experiments using electrical instrumentation and computer analysis tools; required for smart grid option of electrical engineering technology majors. Offered spring only.

**ENT 446 DIGITAL SYSTEMS DESIGN AND ANALYSIS**

3, 2/3

Prerequisite: ENT 346. Study of Field Programmable Gate Arrays (FPGAs) and their Hardware Description Languages (HDLs), used in connection with advanced industry technologies. This includes exposure to microcontrollers for smart devices, serial communication, and survey of smart sensors. Required for Electrical Engineering Technology, Electronics majors. Offered every spring.

**ENT 452 ANALOG SYSTEMS DESIGN AND ANALYSIS**

3, 2/3

Prerequisites ENT 351. Advanced operational amplifiers (op amp) and linear integrated circuits (IC) applications including analog filters, analog-digital and digital-analog converters, pulse circuits, wave-shaping circuits; analysis of frequency-dependent circuits; sensor interfacing; non-ideal op amp properties; introduction to analog integrated circuit design and printed circuit board (PCB) layout considerations. Required for Electrical Engineering Technology, Electronics majors. Offered every spring semester.

**ENT 461 CONTROL SYSTEMS I**

3, 3/2

Prerequisites: ENT 341, ENT 342, and senior status. Applies frequency domain techniques to open-loop and closed-loop systems with emphasis on stability and performance. Classical methods of control engineering are presented: Laplace transforms and transfer functions, root locus analysis, Routh-Hurwitz stability analysis, steady-state error for standard test signals, and second-order system approximations. MATLAB is introduced and utilized extensively for computer-aided analysis. Laboratory exercises provide practical application of the control-system theory. Offered fall only.

**ENT 462 CONTROL SYSTEMS II**

3, 2/3

Prerequisite: ENT 461. Corequisite: ENT 466. Project centered. Students build, tune, simulate, and model a system (such as a magnetic levitation apparatus) for the purpose of demonstrating skills acquired during previous academic work. Project focuses on practical application of the control-system theory developed in Control Systems I. Offered spring only.

**ENT 465 ELECTRICAL DESIGN I**

3, 2/3; IN23, RE23

Co-requisite: ENT 461 and Instructor permission. Advanced topics in electrical and system design, the design process, and project management; a major design project sequence that includes preliminary analysis, working drawings and schematics; preliminary design and its presentation. Offered fall only.



### ENT 466 ELECTRICAL DESIGN II

3, 2/3

Prerequisite ENT465. Corequisite: ENT462. Advanced topics in electrical and system design, the design process, and application of project management; a major design project sequence that culminates with final analysis, working drawings, schematics, and installation or prototype; final design stages of construction, testing and installation of a significant engineering project. Offered every spring semester.

### ENT 471 POWER SYSTEMS I

3, 2/3

Prerequisites: ENT 332 Electric Circuits and senior standing. Basic elements of power systems. Energy sources. Balanced three-phase circuits. Power factor correction. Voltage regulation. Transmission line modeling. Per-unit system. Balanced fault analysis. Load flow analysis using numerical methods. Electric power distribution economics. Offered fall only.

### ENT 472 POWER SYSTEMS II

3, 2/3

Prerequisites: ENT 471 Power Systems I. Calculate electric demand of a power system. Solve line faults using symmetrical components. Use equal area criterion to solve simple stability problems. System protection. Electromechanical and numeric relays and their applications. Voltage quality and reliability. Design of a power distribution system for industrial facility. Offered spring only.

### ENT 473 PLANNING AND OPERATION OF ELECTRIC VEHICLES IN SMART GRID

3, 3/0

Prerequisite: ENT 471 or instructor's permission. This course introduces and explains the latest advancements in the planning and operation of electric vehicles (EV) in smart grid from local electric distribution company's, electric generation company's, and EV aggregator's point of views. The problems such as charging station sizing, charging station placement, and EV's charging management are studied considering the technical specifications of EVs. Offered occasionally.

### ENT 481 RENEWABLE DISTRIBUTED GENERATION AND STORAGE

3, 2/3

Prerequisites: ENT 331 Electric Circuits or equivalent or ENT 332 or instructor's permission. This course introduces renewable and efficient electric power systems. It encourages self-teaching by providing numerous practical examples requiring quantitative analysis. Topics include historical, regulatory, and utility industry perspectives of the electric system as well as most of the electricity, thermodynamics, and engineering economics background needed to understand new power technologies. Offered every spring semester.

### ENT 482 SMART GRID FROM SYSTEMS PERSPECTIVE

3, 2/1

Prerequisites: ENT 331 or equivalent, and ENT 471 or instructor's permission. A comprehensive understanding of smart grid is needed for stakeholders to enable them to develop systems prospective of Smart Grid and its technologies, increase modeling of Smart Grid from multiple perspectives, to increase economic understanding and decision making around current and future technologies, to understand the role of policy and politics in the advancement of Smart Grid over time, to understand how to educate others in Smart Grid, and to understand basic subsystems of the Smart Grid. Offered occasionally.

### ENT 491 OPERATIONS AND MANAGEMENT OF MODERN GRID

3, 3/0

Prerequisites: Senior status or instructor's permission. This course introduces and explains operations of electric utilities including generation, transmission, distribution, and consumption of electric power, defines system operations and their drivers; discusses impact of deregulation and impact of smart grid technologies on systems operations; introduces concepts of business of system operations, and discusses various management systems used by modern utilities. Offered occasionally.

### ENT 495 SPECIAL PROJECT

1-3, 0/0

Offered spring only.

### ENT 497 WORKSHOP

1-3, 0/0

Offered occasionally.

### ENT 499 INDEPENDENT STUDY

3-12, 0/0

Offered every semester.

### ENT 581 RENEWABLE DISTRIBUTED GENERATION AND STORAGE

3, 2/1

Prerequisites: ENT 331 Electric Circuits or equivalent, and ENT 671 Power Systems Analysis I or equivalent, or instructor's permission. This course introduces renewable and efficient electric power systems. It encourages self-teaching by providing numerous practical examples requiring quantitative analysis. Topics include historical, regulatory, and utility industry perspectives of the electric system as well as most of the electricity, thermodynamics, and engineering economics background needed to understand new power technologies.

### ENT 582 SMART GRID FROM SYSTEMS PERSPECTIVE

3, 2/1

Prerequisites: ENT 331 Electric Circuits or equivalent, and ENT 671 Power Systems Analysis or equivalent, or instructor's permission. A comprehensive understanding of smart grid is needed for stakeholders to enable them to develop systems prospective of Smart Grid and its technologies, increase modeling of Smart Grid from multiple perspectives, to increase economic understanding and decision making around current and future technologies, to integrate the role of policy and politics in the advancement of Smart Grid over time, to understand how to educate others in Smart Grid, and to analyze basic subsystems of the Smart Grid.

### ENT 590 INDEPENDENT STUDY

1-3, 0/0

### ENT 591 OPERATIONS AND MANAGEMENT OF MODERN GRID

3, 3/0

Prerequisites: Instructor's permission. This course introduces and explains operations of electric utilities including generation, transmission, distribution, and consumption of electric power, defines system operations and their drivers; discusses impact of deregulation and impact of smart grid technologies on systems operations; introduces concepts of business of system operations, and discusses various management systems used by modern utilities.

ENT 622 MACHINE LEARNING FOR MATERIALS  
SCIENCE IN CLEAN ENERGY

3, 3/0

Prerequisite: ENT 621 or instructor permission. Cover broad guidelines and best practices regarding obtaining and treatment of data in materials science and device physics related directly to Clean Energy. Feature engineering, model training, validation, evaluation and comparison. Include interactive Jupyter notebooks with example Python code to demonstrate important concepts, workflows, and best practices in the field. Offered every spring.

ENT 671 POWER SYSTEMS ANALYSIS I

3, 2/3

Prerequisites: Undergraduate degree in engineering, engineering technology, or related field. Basic elements of power systems. Energy sources. Balanced three-phase circuits. Power factor correction. Voltage regulation. Transmission line modeling. Per-unit system. Balanced fault analysis. Load flow analysis using numerical methods. Electric power distribution economics.

ENT 672 POWER SYSTEMS ANALYSIS II

3, 2/3

Prerequisites: ENT 671 Power Systems Analysis I. Calculate electric demand of a power system. Solve line faults using symmetrical components. Use equal area criterion to solve simple stability problems. System protection. Electromechanical and numeric relays and their applications. Voltage quality and reliability. Design of a power distribution system for industrial facility.