Mechanical Engineering Technology - CPS (MET)

MET 1990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

MET 2000. Engineering Computer-Aided Design and Tolerance Analysis. 3 Hours.
Covers design topics relative to the creation, modification, analysis, and optimization of engineering components and assemblies with extensive use of selected computer-aided design software (CAD). Concentrates on the use of contemporary parametric and/or explicit CAD modeling, management of associative relationships between geometries, and digital prototyping. Studies the role of CAD in product development and product life-cycle management. Involves extensive hands-on practice using commands and featured capabilities of the selected CAD software and completion of individual or team design projects. Projects focus primarily on mechanical systems design. Emphasizes accurate dimensioning, symbol interpretation, and accurate tolerancing of digital designs. Also includes introductory topics of graphical analysis of mechanical stress of elements and assemblies.

MET 2020. Computer Solid Modeling and Virtual Simulation. 3 Hours.
Offers students an opportunity to use computer-aided design tools to perfect, optimize, and simulate functioning of digital engineering designs. Concentrates on 3D solid modeling, structural and thermal graphical analysis, and virtual simulation of digital elements and assemblies. Applies featured capabilities of selected modern CAD software to a host of different mechanical engineering applications, and investigates optimization of designs through virtual experimentation and testing of design parameters including durability, cost, static and dynamic response, assembly motion, and graphical analysis of mechanical stresses. Requires completion and presentation of advanced and comprehensive individual or team-based CAD projects. .

MET 2040. Engineering Manufacturing Process. 3 Hours.
Introduces technologic and economic aspects of engineering that require application of physical and chemical processes to alter properties, geometry, and appearance of a given starting material and transform it into parts, devices, or products. Discusses typical engineering materials used in manufacturing and shaping; metal forming and sheet metal working; machining operations; and joining, molding, and assembling processes such as welding, brazing, and fastening. Introduces fundamental principles of rapid prototyping and advanced manufacturing including numerical control 2, lithography, and product inspection and quality. This is an introductory course. Involves demonstrations of manufacturing processes in the lab and development of small manufacturing projects with opportunities for students to learn the characteristics and use of typical manufacturing machinery such as welders, lathes, milling machines, and CNC equipment.

MET 2100. Mechanics 1: Statics. 3 Hours.
Introduces the fundamental concepts and principles needed to analyze the mechanical equilibrium of engineering systems. Topics include Newton's fundamental laws, systems of units, vector operations, forces, mechanical equilibrium of particles and rigid bodies, moments of forces, moments of couples, free-body diagrams, 2D and 3D equilibrium of bodies, centers of gravity, centroids, concentrated and distributed loads, analysis of mechanical structures, dry friction, moments of areas and inertia, and an introduction to the concepts and definitions of mechanical work and potential energy. .

MET 2200. Mechanics 2: Dynamics. 3 Hours.
Expands and uses the underlying principles and concepts of Newtonian mechanics to study, analyze, and solve problems relative to mechanical systems in motion. Explores approaches to analyze motion both neglecting and considering the cause of motion and their relationship to the design of engineering systems. Discusses subjects pertaining to the study of kinematics and dynamics of particles and rigid bodies in detail. Topics include linear, curvilinear, and rotational motion of particles and rigid bodies, as well as conservation principles and concepts and inherent definitions for the analysis and design of dynamic systems such as velocity, acceleration, linear and angular momentum, impulse, forces, work, kinetic and potential energy, total mechanical energy, and power. .

MET 2990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

MET 3100. Engineering Stress Analysis. 3 Hours.
Covers theoretical principles and methods for analyzing and quantifying mechanical stresses in members and systems subjected to loads. Studies the effects of axial, transversal, and torsional loads, such as elongation, deflection, twisting, buckling, and rupture. Allowable loads and mechanical properties of engineering materials are concatenated to the concept and the prediction of mechanical failure. Covers normal, shear, bearing, and torsional stresses and strains, as well as methods to design mechanical elements by examining their condition of load and the ability of materials to withstand stresses. Concentrates on stresses within the elastic region of mechanical behavior, and includes factors of safety, thermal stresses, geometric concentration of stresses, combined stresses, and theories of failure.

MET 3101. Lab for MET 3100. 2 Hours.
Accompanies MET 3100. Relates the concepts, theoretical principles, and problem-solving techniques to real-life conditions via experimental activity performed in a lab. A variety of elements, components, and systems are subjected to tensile, compressive, torsional, and bending loads in order to quantify the strength of the materials involved and identify and characterize the associated types of failure experimentally. Seeks to reinforce comprehension of theoretical concepts imparted in the lectures about stress, strain, and parameters associated with mechanical failure.

MET 3200. Fluid Mechanics. 3 Hours.
Studies underlying concepts, principles, and definitions relative to the behavior of fluids at rest and in motion. Covers physical properties of fluids, distribution of force and static pressure on walls containing fluids, and buoyancy and stability in submerged or floating bodies in static fluids. Studies principles, definitions, and characterization of fluid flow, the effect of moving flows in submerged bodies, and foundations of aerodynamics. Discusses approaches to solving engineering problems involving fluids in motion and applicability of principles of fluid flow in analysis, design, and/or selection of common engineering devices and systems.

MET 3201. Lab for MET 3200. 2 Hours.
Accompanies MET 3200. Relates concepts, theoretical principles, and problem-solving techniques in real-life conditions via experimental activity performed in the lab. Investigates physical properties of fluids; absolute and manometric pressures; flow velocity; flow rate; flow velocity profiles; pump performance; energy losses in pipe lines and fittings; and the use of widespread instruments such as nozzles, orifice plates, and venture tubes to measure fluid flow parameters.

MET 3300. Engineering Materials Science. 3 Hours.
Studies the foundation of physical and chemical characteristics, properties, behavior, and selection. Discusses the influence of fabrication and treatment methods on the characteristics of typical materials used in engineering applications including metals, ceramics, polymers, and composites. Topics include crystalline and noncrystalline structures, lattices, point defects, and dislocations. Also covers mechanical, thermophysical, and electrochemical characteristics of materials such as hardness, mass diffusion, and electroplating, as well as ferrous and nonferrous metal alloys, the structure and properties of ceramics, fundamentals of polymer science and technology, and synthetic and laminar composites.

MET 3301. Lab for MET 3300. 2 Hours.
Accompanies MET 3300. Experimental activities include sample preparation, microstructure analysis, cooling arches, binary phase diagrams, and experimental determination of thermophysical properties. Experimental themes include optical microscopy, heat treatment of engineering materials, hardening and hardness testing of materials, equilibrium phase diagrams, recrystallization and grain growth, and X-diffraction analysis. Uses modern techniques for materials characterization and relates them to engineering design of hardware.

MET 3400. Engineering Thermodynamics. 3 Hours.
Studies energy interactions among systems and their effect on the physical properties of the systems. Covers the zeroth, first, second, and third laws of thermodynamics in detail and their association with the concepts; definitions; and use of heat, work, mechanical energy, internal energy, enthalpy, and entropy in the analysis, design, and operation of engineering systems and devices commonly used to convert energy and deliver or consume power. Covers the evaluation and interpretation of thermodynamic properties of pure substances and ideal gases via thermodynamic tables, equations of state, or contemporary software. Examines thermodynamic principles behind the functioning and performance of familiar engineering devices such as gas and steam turbines, internal combustion engines, heat exchangers, pumps, compressors, refrigerators, and heat pumps.

MET 3401. Lab for MET 3400. 2 Hours.
Accompanies MET 3400. Experimental activity includes observation, investigation, and quantification of thermodynamic properties of pure substances, boundary work, isothermal compression of gases, energy balances in steady-flow devices such as heat exchangers and throttling devices, thermal efficiencies of heat engines, and coefficients of performance of heat pumps or refrigeration units.

MET 3500. Theory of Engineering Measurements and Data Analysis. 3 Hours.
Covers fundamental theory of engineering measurements as an integral part of the design, control, and operation of advanced engineering systems. This is a multidisciplinary course that uses concepts and principles from various subjects of the curriculum, such as calculus, differential equations, solid and fluid mechanics, stress analysis, electricity, thermodynamics, and heat transfer. Studies characteristics of measurement systems and the theory of underlying phenomena behind the operation of instruments designed to sense and furnish magnitudes of physical quantities. Also covers in detail statistical concepts and techniques to collect and analyze experimental data. Topics include theory of error and uncertainty, statistical confidence and hypothesis testing, standards of measure, dynamic response of measuring systems, transfer functions, signal conditioning, digitizing, and fundamentals of computerized data acquisition.

MET 3501. Lab for MET 3500. 2 Hours.
Accompanies MET 3500. Covers proper design and planning of engineering experimentation; correct characterization and use of instruments to measure typical engineering variables; and application of statistical concepts to collect, analyze, and validate experimental data. Emphasizes the need for reliable measurements in design and control of engineering systems.

MET 3600. Heat Transfer Engineering. 3 Hours.
Studies the concepts, principles, and mathematical and numerical procedures of analysis in the modes of heat transfer—conduction, convection, and radiation. The study of conduction includes 1D and 2D steady-state heat transfer in solids and transient analysis of lumped parameter systems. The study of convection covers heat transfer in internal and external fluid flows and the application of concepts and techniques for analysis and design of heat exchangers such as the LMTD and the NTU methods. Topics of radiation include irradiation, radiosity, spectral distribution, and radiation exchange between black and gray surfaces. Emphasizes use of mathematical and numerical techniques for problem solving in order to apply heat transfer theory to practical analysis and design of advanced engineering systems.

MET 3601. Lab for MET 3600. 2 Hours.
Accompanies MET 3600. Experimental activities involve observation and investigation of the conduction, convection, and radiation mechanisms and experimental quantification of rates of heat transfer. Concentrates particularly on experimental quantification of performance and effectiveness of heat exchangers and the influence of the geometric characteristics of components and thermophysical properties of materials used to manufacture them.

MET 3990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

MET 4100. Mechanical Engineering Systems Design. 3 Hours.
Covers the fundamental principles of mechanical design including details of the engineering design process, design factors, creativity, optimization, safety, and value engineering. Discusses properties and selection of common engineering materials used in design and manufacturing of mechanical components and machines. Focuses on analysis and design of typical machine elements that operate under mechanical loads and stresses, including shafts, gears, bearings, belt and chain drives, clutches, brakes, fasteners, springs, torsion bars, power screws, linear actuators, and joints. Integrates computer usage for efficient and rapid design, formulae evaluation, mathematical simulation, design selection and optimization, and virtual prototyping. Discusses additional elements of engineering design such as cost analysis, robustness, quality improvement, and environmental concerns. .

MET 4200. Thermal Engineering Systems. 4 Hours.
Covers the fundamentals and techniques for design of thermofluids systems and components, including details of the engineering design process, design factors, creativity, optimization, safety, and value engineering. Applies concepts and principles of analysis learned in thermodynamics, heat transfer, fluid mechanics, and basic electricity to design thermal hardware such as heat and mass exchangers, turbines, expanders, compressors, pumps, boilers, and engines that are typically used in industries such as power generation; electric and gas utilities; refrigeration; air-conditioning; heating; and in the food, chemical, and process industries. Integrates computer usage for efficient and rapid design, formula evaluation, mathematical simulation, design selection and optimization, and virtual prototyping. Additional topics include cost analysis, robustness, quality improvement, and environmental considerations of thermal engineering design.

MET 4300. Alternative and Renewable Energy Technology. 3 Hours.
Explores the principles and current technological status of conventional and nonconventional alternative, but not necessarily renewable, energy conversion systems and strictly renewable energy conversion systems for power generation. Discusses the world's energy usage and the current and projected fractions satisfied by alternative and renewable systems in comparison to fossil fuel power-generation systems. Studies in-depth the concept of exergy, the quantification of exergy destruction, and the thermodynamic maximum power that can be extracted from a natural resource with emphasis on renewable resources. Covers fundamental analysis and design of alternative conventional systems, such as hydroelectric and nuclear power plants, as well as renewable energy conversion systems, including wind turbines, solar thermodynamic plants, solar photovoltaic units, and geothermal power plants. .

MET 4310. Power Plant Engineering and Technology. 3 Hours.
Studies conventional engineering systems for power generation within the frame of the world's ever-increasing demand for electricity, current and projected consumption of natural energy resources, and environmental impact. Concentrates on principles of operation and thermodynamic analyses of thermomechanical systems for power generation, including steam power plants, gas turbine and combined-cycle power plants, and diesel and gasoline-engine power generation. Also covers cogeneration, emission control, and heat recovery. Introduces basic analysis of combustion processes and carbon sequestration technologies to reduce pollution and secure long-term sustainable use of fossil fuels. Offers students an opportunity to gain the technical knowledge and skills to better manage the energy, design energy-efficient systems, and reduce environmental impact. .

MET 4320. Lean and Green Manufacturing and Rapid Prototyping Technology. 3 Hours.
Covers definition and principles of lean, Six Sigma fundamentals and their application to manufacturing engineering products. Studies contemporary models of product design and development, including integrated product and process design and concurrent engineering, as well as techniques for reduction of lead and cycle time and waste elimination. Covers stages, tools, and techniques of lean implementation in the manufacturing process, including enterprise value stream mapping and analysis, five-S, SMED, Kanban, process wastes, cellular manufacturing, pull systems, performance metric, LESAT, and capacity and queuing. Studies rapid prototyping and manufacturing techniques. Requires students to complete and document hands-on simulations of lean manufacturing via small projects involving actual manufacturing of mechanical elements and assemblies using techniques and laboratory equipment for rapid prototyping.

MET 4330. Nanotechnology and Nanomaterials Manufacturing. 3 Hours.
Introduces the definitions and primary characteristics of nanoscale science and technology maintaining an engineering approach and focusing on study of the properties, classification, and commercially viable techniques to manufacture nanomaterials. Includes the study of one-, two-, and three-dimensional nanoscale materials, including thin films, graphene, surface coatings, nanowires, nanotubes, nanoparticles, and nanocrystals. Discusses general and specific areas of applicability of nanomaterials in engineering devices and processes, such as in the food, energy, graphene-based, space, cosmetics, OLEDs, OLETs, medicine, environment, and construction industries. Examines existing common and widespread manufacturing methods for carbon nanotubes, thin films, and nanoparticles.

MET 4340. Biomaterial and Biomechanical Manufacturing Technology. 3 Hours.
Offers an overview of types and properties of metals, polymers, and ceramics used to interact with biological systems and in medical devices. Studies biocompatibility and selection techniques and factors of biomaterials within expected scales of applicability. Covers various interaction phenomena, surface properties, materials behavior, and tissue response to biomaterials. The remaining portion of this course builds upon students' knowledge and practice of the principles of mechanics (statics and dynamics) and structural analysis and applies those principles to study musculoskeletal mechanics, kinesiology, ergonomics, implant medicine, sports, and injury and medical rehabilitation, which set the basis for design and manufacturing of mechanical implants and prosthetics.

MET 4350. Biotransport Processes Technology. 3 Hours.
Introduces biotransport engineering. Building on students' knowledge and practice in fluid mechanics, heat transfer, and biology, explores applications in key technologies dealing with protein adsorption to biomaterials, blood flow in arteries, receptor-ligand binding on a cell surface, oxygen delivery to tissues, and hemodialysis. Reviews energy transport principles and introduces basic concepts of mass transport and their relationship to medical technologies, including kidney dialysis engineering, bioassays, and oxygen therapy technology.

MET 4360. Biomedical Sensing and Instrumentation. 3 Hours.
Covers the theory and design characteristics of instrumentation used in measuring typical/major physiological parameters and variables such as bioelectric potential, cardiovascular, respiratory, thermal, and physical movement measurements. Builds upon the knowledge and practice on foundations of measurements and analysis acquired earlier by students and concentrates on the study of characteristics of biologic signals, typical transducers to measure them, and instrumentation for patient monitoring. Discusses noninvasive diagnostic medical instrumentation, including underlying principles of thermography, ultrasound, and polygraphy, as well as the basic principles of biotelemetry, X-ray instrumentation, and instrumentation for clinical tests and analysis with an emphasis in blood cells tests.

MET 4410. Modern HVAC Technology and Design. 3 Hours.
Explores the basic engineering concepts, principles, and procedures needed to design and select and/or integrate the elements and components of heating, ventilating, and air-conditioning systems. Topics include calculation of heating and cooling loads, ventilation needs as per standards, and recommended practices by ASHRAE. Covers principles of psychrometry and thermodynamic processes with moist air in order to condition it for human comfort and/or industrial processes. Studies the basic thermodynamic processes, working substances, and thermodynamic processes and cycles behind equipment commonly used to heat, cool, and ventilate environments, including the standard vapor-compression cycle and the absorption cycle. Includes basic principles of automatic control and techniques for energy conservation in HVAC systems. Discusses simplified procedures for planning and designing HVAC systems. .

MET 4420. Industrial Automation and Control. 3 Hours.
Analyzes feedback control systems under both transient and steady-state conditions. Examines utilization of signal flow graphs and Laplace transforms in the formulation of block diagrams and transfer functions for use in control system modeling. Reviews the basic components and performance characteristics and types of feedback control systems—including PC, PIC, PID, and PD controllers—and tuning parameters. Discusses cascade control; ratio, override, and selective control strategies; and control system stability. Introduces basic concepts on programmable logic controllers (PLC) and its associated I/O elements, as well as relay ladder logic (RLL). Presents an overview of common protocols for industrial control systems and process automation.

MET 4430. Modern Vehicle Engine Technologies and Design. 3 Hours.
Imparts the science and technology of electric vehicles (EV) and hybrid electric vehicles (HEV). Covers the mechanics, power, and propulsion of vehicles for terrestrial transportation. Discusses fundamentals and design of batteries, fuel cells, and DC machines; three-phase AC machines; induction machines; regenerative braking; permanent magnet machines; and switched reluctance machines. Studies electric drive components, the EV transmission configuration, and EV motor sizing. Requires students to complete a design project relative to EV and/or HEV design.

MET 4440. Hydrogen and Fuel Cell Technology. 3 Hours.
Studies the underlying thermodynamics and electrochemical principles of energy conversion through fuel cells, including oxidation, free energy, and standard potential of the cell. Examines hydrogen production means and costs; the thermodynamics of the water-splitting reaction; the electrolysis process; and the characteristics, advantages, and challenges of the main current electrolysis technologies. Covers fuel cell systems, elements, performance characteristics, polarization, and voltage output. Studies regenerative fuel cells and dissociation and discusses classification of fuel cells and its applicability in engineering devices. Emphasizes the study of hydrogen fuel cells with respect to technological innovations and applications in transportation vehicles, biomedicine, and industrial and domestic power generation. Discusses present trends, forecasts, and impact of this technology in areas of energy generation, conservation, and the environment. .

MET 4450. ISO Industrial Standards and Certifications. 3 Hours.
Starts with an in-depth discussion about benefits, need for, and importance of standards in the engineering discipline. Provides an overview of the ISO 9000 family of standards with special focus on the ISO 9001 standard: the set of requirements established by the International Organization for Standardization to secure reliability, safety, and quality of engineering services and manufactured products and the base for audit and certification of the organization. Includes detailed study of the ISO 50001 standard: the requirements that address energy management and continuous improvement in energy use and consumption within the organization. Uses case studies to illustrate principles. Development of a simulated audit to confirm ISO 9001 compliance of a local company is part of this course.

MET 4950. Seminar. 1-4 Hours.
Offers an in-depth study of selected topics.

MET 4955. Project. 1-4 Hours.
Focuses on in-depth project in which a student conducts research or produces a product related to the student's major field. May be repeated without limit.

MET 4983. Topics. 1-4 Hours.
Covers special topics in mechanical engineering technology. May be repeated without limit.

MET 4990. Elective. 1-4 Hours.
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

MET 4991. Research. 1-4 Hours.
Offers students an opportunity to conduct research under faculty supervision.

MET 4992. Directed Study. 1-4 Hours.
Offers independent work under the direction of members of the department on a chosen topic.

MET 4993. Independent Study. 1-4 Hours.
Offers independent work under the direction of members of the department on a chosen topic.

MET 4994. Internship. 1-4 Hours.
Provides students with an opportunity for internship work.

MET 4995. Practicum. 1-4 Hours.
Provides eligible students with an opportunity for practical experience.

MET 4996. Experiential Education Directed Study. 1-4 Hours.
Draws upon the student's approved experiential activity and integrates it with study in the academic major.