The B.Sc. Degree of Mechatronics Engineering Program

Courses Description

Core Courses

MTE 2101 Engineering Mechanics 4 (4,1,0)

Statics: Introduction to Statics: Basic Concepts, Scalars and Vectors, Newton's Laws, Units, Law of Gravitation. Two-Dimensional Force Systems: Rectangular Components, Moment, Couple, Resultants. Three-Dimensional Force Systems: Rectangular Components, Moment and Couple, Resultants. Equilibrium in Two Dimensions, System Isolation and the Free-Body Diagram, Equilibrium Conditions. Equilibrium in Three Dimensions: Equilibrium Conditions. Structures: Frames and Machines. Friction: Types of Friction, Dry Friction, Distributed Forces: Centers of Mass and Centroids of Figures and Composite Bodies.

Particle Dynamics: Kinematics of Particles: Rectilinear Motion, Plane Curvilinear Motion, Rectangular Coordinates (X-Y), Normal and Tangential Coordinates (N-T), Polar Coordinates (R-θ), Relative Motion, Constrained Motion of Connected Particles. Kinetics of Particles: Force, Mass, And Acceleration: Newton's Second Law, Equation of Motion, Rectilinear Motion, Curvilinear Motion, Work and Energy: Work and Kinetic Energy, Potential Energy. Impulse and Momentum: Linear Impulse and Linear Momentum, Angular Impulse and Angular Momentum.

Prerequisite: PHYS 1040, MATH 1060, MTE 1070

Corequisite: None

Textbooks: J.L. Meriam and L.G. Kraige "Engineering Mechanics, Statics, SI version", John Wiley & Sons, Inc., Latest Edition.

J.L. Meriam and L.G. Kraige "Engineering Mechanics, Dynamics, SI version", John Wiley & Sons, Inc., Latest Edition.

F. P. Beer and E. Russel Johnston "Vector Mechanics for Engineers, Statics and dynamics" McGraw Hill, Latest Edition.

MTE 2050 Engineering Statistics 3 (2,1,1)

This course is designed to enable students to analyze the concepts of the presentation and analysis of data, measures of central tendency, measures of dispersion, probability theory, discrete and continuous statistical distributions, sampling methods, testing hypotheses, goodness of fit tests, correlation coefficients, and regression analysis.

Prerequisite: MATH 1060

Corequisite: None

Textbooks: Applied Statistics and Probability for Engineers by D. C. Montgomery and G. C. Runger, (Last Edition) John Wiley & Sons, Inc.

MTE 2111 Materials Engineering 3 (2,1,1)

Introduction to materials engineering. Types and properties of materials (metallic, polymeric, ceramic, and composites), Internal structure of materials. Solidification of metals and crystalline imperfections, Diffusion in solids, Mechanical properties of materials, Equilibrium-phase diagrams. Heat treatment of ferrous and non-ferrous metals. Corrosion of metals and protection. Introduction to smart materials used for actuation and sensing in mechatronics systems such as elastomer, IPMC, SMA, Piezoelectric.

Lab: Metallographic preparation of samples and optical microscopy investigation, tensile and compression tests, Impact test, hardness test, bending test, torsion test, fatigue test, heat treatment of materials.

Prerequisite: PHYS 1040, CHEM 1010

Corequisite: None

Textbooks: William F. Smith, Principals of Materials Science and Engineering, McGraw HILL, Sixth Edition

W.D. Callister, “Materials Science and Engineering - An Introduction", John Wiley, Latest Edition.

Donald R. Askeland, The Science and Engineering of Materials” Latest edition

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MTE 2121 Rigid body Dynamics 2 (2,1,0)

Area and Mass Moments of Inertia. Plane Kinematics of Rigid Bodies: Rotation, Relative Velocity, Relative Acceleration, Motion Relative to Rotating Axes. Plane Kinetics of Rigid Bodies: Force, Mass, and Acceleration: General Equations of Motion, Translation, Fixed-Axis Rotation, General Plane Motion. Work and Energy: Work-Energy Relations, Acceleration from Work-Energy, Virtual Work. Impulse and Momentum: Impulse-Momentum Equations.

Prerequisite: MTE 2101

Corequisite: None

Textbooks: J.L. Meriam and L.G. Kraige "Engineering Mechanics, Dynamics, SI version", John Wiley & Sons, Inc., Latest Edition.

F. P. Beer and E. Russel Johnston "Vector Mechanics for Engineers, dynamics" McGraw Hill, Latest Edition.

MTE 2131 Manufacturing Processes 3 (2,1,1)

Introduction and overview of manufacturing. Metal Casting Fundamentals & Processes. Fundamentals of metal forming. Bulk Metal Forming Processes. Sheet Metal Forming Processes. Theory of Metal Machining. Machining Processes. Manufacturing process planning. Welding Processes. Rapid-Prototyping. Introduction to Advanced Machining Processes.

Lab covers Workshop metrology. Sand Casting process. Metal forming processes: Rolling, Forging, Bending, and shearing. Welding processes: Gas welding, Arc welding, Brazing and Soldering. Machining processes (turning, boring, drilling, tapping, milling, and gear manufacturing).

Prerequisite: MTE 2111

Corequisite: None

Textbooks: Mikell P. Groover, “Fundamentals of Modern Manufacturing”, Prentice-Hall, last Edition.

Serope kalpakjian and S. Schmid, “Manufacturing Engineering and Technology”, Prentice-Hall, 6th Edition.

MTE 2141 Thermo-Fluids 4 (3,1,1)

Basic concepts and definitions - closed and open system - property and state - procedures and cycles - first law of thermodynamics - application of the first law to procedures - The second law of thermodynamics - Carnot's cycle - analyzing and signing the cycle on the axes (temperature - entropy) and (pressure - volume) and calculating the efficiency of the cycle and applications for each of:, Otto cycle, diesel cycle, Brayton cycle, Air refrigeration cycle – Vapor compression refrigeration cycle.

Fundamentals of fluid mechanics - Fluid statics - Fluid kinematics - Fluid dynamics - Applications to the kinematics equation (Bernoulli's equation) - Real fluid flow in pipes - Fluid machines - Definitions of fluid machines - Pumps - Centrifugal pumps - Axial pumps - Fans - Compressors - turbines.

Methods of heat transfer (conduction - convection - radiation) - fins and extended surfaces - principles of convection - flow Inside pipes - heat exchangers (classification - performance - effectiveness - performance coefficients) - heat transfer applications

Lab: Multistage reciprocating air compressor performance test. Measuring performance of the refrigeration cycle. Gas turbine performance measurement. Simulation of thermodynamic cycles. Visualization of real flow around streamlined and bluff bodies. Pipe flow. Velocity distribution. Pressure drop and friction factor. Flow measurements. Heat conduction in solid, thermal conductivities of metals. Free and forced convection.

Prerequisite: PHYS 1040

Corequisite: None

Textbooks: R.W. Fox, and A.T. McDonalds, "Introduction to Fluid Mechanics", John Wiley and Sons, Last Edition.

M.J. Moran and H.N. Shapiro, "Fundamentals of Engineering Thermodynamics", Wiley, Last Edition.

F. Incropera and D. Dewitt, J. "Fundamentals of Heat and Mass Transfer", Wiley & Sons, Last Edition

B. Munson, D. Young and T. Okiishi, "Fundamentals of Fluid Mechanics", J. Wiley, Last Edition.

Y.A. Cengel and M.A. Boles, "Thermodynamics - An Engineering Approach", McGraw Hill, Last Edition

F. Kreith and M. Bohn, "Principles of Heat Transfer", Pub. West, Last Edition.

MTE 2201 Electric Circuits 3 (2,1,1)

Circuits variables and circuit elements. Circuit simplification techniques. Techniques of circuit analysis. The natural and step response of RL and RC circuits. Natural and step responses of RLC circuits. Sinusoidal steady-state analysis. Introduction to the Laplace Transform. The Laplace Transform in circuit analysis.

Lab: General introduction to the laboratory, the experiments include voltage, current, and power in DC circuits using KVL and KCL. Superposition, Thevenin's, and maximum power transfer theorems in DC circuits; series and parallel AC circuits. resonance in series and parallel circuit; maximum power transfer theorem and power factor improvement in AC circuits; transients in DC circuits; magnetically-coupled circuits. Three phase circuits.

Prerequisite: None

Corequisite: None

Textbooks: James W. Nilsson, Susan A. Riedel, “Electric Circuits”, Pearson; 11th edition.

Boylestad, "Introductory Circuit Analysis", Prentice Hall, Last Edition

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MTE 2301 Programming for Mechatronics Eng. 2 (1,1,1)

Revision of C/C++; Python: Basics, Program flow, Function and Modules, Handling of Exception and file, Classes, GUI; MATLAB: M-file, Simulink; Introduction to Java and Hardware Description Languages (HDLs).

Lab

Python (Syntax, Semantics and create Functions; Handle Strings and Files; Object Oriented Programming concepts; Network and Database Programming).

MATLAB (Mathematical Function Library, Graphics, Application Program Interface, SIMULINK)

Prerequisite: GEU 1090

Corequisite: None

Textbooks: Introduction to MATLAB, Etter, D.M., Kuncicky, D.C. and Hull, D.W., 2002. Hoboken, NJ, USA: Prentice Hall.

An introduction to Python, Drake, F.L. ed., 2003. Bristol: Network Theory Ltd..

Object-oriented programming for engineering software development, Fenves, G.L., 1990. Engineering with computers, 6, pp.1-15.

MTE 2401 Computer Aided Drawing 3 (1,0,2)

Introduction to engineering drawings and technical communications, Introduction to CAD tools, standard sheets, standard layout elements.

Orthographic projection, Isometric sketching, Dimensioning, Sectional and auxiliary views, Intersections, and Developed views using CAD tools.

Modeling for Manufacture and Assembly: Assembly models, Constraint-Based Assemblies, Parent Part, Introduction to Computer-Integrated Manufacturing

Electric and Electronic diagrams

Lab: CAD sketching, coordinates for 3D CAD modeling, geometric entities, sketch constraints, the base feature editing the model, constraint-based modeling modes, orthographic projection and 2D drawing representation, section views, Electric and electronic diagrams.

Prerequisite: None

Corequisite: None

Textbooks: E. G. Frederick, S. Lockhart, M. Goodman, C. M. Johnson " Technical Drawing with Engineering Graphics", Pearson Prentice Hall (2016)

C.H. Simons and E.E. Maguire, "A Manual of Engineering Drawing Practice", Hodder and Stoughton, (2010).

MTE 3111 Mechanics of Machinery 3 (2,1,1)

Introduction, Graphical position, velocity, and acceleration analysis of mechanisms, Analytical linkage analysis, Profile cam design, Gear trains, Static and dynamic force analysis of mechanisms, Flywheels, Balancing of rotating and reciprocating masses, Gyroscopes.

Lab: 2D- mechanisms, Flywheels. Cam mechanisms, Mass moment of inertia, Simple and epicyclic gear trains. Rolling and sliding contacts, static and dynamic balancing.

Prerequisite: MTE 2121

Corequisite: None

Textbooks: K. J. Waldron and G. L. Kinzel "Kinematics, Dynamics, and Design of Machinery" John Wiley, latest edition.

J. E. Shigly and J. J. Uicker “Theory of Machines and Mechanisms” McGraw-Hill, Latest edition.

H. H. Mabie” Mechanisms and Dynamics of Machinery” John Wiley, Latest edition.

MTE 3121 Mechanical Design I 3 (3,1,0)

Stress: Equilibrium of a Deformable Body Stress, Average Normal Stress in an Axially Loaded Bar, Average Shear Stress,

Strain: Deformation and Strain,

Axial Load: Saint-Venant’s Principle, Elastic Deformation of an Axially Loaded Member, Principle of Superposition, Statically Indeterminate Axially Loaded Members, Thermal Stress,

Torsion: Torsional Deformation of a Circular Shaft, The Torsion Formula, Angle of Twist,

Bending: Shear and Moment Diagrams, Bending Deformation of a Straight Member, The Flexure Formula, Stress Transformation: Plane-Stress Transformation, General Equations of Plane-Stress Transformation, Principal Stresses and Maximum In-Plane Shear Stress, Mohr's Circle—Plane Stress, Absolute Maximum Shear Stress,

Stress Analysis: Allowable Stress Design, Limit State Design, Stress Concentration.

Prerequisite: MTE2111

Corequisite: None

Textbooks: R.C. Hibbeler "Mechanics of Materials", 8th edition, Prentice Hall, 2008.

R. Budynas, K. Nisbett - Shigley's Mechanical Engineering Design-McGraw-Hill Education (2019).

MTE 3201 Electromecahnical Energy Conversion 3 (2,1,1)

Magnetic circuits, single phase transformers, three phase transformers, electromechanical energy conversion principles, rotating magnetic field, torque production, synchronous machines, induction motors, DC machines, steady state operating characteristics, speed control.

Lab: Lab Safety Measures and Guidelines, Three Phase and Two Wattmeters Method, Magnetic Circuits Characteristics, Equivalent Circuit and Performance Evaluation of Single-Phase Transformer, Three Phase Transformers, DC Generator Characteristics, DC Motor Characteristics, Determination of Parameters of Three Phase Synchronous Generators and Equivalent Circuit, Performance, and Torque-Speed Characteristics of 3-phase Induction Motors.

Prerequisite: MTE 2201

Corequisite: None

Textbooks: Stephen Chapman, "Electric Machinery Fundamentals", McGraw Hill, Latest Edition.

Mulukutla S. Sarma, “Electric Machines: Steady State Theory and Dynamics Performance”, West Publishing Co., Latest Edition.

MTE 3211 Electronic Circuits 3 (2,1,1)

Analog electronics components: diodes, switching, MOSFET, Filters, optocoupler, safety circuit like Zener diode or fuse etc. The performance of single, differential, and multistage amplifiers. The cascade configuration, current mirror and active loads. A detailed study of operational amplifier circuits. Transistor frequency response analysis. Feedback circuit configurations and oscillators. A detailed study of stability and compensation for multistage and operational amplifiers. Introduction to common circuit blocks; A/D (analog-to-digital) converters, D/A (digital-to-analog) converters, and phase-locked loops.

Lab: Simulation Analysis using SPICE and Multisim, BJT Differential Amplifier, Frequency Response of the Common Source Amplifier, Frequency Response of Multistage Amplifier (CE-CC), Frequency response of op amp-based amplifiers, Applying Negative Feedback on Amplifiers and Rectifiers, Various types of first-order active filters and their applications, Second-order active filters, Sinusoidal Oscillators, and Signal Generators.

Prerequisite: MTE 2201

Corequisite: None

Textbooks: Robert L. Boylestad, Louis Nashelsky, Electronic Devices and circuit Theory, 11/E Pearson, 2012.

Adel S. Sedra, Kenneth C. Smith Robert, Microelectronic Circuits, International 6th Edition, Oxford University Press, 2012.

MTE 3221 Signals and Systems 2 (2,1,0)

Continuous-time and discrete-time signals and systems. Linear time-invariant (LTI) systems: system properties, convolution sum and the convolution integral representation, system properties, LTI systems described by differential and difference equations. Fourier series: Representation of periodic continuous-time and discrete-time signals and filtering. Continuous time Fourier transform and its properties: Time and frequency shifting, conjugation, differentiation and integration, scaling, convolution, and the Parseval`s relation. Representation of aperiodic signals and the Discrete-time Fourier transform. Properties of the discrete-time Fourier transform.

Prerequisite: MTE 2201

Corequisite: None

Textbooks: Alan Oppenheim, Alan Willsky, S. Nawab, "Signals and Systems", Prentice-Hall, Last Edition

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MTE 3231 Digital Electronics and Microcontroller Application 3 (2,1,1)

Number systems, logic gates, Boolean algebra. Karnaugh maps, and combinational logic design. Implementation of combinational logic circuits. combinational logic circuits design and analysis; synchronous sequential logic; flip flops; analysis of clocked sequential circuits. Basics of Microprocessors and 8051 Microcontroller. Microprocessors 8086 structure and operation, I/O, and interfacing and interrupts. Microcontroller 8051 Instruction Set and programming. 8051 Memory, device Interfacing and Application. Field Programmable Gate Arrays (FPGA). Sequential logic and state machines. Microprocessor and Microcontroller structure and operation, I/O, and interfacing and interrupts. Assembly language programming. Laboratory work includes Microprocessor programming.

Prerequisite: MTE 3211

Corequisite: None

Textbooks: Moris, "Digital Design", Prentice Hall, Last Edition.

Sunil Mathur and Jeebananda Panda, Microprocessors and Microcontrollers, Last Edition.

MTE 3241 Electric Drives and Power Electronics 3 (2,1,1)

Power Switches (SCRs, Diacs, Triacs and IGBT) and Triggering Devices (UJT and PUT). Operational Amplifiers, Instrumentation Amplifier, Comparator, and Op amp Applications. Timers and Oscillators. Industrial Rectifier Circuits and applications. Power Inverters and DC-To-DC Converters. Analysis, design and control of power electronic converters, principles of operation and control of DC and special-purpose motors (such as BLDC, Servo, Stepper and electrical drives such as solenoid. It is useful to cover new of motor such as piezo and ultrasonic etc.), power electronics-based control of DC and special-purpose motors.

Lab: Lab Safety and Introduction to Lab Equipment, Instrumentation Amplifier, 555 Timer Industrial Applications, SCR and UJT Simulation, Light Dimmers and Motor Speed Control, UJT and SCR Relaxation and Sinusoidal Oscillators, Voltage Regulators, DC-DC Converters. MATLAB simulation applied to half-wave rectifiers, Three-phase bridge rectifier, Single-phase controlled bridge rectifier, Three-phase controlled bridge rectifier, Single-phase AC voltage controller, DC-DC converters, Buck/Boost Converters, Single-phase voltage source inverter, and Three-phase voltage source inverter.

Prerequisite: MTE 3211

Corequisite: None

Textbooks: Daniel W. Hart, "Power Electronics", Prentice Hall, Last Edition.

R. Krishnan, "Electric Motor Drives - Modeling, Analysis and Control", Prentice Hall, Last Edition.

Mohan, “Power Electronics Converters, Applications, and Design”, Last Edition.

MTE 3251 Automatic Control Systems 4 (3,1,1)

Introduction to control: open-loop and closed loop control. Modeling: transfer function, block diagram, signal flow graph, state equations. Feedback control system characteristics: sensitivity, disturbance rejection, steady-state error. Performance specifications: second-order system, dominant roots, steady-state error of feedback systems. Stability: Routh-Hurwitz criterion, relative stability. The root-locus method, Bode diagram, Nyquist stability criterion, gain margin and phase margin, Nichols characteristics. Lead and lag compensator design. Proportional, integral, and derivative control design.

Lab: Introduction to the computer aided design package MATLAB & Lab Safety Measures and Guidelines, Introduction to SIMULINK and simulation of a speed control system, Servo Trainer: Familiarization,

Experimental Determination of the servo-trainer DC Motor Model, Model-based Investigation of the Effect of Tuning Parameters on a Servo Motor Response and Mode Transition, Speed Control Servo with Proportional + Integral Control, Servo Motor Position Control Using Position and Speed feedback, Position Control Servo-system Error Cancellation Using Proportional-Integral (PI) Controllers and Effect of lead and lag RC circuits on the performance of Servo-motor.

Prerequisite: MTE 3221, MTE 3401

Corequisite: None

Textbooks: Dorf and R. Bishop, “Modern Control Systems", Addison-Wesley, Last Edition.

MTE 3401 System Dynamics and Vibration 4 (4,1,0)

Introduction, Laplace transform. Modeling of mechanical, electrical, electromechanical, fluid, and thermal systems. Transfer functions, Analogies, State-space approach, Linearization of nonlinear systems. Vibration of single degree of freedom systems (free, damped, forced), Vibration isolation, Vibration of two degree of freedom systems (free, forced), Vibration absorber, Vibration of multi-degree of freedom systems (free, forced), Vibration Control, Vibration Measurement, and applications.

Prerequisite: MTE 2040, MTE 2121, MTE 2301

Corequisite: None

Textbooks: K. Ogata, "System Dynamics", Prentice Hall, Latest Edition.

S.S. Rao, "Mechanical Vibrations", Addison Wesley, Latest Edition.

A. Shabana, “Theory of Vibration” Springer; Latest Edition.

W.T. Thomson, "Theory of Vibration with Applications", Prentice Hall, Latest Edition.

MTE 4301 Embedded Systems 3 (2,1,1)

Introduction to Embedded Systems: History, Classification and Purpose of Embedded Systems; The Embedded System Design Process-Requirements; Applications of Embedded Systems.

Typical Embedded System: Core of the Embedded System-General Purpose and Domain Specific Processors, Asics, PLDs, COTs; MEMORY, Memory Selection for Embedded Systems, Sensors, Actuators, I/O Components: Seven Segment, LED, LCD Relay, Piezo Buzzer, Push Button Switch, Other Sub-Systems: Reset Circuit, Brownout Protection Circuit, Oscillator Circuit Real Time Clock, Watch Dog Timer; ADC, DAC, Data Acquisition and Control.

Communication Interface: Onboard Communication Interfaces (I2C, SPI, CAN, Parallel Interface); External Communication Interfaces (RS232 and Rs485, USB, Infrared, Bluetooth, Wi-Fi, Zigbee, GPRs, GSM)

Embedded Firmware Design and Development: Embedded Firmware Design Approaches and Embedded Firmware Development Languages.

Selected Microcontroller Based Embedded System Design: PIC, Arm, 8051, AVR, MSP, Arduino.

LAB: Introduction to the available microcontrollers; Interface with switch, motor, DAC, ADC; Display with 7-segment, LED, LCD; Interrupt performance characteristic of ARM and FPGA; Control of DC motor, Stepper motor, servo motor; Using sensors; Inter-Integrated Circuit (I2C) communication.

Prerequisite: MTE 3231

Corequisite: None

Textbooks: Introduction to Embedded Systems - shibu k v, Mc Graw Hill Education.

Computers as Components –Wayne Wolf, Morgan Kaufmann (second edition)

Embedded System Design -frank vahid, tony grivargis, john Wiley.

Embedded Systems- An integrated approach - Lyla b das, Pearson education 2012.

MTE 4401 Sensors & Industrial Instrumentation 3 (2,1,1)

Introduction: Definition and types of sensors, principles of operation of sensors, industrial instrumentation, design and selection of sensors. Sensors general characteristics: measurement errors, sensitivity, time delay, static and dynamic characteristics. Signal conditioning. Typical instrumentation system. Sensors and transducers: Thermal sensors, mechanical sensors and optical sensors (proximity sensor, accelerometer, IR sensor, resistive transducers, inductive transducers, capacitive transducers, piezoelectric transducer, optical transducers, digital transducers, etc.). Pulse code modulation formats. Calibration. Grounding, shielding, and noise reduction. Elements of data acquisition system.

Lab covers practical tasks where the students will use different types of sensors, understand their principles of functioning and process the output data and using related software.

Prerequisite: MTE 3231

Corequisite: None

Textbooks: William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, McGraw-Hill, Last Edition.

William C. Dunn Introduction to Instrumentation, Sensors, and Process Control, Artech House, Inc. Last Edition.

David and Buchla and Wayne McLachlan, "Applied Electronics Instrumentations and Measurements", Prentice Hall, Last Edition.

MTE 4111 Computer Integrated Manufacturing 3 (2,1,1)

Introduction to CAD/CAM, 2D and 3D geometric graphics, the basics of CAM, the basics of Numerical Control, programming of CNC machines Types of CIM, applications of CIM systems, importance of CIM systems, and components of CIM systems Role of CNC machines on CIM systems. Concept and configuration of industrial robots in production lines Automated handling system. Introduction to Computer-Aided Process Planning, Designing, and Development of CAPP Systems Study of variant and generative CAPP and implementation for sample parts Basics of Group Technology, Cellular Manufacturing Systems (CMS), and Flexible Manufacturing Systems (FMS) .

Lab: Using CAD/CAM software for turning and milling operations, generating G code, and simulating the process, manufacturing real products using CNC lathes and milling machines, programming industrial robots, and using them in CIM systems.

Prerequisite: MTE 2131

Corequisite: None

Textbooks: Chang, T.C., Wysk, R.A. & Wang, H.P., "Computer Integrated Manufacturing", Prentice Hall, Last Edition.

Mikell P. Groover "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson, Last Edition

Automation, Production Systems and CIM/Groover M.P./PHI/2007

MTE 4101 Mechanical Design (2) 3 (2,1,1)

Mechanical engineering design Process: The design process, The life of a product, The Product Design Specification (PDS), Concept design - idea generation, Concept selection, The Quality function deployment (QFD) method.

Failures Resulting from Static Loading: Failure Theory (Maximum Normal stress theory), Maximum Shear stress Theory, Von Mises Theory,

Screws, Fasteners, and the Design of Nonpermanent Joints: Thread standard and Definition, Tension Loaded Bolted Joints, Bolt joint stiffness, Member stiffness, Bolted and Riveted Joints Loaded in Shear,

Welding, Bonding, and the Design of Permanent Joints: Welding Symbols, Butt and Fillet Welds, Stresses in Welded Joints in Bending, The Strength of Welded Joints,

Shafts: Shaft Materials, Shaft Layout, Shaft Design for Stress, Deflection Considerations,

Rolling-Contact Bearings, Bearing Types, Bearing Life, Bearing, Selection of Ball and Cylindrical Roller Bearings, Selection of Tapered Roller Bearings, Design Assessment for Selected Rolling-Contact Bearings, Mounting and Enclosure,

Gears: Power Transmission, Types of Gear.

Lab: The lab is organized as a project-like activity where the students have to work on a mechanical design that includes different mechanical elements like gears, brakes, bearings, etc, and using a CAD software.

Prerequisite: MTE 3121 MTE 3111

Corequisite: None

Textbooks: R. Budynas, K. Nisbett - Shigley's Mechanical Engineering Design-McGraw-Hill Education (2019).

R.C. Hibbeler "Mechanics of Materials", 8th edition, Prentice Hall, 2008.

Kenneth S. Hurst, Engineering Design Principles, Elsevier Editions.

David G. Ullman, "The Mechanical Design Process", Fourth Edition, McGraw-Hill.

MTE 3301 Artificial Intelligence 2 (2,1,0)

Differentiate between classical and advanced intelligent control system approaches. Explain the basics of most artificial intelligence methods, aspects of neural networks (construction, types, training, applications), and fuzzy logic (fuzzification, defuzzification, inference systems, memberships, applications). Integrate mechatronic systems applications utilizing artificial neural networks and fuzzy logic control techniques. Introduction to Machine Learning, Supervised and Unsupervised Learning, and Machine Learning Algorithms basics of design learning. Applications of artificial intelligence in mechatronics systems.

Prerequisite: MTE 2301

Corequisite: None

Textbooks: S. Russell and P. Norvig, Artificial Intelligence: a modern approach, Prentice Hall, 4 th edition, 2020.

Mikell P. Groover "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson, Last Edition

Robin R Murphy, Introduction to AI Robotics PHI Publication, last edition

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MTE 4411 Robotics 4 (3,1,1)

Introduction to robotics. classification and characteristics of robots. Spatial description and transformation. Robot arm kinematics (direct kinematics and inverse kinematics problem). Differential kinematics (Jacobean Analysis) and statics. Dynamics of robot manipulators (Lagrange formulation and Newton Euler Formulation). Trajectory planning and motion control of robot manipulators. Actuators and sensors used in robotic systems.

The lab includes experiments that illustrate robot components, direct and reverse kinematics of robots, robot programming, robot control.

Prerequisite: MTE 3401

Corequisite: None

Textbooks: John J. Craig "Introduction to Robotics: Mechanics and Control", Prentice Hall, Latest Edition.

Lung-Wen Tsai, "Robot Analysis", John Wiley & Sons, Latest Edition.

L. Sciavicco and B. Sicilliano, "Modeling and Control of Robot Manipulators", Springer-Verlag London Limited, Latest Edition.

K. S. Fu, R. C. Gonzalez, and C. S. G. Lee, "Robotics: Control, Sensing, Vision, and Intelligence", McGraw Hill, Latest Edition.

MTE 4431 Industrial Automation 3 (2,1,1)

Introduction to factory automation. Industrial automation applications. Actuator types. Design Pneumatic and electro-pneumatic systems. Design Hydraulic and electro-hydraulic systems. Control of DC, AC motors, stepper and servo motors. Introduction to Programmable Logic Controller (PLC). PLC programming) PLC timer counter, registers, digital and analog input outputs). Protocols of industrial communication. Communication between HMI with PLC.

Lab: Design and installation of Pneumatic and electro-pneumatic systems. Design and installation of hydraulic and electro-hydraulic systems, PLC programming and industrial communication.

Prerequisite: MTE 3241

Corequisite: None

Textbooks: Masoud Soroush, Michael Baldea, Thomas F. Edgar, “Smart Manufacturing": Concepts and Methods", Last Edition

Smart Manufacturing: Integrating Transformational Technologies for Competitiveness and Sustainability. Shemwell, S.M. and Quazi, H.A., CRC press

Automation, Production Systems and CIM/Groover M.P./PHI/2007

MTE 4980 Senior Design Project (1) 3 (1,0,2)

In graduation project (1) students learn how to choose a topic in mechatronics, establish a project plan, and conduct a literature review of the engineering design problem including the problem definition and the existing challenges, and then propose a solution, utilizing recent scientific research papers and well-established books. They prepare for/or preliminary conducting the experiments. Students collect the field data and develop the mathematical/computer model if applicable. They write a final report with a minimum of two chapters, and they may include any preliminary findings.

Prerequisite: Passing Successfully 132 Credit Hours

Corequisite: None

Textbooks: Will be identified according to the topics selected.

MTE 4990 Senior Design Project (2) 3 (1,0,2)

Senior Design Project II is the continuation of the Senior Design Project I. Students work on the solution of the design problem, experiment data, and survey outcomes including running and finalizing the experimental program or the mathematical/computer model, analyzing the results and findings, and drawing the conclusion. Students are encouraged to make a workable prototype and write a program using simulation software and/or mathematical modeling of the engineering design problem. The output and the results obtained are then documented and submitted in the form of a scientific project report and a poster. Finally, students present and defend their project in front of an examination committee.

Prerequisite: MTE 4980

Corequisite: None

Textbooks: Will be identified according to the topics selected.

MTE 4930 Seminars in Mechatronic Engineering 1 (0,0,1)

This seminar course focuses on topics related to emerging research areas or specific new interest in the field of Mechatronic Engineering. Experts from the fields can contribute to this course as guest lecturers. The course may include field trips, and career development workshops. Each seminar section will include an active learning element such as group projects, class discussions, writing reports, and/or presentation. The specific course topic associated with academic study, chosen by the course instructor, will vary by section and semester and will be indicated at the beginning of the course.

Prerequisite: None

Corequisite: None

Textbooks: Will be identified according to the topics selected.

MTE 9990 Practical Training 1 (8 weeks)

A continuous period of 8 weeks spent in the industry working in any of the fields of Mechatronic engineering. During this training period, the student is exposed to the profession of Mechatronic engineering through working in many of its fields. The student is required to submit, and present, a formal written report of his work.

Prerequisite: Passing Successfully 112 Credits

Corequisite: None

Textbooks: Will be identified according to the topics selected.

Elective Courses

MTE 4351 Robotics Programming: Robotic Operating System (ROS) for Robotic Applications 3 (3,1, 0)

Introduction. ROS architecture: Master, nodes, topics, messages, services, parameters, and actions. Console commands: Navigating and analyzing the ROS system and the catkin workspace. Creating ROS packages: Structure, launch-files, and best practices. ROS C++ client library (roscpp): Creating your own ROS C++ programs. Simulating with ROS: Gazebo simulator, robot models (URDF) and simulation environments (SDF). Working with visualizations (RViz) and user interface tools (rqt). Inside ROS: TF transformation system, time, bags.

Introduction to ROS2. Creation of ROS2 packages. Management of the new Colcon universal building system. Topic Publishers and subscribers in ROS2 C++. New Launch system based on python. Service servers and client generation for ROS2. Usage of executors and callback groups to manage multithreading in ROS2. Use of Debugging tools in ROS2.

Prerequisite: MTE 4411

Corequisite: None

Textbooks: Lentin Joseph, Jonathan Cacace, " Mastering ROS for Robotics Programming", Packt Publishing, Latest Edition.

Francisco Martín Rico, " A Concise Introduction to Robot Programming with ROS2", Chapman and Hall/CRC, Latest Edition.

MTE 4461 Soft Robotics 3 (3,1,0)

Introduction to soft robotics: definitions and applications; materials for soft robotics (fundamentals of mechanics of polymers) thermoplastics and textiles Advanced materials; shape memory material. Localized compliance and bending. Soft actuation (design, modeling, manufacturing, and characterization) ; soft electronics and soft sensing; Bioinspiration robots. Variable Stiffness mechanisms; design and control of soft robots. Soft robotics manufacturing.

Prerequisite: MTE 4411

Corequisite: None

Textbooks: Koichi Suzumori, Kenjiro Fukuda, Ryuma Niiyama, Kohei Nakajima ,"The Science of Soft Robots Design, Materials and Information Processing",Springer , Last Edition

Gareth J. Monkman,"Soft Robotics", Bentham , Last Edition

MTE 4471 Biomedical Equipment 3 (3,1,0)

The human body: An overview. The heart and circulatory system. Introduction to biomedical instrumentation & measurement. Bioelectric amplifiers. Electrocardiographs. Physiological pressure and other cardiovascular measurements and devices. The human respiratory system and its measurement. Respiratory therapy equipment. The human nervous system. Instrumentation for measuring brain function. Intensive and coronary care units. Operating rooms. Medical laboratory instrumentation. Medical ultrasonography. Electrosurgery generators. Care and feeding of battery-operated medical equipment. Waveform display devices. Electro-optics (Fiber Optics and Lasers). Computers in biomedical equipment. Radiology and nuclear medicine equipment. Electromagnetic interference to medical electronic equipment. Introduction to medical equipment maintenance: Management, facilities, and equipment.

Prerequisite: MTE 4401

Corequisite: None

Textbooks: John M. Brown and Joseph J., Introduction to Biomedical Equipment Technology Prentice Hall PTR, Last edition.

MTE 4481 MEMS Sensors 3 (3,1,0)

Modeling of MEMS sensors and performance analysis. Analog and digital interface for MEMS sensors with applications to:

- Accelerometers
- Gyroscopes

- Pressure sensors
- Piezoelectric devices
- Resonant devices

Prerequisite: MTE 4421

Corequisite: None

Textbooks: M I Younis "MEMS Linear and Nonlinear Statics and Dynamics", Springer, 2011.

S.D. Senturia, Microsystem Design, Kluwer academic, 2001.

JW Gardner, VK Varadan, OO Awadelkarim, Microsystems, MEMS and Smart Devices, Wiley, 2001.

MTE 4141 Digital Manufacturing 3 (3,1,0)

Conception and development of products; Computer Aided Design (CAD); Computer Aided Engineering (CAE) Finite Element Analysis (FEA) to validate functional; Reverse engineering; Advanced manufacturing; Additive manufacturing; prototyping.

Prerequisite: None

Corequisite: None

Textbooks: Zude Zhou, Shane (Shengquan) Xie Dejun Chen Fundamentals of Digital Manufacturing Science, last edition

Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Mikell P Groover, last edition.

Automation, Production Systems and CIM/Groover M.P./PHI/2007

MTE 4131 Smart Manufacturing 3 (2,1,1)

Introduction to smart manufacturing technologies; Implementing smart manufacturing in industries; role of smart manufacturing in Industry 4.0; Industrial Internet of Things IIoT; hardware and software in smart manufacturing. Communication of different devices with PLC, smart sensor, and HMI; Data transforming. Integrated robots with manufacturing; Automation and material handling within factories; Advanced manufacturing technologies; Computer Integrated Design of smart manufacturing systems, Digital Twin.

Prerequisite: None

Corequisite: None

Textbooks: Masoud Soroush, Michael Baldea, Thomas F. Edgar, “Smart Manufacturing": Concepts and Methods", Last Edition

Smart Manufacturing: Integrating Transformational Technologies for Competitiveness and Sustainability. Shemwell, S.M. and Quazi, H.A., CRC press

Automation, Production Systems and CIM/Groover M.P./PHI/2007

MTE 4151 Advanced Topics in Manufacturing 3 (3,1,0)

Study of selected topics in Mechatronic Systems that are not covered in other courses (the course content should be approved by the department council each time this course is offered).

Prerequisite: None

Corequisite: None

Textbooks: Will be identified according to the topics selected.

MTE 4491 Selected Topics in Mechatronic Systems 3 (3,1,0)

Study of selected topics in Mechatronic Systems that are not covered in other courses (the course content should be approved by the department council each time this course is offered).

Prerequisite: None

Corequisite: None

Textbooks: Will be identified according to the topics selected.

MTE 4121 Finite element Method 3 (2,1,1)

General Introduction, Introduction to the Stiffness (Displacement) Method, Development of Truss Equations, Development of Beam Equations, Frame and Grid Equations, Development of the Plane Stress and Plane Strain Stiffness Equations, Practical Considerations, Three-Dimensional Stress Analysis.

Lab: Use FE software to solve various 1-D, 2-D and 3-D design problems.

Prerequisite: None

Corequisite: None

Textbooks: Daryl L. Logan "A First Course in the Finite Element Method", Cengage Learning, Last Edition.

J. N. Reddy, " An Introduction to the Finite Element Method", McGraw-Hill Education, Last Edition.

Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and applications of finite element analysis”

MTE 4161 Selected Topics in Mechanical Engineering 3 (3,1,0)

Study of selected topics in Mechanical Engineering that are not covered in other courses (the course content should be approved by the department council each time this course is offered).

Prerequisite: None

Corequisite: None

Textbooks: Will be identified according to the topics selected.

MTE 4171 Course: Renewable Energy 3 (2,1,1)

- Introduction of Renewable Energy Sources: To understand the Basics of Energy, Current Energy Scenario and Fossil Fuel Reserves, Sustainability and Renewable Energy and Importance and Drawbacks of Renewable Energy.

- Photovoltaic Energy System: To know about Solar Spectrum, Extra-terrestrial Radiation, Radiation on earth surface, Geographical Distribution, Atmospheric Factors, Optimal Tilt, Monthly Averaged Global Radiation at optimal Tilt, Solar Tracking Arrangements. To perform solar PV calculations as well as design PV systems per given specifications or energy demand.

- Wind Energy System: To learn about Wind flow, Motion of wind, Energy and Power Calculation, Distribution of Wind Speed, Types and characteristic of Wind Turbine.

- Biomass Energy: To understand Biomass Energy which includes types of biomasses and application, Energy content in biomass, Biomass from quickly growing plants.

- Energy Storage Devices.

- Integration of Renewable Energy Sources.

- Distributed Generation.

- Application.

Prerequisite: None

Corequisite: None

Textbooks: John Twidell and Tony Weir, “Renewable Energy Resources”, 3st Edition, CRC Press, USA, 2015.

Robert Ehrlich, “Renewable Energy: A first course”, CRC Press, 1st Edition, CRC Press, USA, 2013.

Mohamed Elsharkawi, “Wind Energy: An Introduction”, 1st Edition, CRC Press, USA, 2015.

Robert Foster, Majid Ghassemi and Alma Cota, “SOLAR ENERGY Renewable Energy and the Environment”, 1st Edition, CRC Press, USA, 2010.

MTE 4181 Sustainable Design Engineering 3 (2,1,1)

Introduction to sustainability issues in the design process. Product analysis and related system in the context of sustainability principles. Applying appropriate methods to design for sustainability. Environmental analysis. Example of Design for manufacture; Design for assembly and disassembly; Design for lifecycle; Design for reuse, remanufacture, recycling; Design for energy minimization; Life cycle assessment.

Prerequisite: None

Corequisite: None

Textbooks: Anoop Desai and Anil Mital, Sustainable Product Design and Development, CRC Press, 2021

Gerald Jonker, And Jan Harmsen, Engineering for Sustainability a Practical Guide for Sustainable Design, Elsevier, 2012

J. K. Yates, D. Castro-Lacouture, Sustainability in Engineering Design and Construction, CRC Press, 2016.

MTE 4441 Mobile Robots 3 (3,1,0)

Introduction to mobile robots. Locomotion: Legged Mobile Robots, Wheeled Mobile Robots, Aerial Mobile Robots. Mobile robot kinematics: Kinematic Models and Constraints, Mobile Robot Maneuverability, Mobile Robot Workspace, Motion Kinematic Control. Perception: sensors for Mobile Robots, Fundamentals of Computer Vision, Fundamentals of Image Processing. Mobile robot localization. Planning and navigation.

Prerequisite: MTE 4411

Corequisite: None

Textbooks: Siegwart, Roland, Nourbakhsh, Illah Reza, and Scaramuzza, Davide "Introduction to Autonomous Mobile Robots" The MIT press, Latest edition.

MTE 4451 Parallel Robots 3 (3,1,0)

Introduction. Classification of parallel robots. Position analysis of parallel manipulators. Jacobian analysis of parallel manipulators: Jacobian matrices, singularity conditions. Statics of parallel manipulators. Stiffness analysis of parallel manipulators. Wrist mechanisms. Dynamics of parallel manipulators: Newton Euler formulation, Lagrangian formulation.

Prerequisite: MTE 4411

Corequisite: None

Textbooks: Lung-Wen Tasi, "Robot analysis: the Mechanics of Serial and Parallel Manipulators", John Wiley and Sons, Latest edition.

MTE 4211 Intelligent Control 3 (3,1,0)

Intelligent control strategies: Expert systems, Fuzzy logic control, Neural networks. Optimization control techniques: genetic algorithms, simulated annealing, TABU search. Hybrid systems. Applications.

Prerequisite: MTE 3251

Corequisite: None

Textbooks: Marco P. Schoen, Introduction to Intelligent Systems, Control, and Machine Learning using MATLAB, 2023.

Vinod Chandra, Artifical Intelligence and Machine Learning, PHI; 1st edition (January 1, 2014).

MTE 4201 Digital Control System 3 (2,1,1)

This course introduces digital control and discrete transform (z-transform). Discrete and hybrid Signal Flow Graphs (SFGs). Solutions of discrete-time state space. System discretization, Modified z-transform. Time-response and characteristic equations. Stability concepts in discrete systems. The root locus method, Nyquist method, and Bode plots. Digital lead-lag compensators applied to digital systems, PID Control.

Digital Control Systems Lab: Analysis with MATLAB, Sample/Hold unit with zero-order hold, Simulink Primer, MATLAB Simulation of Digital Control Systems, Sampled-data Servo Control System, Performance of a Digital PID Controller, Pole Placement Controller Implementation, Discretization of Continuous-time State Space Equations, Digital Servo Workshop, Digital Pendulum Control System and Magnetic Levitation System.

Prerequisite: MTE 3251

Corequisite: None

Textbooks: M. Sami Fadali and Antonio Visioli, Digital Control Engineering Analysis and Design, Academic Press is an imprint of Elsevier, Third Edition.

MTE 4221 Automation Devices and Electronics 3 (3,1,0)

Basic concept of switching, different input-output switching devices and designing automation systems using PLCs. Power-electronic switching devices, DC and AC power control using SCR, TRIAC, power transistors, etc. Concept of actuation, linear and rotary actuators of electrical and fluidic types. Principle of operation and modeling of electro-mechanical devices, and various types of DC, AC and Stepper motors, and their speed-control through power-electronic switching circuits.

Prerequisite: MTE 3211

Corequisite: None

Textbooks: Dale R. Patrick, Stephen W. Fardo, Industrial Electronics Devices and Systems, Second Edition.

Control and Automation: Devices, Systems and Engineering Applications

by Marques Vang.

MTE 4321 Advanced Artificial Intelligence 3 (3,1,0)

The course goes in depth on selected topics and methods within artificial intelligence (AI), machine learning (ML), Deep Learning (DL) and their applications. Examples include computational intelligence algorithms in search, optimization and classification. Examples of relevant applications include robotics and biomedical.

Prerequisite: MTE 3301

Corequisite: None

Textbooks: Stuart Russell, " Artificial Intelligence: A Modern Approach", 1st Edition, November 2020

Ian Goodfellow and Yoshua Bengio, “Deep Learning”, 1st Edition, 2016

MTE 4251 Selected Topics in Electrical and Electronic Engineering 3 (3,1,0)

Study of selected topics in Electrical and Electronic Engineering that are not covered in other courses (the course content should be approved by the department council each time this course is offered).

Prerequisite: None

Corequisite: None

Textbooks: Will be identified according to the topics selected.

MTE 4331 Industrial Internet of Things (IIoT) 3 (2,1,1)

Introduction to IoT and IIoT and the components of IIoT. Introduction to data sources (sensors, machines, and processes), process automation, and data acquisition on IoT platforms. Embedded controllers with IoT. IoT Gateways, IoT and layer system programming, cloud computing, real-time dashboard for Data Monitoring, the transformation of industrial data, and the identification of technologies to collect, store, transmit, and visualize data. IIoT applications, the role of IIoT in industrial manufacturing processes and plant maintenance, and networking for IIoT. Case Studies of IIoT systems.

Prerequisite: None

Corequisite: None

Textbooks: Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor)

Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer

The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.)

MTE 4311 Computer Vision 3 (2,1,1)

Image formation/lighting/projective geometry, image processing / filtering, linear models and basic optimization, neural networks, motion and flow, geometry, applications, Introduction to Machine Learning and Deep learning techniques, Applications of artificial intelligence in mechatronics systems.

Lab

Basic Digital Image Formation and low-level processing; Geometric Transformation; Homograph Matrix; Perspective Transformation; Camera Calibration; Compute Fundamental Matrix; Edge Detection, Line Detection and Corner Detection; Pattern Analysis, Motion Analysis SIFT Feature descriptor; SURF and HOG feature descriptor; Project based on Computer Vision Applications.

Prerequisite: MTE 3301

Corequisite: None

Textbooks: Computer Vision: Algorithms and Applications by Richard Szeliski

Computer Vision: A Modern Approach (Second Edition) by David Forsyth and Jean Ponce.

Elements of Statistical Learning by Trevor Hastie, Robert Tibshirani, and Jerome Friedman.

Multiple View Geometry in Computer Vision (Second Edition) by Richard Hartley and Andrew Zisserman.

MTE 4361 Selected Topics in Computer and Software Engineering 3 (3,1,0)

Study of selected topics in Computer and Software Engineering that are not covered in other courses (the course content should be approved by the department council each time this course is offered).

Prerequisite: None

Corequisite: None

Textbooks: Will be identified according to the topics selected.

MTE 4241 Special Electrical Machines 3 (3,1,0)

Single phase Induction motor: construction, theory, methods of starting, equivalent circuit, parameters calculation using open circuit and short circuit tests. Variable Reluctance machines: Switched Reluctance, Synchronous Reluctance, and Stepper motor. Hysteresis Motor, Linear machine: Induction, Synchronous reluctance and dc. Permanent magnet motors, servo motors. Synchronous-asynchronous motor, Double-fed asynchronous motor, High frequency motors, Linear machines, Brake Motors, Motors with exterior rotors, Vibration motors, Drum motors, Single phase commutator motor, Multi phase commutator motor, Schrage Motors, Reluctance Motors, Hysteresis Motors, Step motors, Permanent magnet motors, Electrical motors with combustion systems.

Prerequisite: MET 3201

Corequisite: None

Textbooks: Stephen Chapman, "Electric Machinery Fundamentals", McGraw Hill, Latest Edition.

Mulukutla S. Sarma, “Electric Machines: Steady State Theory and Dynamics Performance”, West Publishing Co., Latest Edition.

MTE 4231 Digital Signal Processing 3 (3,1,0)

Overview of digital signals and systems. Frequency and time representation of sampling, decimation, interpolation. Z-transform: Evaluation, region of convergence (ROC) and properties. Discrete time system structures: tapped delay line and lattice structures. Fast Fourier Transform (FFT). Digital filter design: Finite impulse response (FIR), infinite impulse response (IIR), windowing, Hilbert transform.

Prerequisite: MET 3221

Corequisite: None

Textbooks: Sanjit K. Mitra, "Digital Signal Processing: A Computer Based Approach", Mc Graw Hill, Last Edition.

MTE 4341 Advanced Embedded Systems Design 3 (3,1,0)

In-depth coverage of systematical development and synthesis of advanced embedded systems with emphasis on Field Programmable Gate Array (FPGA) and SoC technologies. Examines contemporary issues and problems in the design, development, and test of contemporary real-time embedded systems while emphasizing solid design practices to ensure safety and reliability. Selected topics addressing leading edge material of current interest in the domain of embedded systems design.

Prerequisite: MTE 4301

Corequisite: None

Textbooks: Designing Embedded Hardware, John Catsoulis. 2nd edition. Shroff Publishers and Distributors

Embedded System Design: A Unified Hardware / Software Introduction. Tony Givargis and Frank Vahid. Wiley.

MTE 4421 Design of MEMS 3 (3,1,0)

Necessary analytical and computational tools for MEMS designers to model and simulate most known MEMS devices, structures, and phenomena. With an introduction to the analysis and treatment of the most common static and dynamic phenomena in MEMS that are encountered by engineers.

- Introduction to MEMS technology
- Introduction to microfabrication techniques
- Sensing and Actuation in MEMS
- Elements of Lumped-Parameter Modeling and analysis in MEMS

Prerequisite: MTE 3401

Corequisite: None

Textbooks: M I Younis "MEMS Linear and Nonlinear Statics and Dynamics", Springer, 2011.

O. Brand, I. Dufour, S.M. Heinrich, F. Josse, Resonant MEMS, Wiley, 2015

S.D. Senturia, Microsystem Design, Kluwer academic, 2001.

MTE 4501 Industrial Safety 3 (3,1,0)

Introduction to law and regulations. Concepts of Hazard avoidance. Hazard analysis, Hazard Assessment, Hazard Prevention, and Hazard Control in Buildings and Facilities. Personal Protection Equipment. Fire Protection. Safety in Materials Handling and Storage. Machine Guarding. Electrical Hazards. Occupational diseases. Management of Safety and Health: OSHA Standards, Evacuation planning, First Aids in emergency, Emergency planning, and Safety Management.

Prerequisite: None

Corequisite: None

Textbooks: C. Ray Asfahl, "Industrial Safety and Health Management", Prentice Hall, Latest Edition.

Goetsch, D. L., & Ozon, G. Occupational safety and health for technologists, engineers, and managers. Pearson, Latest Edition.

Roger L. Brauer," Safety and Health for Engineers" Wiley, Latest Edition.

MTE 4511 Quality Control 3 (2,1,1)

Introduction to quality control: Fundamentals of statistical quality control, the basic concepts of quality, quality engineering terminology, basic tools of quality, and Probability Distributions. Control charts for variables. Control charts for attributes. Process capability. Acceptance sampling. Lot by Lot Acceptance sampling by attributes: Concept, sampling plans design for single, double, and multiple plans. Sequential and dodge romig plans. Acceptance sampling plans by variables. Quality costs. Computer application in quality.

Lab. Work: Measurement of different dimensions (length, width, and height). Use computer software for Descriptive statistics, variables control charts. Design/use of gages for attributes measurement. Attributes control charts.

Develop cause and effect diagram, Plot Pareto chart, scatter diagram, Dot plot, box plot, stem and leaf plot. Perfrom a process capability study.

Project work: Term project and practical case.

Prerequisite: MTE 2050

Corequisite: None

Textbooks: D.C. MONTGOMERY, “Introduction to Statistical Quality Control”, Latest edition.

D.H. Besterfield, "Quality Control", Prentice Hall, Latest Edition.

G.M. Jurna & F.M. Gryna, "Quality Planning & Analysis", McGraw-Hill, Latest Edition

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MTE 4521 Maintenance and Diagnosis of Mechatronics Systems 3 (3,1,0)

Maintenance systems, organization of maintenance department, and its responsibilities.

Different types of maintenance policies. Corrective maintenance. Preventive Maintenance: concepts, modeling, and analysis. Predictive maintenance, inspection, and diagnostics techniques. Advanced maintenance philosophies: Reliability centered maintenance, Total productive Maintenance, Overall Equipment Effectiveness (OEE), Root cause failure analysis, Failure modes and effect analysis, Intelligent Maintenance. Maintenance Key Performance Indicators (KPIs). Computerized Maintenance Management

Systems (CMMS). Replacement studies. Application of troubleshooting techniques to systems having combined mechanical and electrical actuation.

Prerequisite: None

Corequisite: None

Textbooks: Planning and Control of Maintenance Systems, Duffuaa, S. O., Raouf, A. and Campbell, J. D., Modeling and Analysis, John Wiley & Sons, last edition.

Maintenance Planning and Scheduling Handbook, Palmer, D, McGraw Hill, New York. Last edition.
