FAHAD BIN SULTAN UNIVERSITY
College of Engineering
Department of Mechanical Engineering

Bachelor Degree in Mechanical Engineering

2023 Study Plan

Two Tracks:

1. **General Mechanical Engineering.**
2. **Mechatronics and Robotics.**

1. University Graduation Requirements

To receive a bachelor's degree in Mechanical Engineering, a student must fulfill all requirements related to credit hours, grade point average, program of study, and courses.

2. Degree Requirements

Type of Requirement	Credit Hours
University Requirements	37
College Requirements	40
Compulsory Specialization Requirements	69
Elective Specialization Requirements	12
Total	**158**

3. University Requirements

- **A: University Requirements consist of 34 credit hours distributed as follows:**

Course ID	Course Title	Credit Hours	Prerequisite
ARAB 101	Basic Academic Arabic	3	
ARAB 201	Advanced Academic Arabic	3	ARAB 101
ENGL 100	General English	3	
ENGL 101	Basic Academic English I	3	ENGL 100
ENGL 102	Basic Academic English II	3	ENGL 101
ENGL 203	Advanced Academic English I	3	ENGL 102
ENGL 206	Technical Writing	3	ENGL 203
IT 100	Information Technology	3	
MATH 100	Mathematics I	3	
PHE 101	Physical Education I	1	
SOCS 101	Islamic Civilization I	3	
STAT 100	Introduction to Probability and Statistics	3	MATH 100
Total		**34**	

- **B: Free Elective Course: 3 credit hours to be chosen from the following list.**

Course ID	Course Title	Credit Hours	Prerequisite
ASTR 150	Introduction to Astronomy	3	
CHEM 150	Chemistry & Society	3	
CIT 101	Future Technology	3	
FREN 101	Basic French I	3	
SOCS 201	Islamic Civilization II	3	SOCS 101
SOCS 202	World Civilization	3	
SOCS 203	History of the Kingdom of Saudi Arabia	3	

4. College Requirements

College Requirements consist of 40, credit hours distributed as follows:

Course Code	Title of the Course	Credit Hours	Pre-requisite
CHEM 101	General Chemistry I	3	
CHEM 101L	General Chemistry Lab	1	CHEM 101
CIVE 205	Engineering Drawing	1	IT 100
COEN 300	Engineering Economy	3	STAT 100
COEN 401	Engineering Ethics	1	ENGL 203
CSC 101	Introduction to Computing for Engineers	3	IT 100
ELEE 230	Programming for Engineers	3	CSC 101
MATH 101	Calculus I	3	MATH 100
MATH 102	Calculus II	3	MATH 101
MATH 201	Calculus and Analytic Geometry III	3	MATH 102
MATH 202	Differential equations	3	MATH 201
MATH 215	Linear algebra and Numerical Techniques	3	MATH 202 (co)
PHYS 101	General Physics I	3	
PHYS 102	General Physics II	3	PHYS 101
PHYS 103L	General Physics Lab	1	PHYS 102
STAT 230	Probability and Statistics	3	STAT 100
Total		**40**	

5. Program Specialization Requirements

Program specialization requirements consist of **81** credit hours: **69** compulsory credit hours and 12 Elective Credit hours distributed as follows:

➢ Compulsory Specialization Requirements:

(64) Credit hours distributed as follows:

Course Number	Course Title	Credit Hours	Pre-requisite
CIVE 210	Statics	3	MATH 102(co)
MECH 201	Engineering Graphics	1	CIVE 205
MECH 210	Thermodynamics I	3	PHYS 101, CHEM 101
MECH 220	Dynamics	3	CIVE 210
MECH 231	Strength of Materials	3	CIVE 210
MECH 232	Engineering Materials	2	CHEM 101
MECH 233	Materials Lab	1	MECH 232 (co)
MECH 308	Electrical Circuits and Machines	3	PHY 102
MECH 310	Thermodynamics II	3	MECH 210
MECH 320	Kinematics of Mechanical Systems	3	MECH 220
MECH 330	Mechanical Design	3	MECH 201, MECH 231(co)
MECH 341	Fluid Mechanics	3	MECH 220
MECH 342	Heat Transfer	3	MATH 202, MECH 310(co)
MECH 343	Heat Transfer Lab	1	MECH 342(co)
MECH 344	Fluid Mechanics Lab	1	MECH 341(co)
MECH 352	Instrumentation and Measurements	2	PHY 102 MECH 308(co)
MECH 353	Instrumentation and Measurements Lab	1	MECH 352(co)
MECH 355	Introduction to Mechatronics and Robotics	3	MECH 308, MECH 352
MECH 360	Manufacturing Processes I	3	MECH 231, MECH 232
MECH 361L	Manufacturing Processes I Lab	1	MECH 360(co)
MECH 371	Pneumatic and Hydraulic Systems	3	MECH 341, MECH 352
MECH 400	Summer Internship	1	Last Summer
MECH 434	Mechanical Vibrations	3	MECH 220, MATH202
MECH 437	Turbo Machinery	2	MECH 210, MECH 341
MECH 442	Thermal Desalination Systems	3	MECH 341, MECH 342
MECH 443	Energy Conversion	3	MECH 310, MECH 342
MECH 490	Dynamic Systems and Control	3	MECH308, MECH 352
MECH 491	Dynamic Systems and Control Lab	1	MECH 490(co)
MECH 498	Final Year Project (1)	1	*110 C. hrs., ENGL 206*
MECH 499	Final Year Project (2)	3	MECH 498
Total		**69**	

6. Elective Specialization Requirements - **12** credit hours could be chosen from the following list:

1. General Mechanical Engineering.

Course Number	Course Title	Credit Hours	Prerequisite
1. General Mechanical Engineering.			
MECH 430	Product Design and Development	3	MECH 320, MECH 330.
MECH 431	Manufacturing Processes II	3	MECH 360
MECH 432	Mechanical CAD/CAE/CAM	3	MECH330, MECH360
MECH 444	Internal Combustion Engines	3	MECH 310
MECH 446	Gas Turbine	3	MECH 310, MECH 342
MECH 447	Steam Turbine	3	MECH 310, MECH 342
MECH 448	Refrigeration Systems	3	ME 341, MECH 342
MECH 449	Air Conditioning Systems	3	MECH 341, MECH 342
MECH 451	Solar Energy	3	MECH 342, MECH 308
MECH 452	Power Plants	3	MECH 310, MECH 342
MECH 453	Int. to Renewable Energy Systems	3	MECH 342, MECH 308
MECH 460	Finite Element Methods in Mechanical Engineering	3	MECH 231, MECH 201
MECH 470	Mechanics of Composite Materials	3	MECH 231, MECH 232
MECH 496	Special Topics in Mechanical Engineering	3	Discretion of HOD

2. Mechatronics & Robotics Engineering

Course Number	Course Title	Credit Hours	Prerequisite
2. Mechatronics & Robotics Engineering Track Electives			
MECH 420	Advanced Mechatronics and Robotics	3	MECH 355
MECH 430	Product Design and Development	3	MECH 320, MECH 330.
MECH 432	Mechanical CAD/CAE/CAM	3	MECH330, MECH360
MECH 433	Mechatronics System Design	3	MECH 355
MECH 440	Intelligent Control of Robotic Systems	3	MECH 355, MECH 490
MECH 460	Finite Element Methods in Mechanical Engineering	3	MECH 231, MECH 201
MECH 470	Mechanics of Composite Materials	3	MECH 232, MECH 231
MECH 481	Computer-Integration Manufacturing Systems	3	MECH 360,MECH 201
MECH 485	Industrial Robotics and Applications	3	MECH 355

MECH 492	Special Topics in Mechatronics & Robotics	3	Discretion of HOD

Proposed Sequence of Study

Year I – First Semester

First Semester 18 Credit hours			
Course Code	**Title**	**Credits**	**Pre-requisites**
ENG 100	General English	3	
IT 100	Information Technology	3	
MATH 100	Mathematics I	3	
ARAB 101	Basic Academic Arabic	3	
SOCS 101	Islamic Civilization I	3	
PHYS 101	General Physics I	3	
TOTAL 18			

Year I – Second Semester

Second Semester 17 Credit hours			
Course Code	**Title**	**Credits**	**Pre-requisites**
ENGL 101	Basic Academic English II	3	ENGL 200
STAT 100	Introduction to Probability and Statistics	3	MATH 100
CSC 101	Introduction to Computing for Engineers	3	IT 100
CHEM 101	General Chemistry I	3	
ARAB 201	Advanced Academic Arabic	3	ARAB 101
CHEM 101L	General Chemistry Lab	1	CHEM 101
PHE 101	Physical Education I	1	
TOTAL 17			

Year II - *Third Semester*

Third Semester 15 Credit hours			
Course Code	**Title**	**Credits**	**Pre-requisites**
PHYS 102	General Physics II	3	PHYS 101
CIVE 205	Engineering Drawing	1	IT 100
ENGL 102	Basic Academic English II	3	ENGL 101
MATH 101	Calculus I	3	MATH 100
MECH 210	Thermodynamics I	3	PHYS 101, CHEM 101
MECH 232	Engineering Materials	2	CHEM 101
TOTAL 1 5			

Year II - *Fourth Semester*

Fourth Semester 16 Credit hours			
Course Code	**Title**	**Credits**	**Pre-requisites**
CIVE 210	Statics	3	MATH 102(co)
ENGL 203	Advanced Academic English I	3	ENGL 102
MATH 102	Calculus II	3	MATH 101
PHY 103L	Physics Lab.	1	PHY 102
MECH 310	Thermodynamics II	3	MECH 210
ELEE 230	Programming for Engineers	3	CSC 101
TOTAL 16			

Year III - *Fifth Semester*

Fifth Semester 16 Credit hours			
Course Code	**Title**	**Credits**	**Pre-requisites**
MATH 201	Calculus and Analytical Geometry III	3	MATH 102
MECH 220	Dynamics	3	CIVE 210
MECH 231	Strength Of Materials	3	CIVE 210
MECH 308	Electric Circuits and Machines	3	PHY 102
ENGL 206	Technical Writing	3	ENGL 102
MECH 201	Mechanical Engineering Graphics	1	CIVE 205
Total 16			

Year III - *Sixth Semester*

Sixth Semester 16Credit hours			
Course Code	**Title**	**Credits**	**Pre-requisites**
MECH 320	Kinematics of Mechanical Systems,	3	MECH 220
MATH 202	Differential Equations	3	MATH 201
MECH 341	Fluid Mechanics	3	MECH 220
MECH 344	Fluid Mechanics Lab	1	MECH 341(co)
MECH 360	Manufacturing Processes I	3	MECH 232, MECH 231
MATH 215	Linear Algebra and Num. Tech.	3	MATH 202(co)
Total 16			

Year IV - *Seventh Semester*

Seventh Semester		15Credit hours	
Course Code	**Title**	**Credits**	**Pre-requisites**
MECH 330	Mechanical Design	3	MECH 201, MECH 231
MECH 342	Heat Transfer	3	MATH 202, MECH 310
COEN 401	Engineering Ethics	1	ENGL 203
MECH 343	Heat Transfer Lab	1	MECH 342 (co)
MECH 352	Instrumentation and Measurements	2	PHY 102, MECH 308 (co)
MECH 353	Instrumentation and Measurements Lab	1	MECH 352 (co)
MECH 233	Materials Lab	1	MECH 232 (co)
MECH 370	Pneumatic and Hydraulic Systems	3	MECH 341, MECH 352
	TOTAL	15	

Year IV - *Eighth Semester*

Eighth Semester		16 Credit hours	
Code Course	**Title**	**Credits**	**Pre-requisites**
STAT 230	Probability and Statistics	3	STAT 100
MECH 442	Thermal Desalination Systems	3	MECH 341, MECH 342
MECH 443	Energy Conversion	3	MECH 310, MECH 342
MECH 434	Mechanical Vibrations	3	MECH 220, MATH 202
	University free elective	3	
MECH 361L	Manufacturing Processes I Lab	1	MECH 360 (co)
	TOTAL	1 6	

Year IV – *Summer Semester*

Summer Semester	1 Credit hours		
Course Code	**Title**	**Credits**	**Pre-requisites**

MECH 400	Summer internship	1	
Total 1			

Year V – *Ninth Semester*

Ninth Semester 16 Credit hours			
Code Course	**Title**	**Credits**	**Pre-requisites**
MECH 437	Turbo Machinery	2	MECH 210, MECH 341
MECH 355	Introduction to Mechatronics and Robotics	3	MECH 308, MECH 352
MECH 490	Control Systems	3	MECH 308, MECH 352
MECH 491	Control Systems Lab	1	MECH 490 (co)
MECH xxx	Program Elective Course	3	
MECH xxx	Program Elective Course	3	
MECH 498	FYP I	1	90 C. Hrs., ENGL 206
TOTAL		1 6	

Year V – *Tenths Semester*

Tenths Semester 12 Credit hours			
Code Course	**Title**	**Credits**	**Pre-requisites**
COEN 300	Engineering Economy	3	STAT 100
MECH xxx	Program Elective Course	3	
MECH xxx	Program Elective Course	3	
MECH 499	FYP II	3	MECH 498 FYP I
TOTAL		1 2	

Course Descriptions

Required Courses:

[1] Credits hrs. (Lecture, Tutorial, Lab)

MECH 201 Mechanical Engineering Graphics 1(0, 0, 2)

Principles and techniques of 3D surface and solid modeling; Feature-based and constraint-based modeling systems; Data transfer between systems; Relationship of geometric modeling to manufacturing; Analysis and rapid prototyping; Development of 2D drawing from the solid model database: Design annotation including mechanical fastener specification, geometric Dimensioning and tolerance. Prerequisites: CIVE 205

MECH 210 Thermodynamics I 3(3, 0, 0)

Thermodynamic concepts and definitions, states, properties, systems, control volume; processes, cycles, and units; pure substances, equation of states, table of properties; work and heat; the first law, internal energy and enthalpy; conservation of mass; SSSF and USUF processes; the second law, heat engines and refrigerators, reversible processes, Carnot cycle; entropy, Clausius inequality, principle of the increase of entropy, Efficiencies. Prerequisite: PHYS 101, CHEM 101

MECH 211 Thermodynamics (*for Civil Engineering*) 2(2, 0, 0)

Introduction to the thermodynamics: which include thermodynamics state and properties of a pure substance, system and control volume concepts, work and heat, the first law of thermodynamics, energy and mass conservation, entropy, the second law of thermodynamics; applications to closed setups and flow devices; simple vapor and gas cycles applications. Prerequisite: PHYS 101, CHEM 101

MECH 220 Dynamics 3(3, 0, 0)

Kinematics of particles; Rectilinear and curvilinear motion in various coordinate systems. Kinetics of particles; Newton's second law, Central force motion, Work-energy equation, Principle of impulse and momentum, Impact, Conservation of energy and momentum, Application to a system of particles. Kinematics of rigid bodies; Relative velocity and acceleration, Instantaneous center, Analysis in terms of a parameter. Plane kinetics of rigid bodies with application of Newton's second law, Energy and impulse-momentum. Prerequisites: CIVE 210.

MECH 225 Engineering Mechanics *(for Electrical Engineering Students)* **(3, 0, 0)**

A course outlining vector mechanics of forces and moments; free-body diagrams; equilibrium of particles and rigid bodies in two and three dimensions; plane and space trusses. Kinematics of particles; Rectilinear and curvilinear motion in various coordinate systems, Kinetics of particles; Newton's second law, Central force motion. Axial loading, Material properties obtained from tensile tests, Stresses and strains due to axial loading. Thermal Stresses.

MECH 231 Strength of Materials 3(3, 0, 0)

Axial loading, Material properties obtained from tensile tests, Stresses and strains due to axial loading, Thermal Stresses, Elementary theory of torsion, Solid and hollow shafts, Thin-walled tubes, Rectangular cross-section, Stresses in beams due to bending, shear and combined forces. Composite beams, Analysis of plane stress, Mohr's Circle, Combined stresses, Thin-walled pressure vessels, Deflection of beams, buckling of columns. Prerequisite: CIVE 210.

MECH 232 Engineering Materials 2(2, 0, 0)

Atomic structure and bonding. Crystalline structure. Imperfections in solids (defects in crystals). Diffusion. Mechanical properties of metals. Classification of materials (properties and applications). Failure; Phase diagram and alloy systems. The iron phase diagram. Phase transformations. Ferrous and non- ferrous metal alloys, ceramics, and polymers. Structure-property relationships. Material selection case studies. Prerequisite: CHEM 101

MECH 233 Engineering Materials Lab 1(0, 0, 2)

A laboratory course consisting of standard metallurgical and mechanical characterization tests on metals. Stress-strain plots, derived properties, fracture toughness, crystallography, hardness, and other properties. Ceramic flexure testing: Weibull plots. Polymers: stress-strain plots and derived properties, impact properties, creep, and relaxation. Prerequisite: MECH 232.

MECH 308 Electrical Circuits and Machines 3(3, 0, 0)

Introduction for DC circuit analysis, series and parallel, Ohm's law, KVL, KCL , Superposition theory and maximum power transfer , Introduction to analysis of AC circuit, Phasor analysis for single-phase , KVL and KCL in AC circuits, Analysis of three phase AC circuits, Transformers (construction, operation of single-phase transformers, equivalent circuit, voltage regulation and efficiency, auto-transformer, three-phase transformers), AC machinery fundamentals, three-phase induction machines (construction, operation, equivalent circuit, performance, calculations, starting of induction motors, speed control). Prerequisite: PHY 102

MECH 310 Thermodynamics II 3(3, 0, 0)

A course investigating the availability and work potential of systems; irreversibility; second law efficiency; availability; gas mixtures, air-conditioning; chemical reactions; high speed flow, nozzles and diffusers, environmental, economic, and social implications. Prerequisite: MECH 210.

MECH 320 Kinematics of Mechanical Systems 3(3, 0, 0)

Mechanisms and applications, mobility and linkages. Cams, gears and gear trains. Velocity and acceleration analysis in mechanisms. Inertia forces. Principles of balance in rotating & reciprocating masses. Prerequisite: MECH 220.

MECH 330 Mechanical Design 3(3, 0, 0)

Meaning and phases of design, considerations of design, stress analysis, deflection analysis, static strength and theories of failure, fatigue strength. Design of fasteners and connections; riveted joints, bolts and screws, force-deflection diagrams of bolted connections. Welded joints. Mechanical springs, helical, leaf, torsional spring Shafts. Prerequisites: MECH 201, MECH 231.

MECH 341 Fluid Mechanics 3(3, 0, 0)

Basic and definitions, units, fluid proprieties, hydrostatics, basic control volume approach, continuity equation, Bernoulli equation, Euler's equation, energy equation, momentum principle and its applications, flow through orifice, pipe, major and minor losses in pipe. Prerequisite: MECH 220.

MECH 342 Heat Transfer 3(3, 0, 0)

Introduction to modes of heat transfer, one dimensional conduction; steady state and transient analysis, introduction to convection, forced and free convection analysis, internal and external flow, heat exchangers, introduction to thermal radiation heat transfer. Prerequisite: MATH 202, MECH 310.

MECH 343 Heat Transfer Lab 1(0, 0, 2)

One-dimensional conduction heat transfer. Heat transfer through composite walls. Thermal conductivity of insulating material. Transient heat transfer. Forced convection heat transfer inside a heated tube. Forced convection from a circular cylinder subjected to cross flow. Natural convection from a vertical flat plate. Overall heat transfer coefficient in a double pipe heat exchanger. Heat exchanger test – shell and tube heat exchanger. Prerequisite: MECH 342

MECH 344 Fluid Mechanics Lab 1(0, 0, 2)

Pressure Measurements: Manometers, Flow visualization: streak-lines and streamlines, Measurement of velocity distribution using Pitot-static tube. Jet impact on a flat plate- linear momentum. Volume flow measurements: orifice, nozzle and venture, Reynolds Experiment: Laminar and Turbulent flows. Losses in Pipes. Pumps. Prerequisite: MECH 341

MECH 352 Instrumentation and Measurements 2(2, 0, 0)

This course introduces general concepts of measurement systems; classification of sensors and sensor types; interfacing concepts; data acquisition, manipulation, transmission, and recording; introduction to LabVIEW; applications; team project on design, and implementation of a measuring device. Pre- or co-requisite: P H Y 1 0 2 , MECH 308.

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MECH 353 Instrumentation and Measurements Lab 1(0, 0, 2)

Temperature Measurement and Calibration of Thermocouple, Pressure Measurement Calibration, Deflection Sensor, Force Sensor, Torque Sensor, Response of First Order Measuring System, Flow Sensor, Calibration of a Velocity Sensor Measurement of sound. Prerequisite: MECH 352

MECH 355 Introduction to Mechatronics and Robotics 3(2, 0, 2)

This course will introduce you to Mechatronics and robotics as a multidisciplinary engineering discipline that includes electronics, electrical, mechanical, computer systems engineering, together with information technology. Theory lectures will introduce the core components of mechatronic and robotics systems: electrical and electronic components and circuits, sensors and actuators. In laboratory work, you will work on putting theory into practice in the context of a challenging project that is at the core of a national design and build competition. This course significantly develops the generic skills of teamwork, planning,

leadership, and communication. Conventional lectures will be given on the theoretical aspects of these graduate capabilities. You will then apply these skills in the completion of specific learning activities such as design project, report, testing and prototyping. The dry run testing of the prototype Mechatronics and robotics mechanisms will provide an opportunity for you to receive feedback. MECH 308, MECH 352.

MECH 360 Manufacturing Processes I 3(3, 0, 0)

A course on material removal processes, processes both traditional and non-traditional. Assembly processes such as welding, brazing, soldering, and fastening are also covered with an emphasis on process capabilities and limitations, relative cost, and guidelines for process selection. This course examines the behavior of materials under processing conditions and design for
Manufacturing guidelines, and involves hands-on exercises in a machine shop environment. Prerequisite: MECH 231, MECH 232.

MECH 361L Manufacturing Processes Laboratory 1(0, 0, 2)

An introduction to the use and operation of selected industrial machinery, various machining operations, selected welding Processes and precision measuring instruments. Laboratory projects will emphasize safety and apply selected manufacturing processes, various inspection processes, fixturing and engineering materials. Pre- or co-requisite: MECH 360.

MECH 370 Pneumatic and hydraulic Systems 3 (3,0,0)

Pneumatic and Hydraulic Basics, positive displacements pumps, control valves, solenoid valves, accumulator and filters, Actuators, hydraulic motors, hydrostatic transmissions, circuit design, proportional and servo valves, Two –Stage electro hydraulic servo valves: Static and dynamic characteristics, Design of electrohydraulic systems, Closed loop response of electrohydraulic servo systems – troubleshooting in fluid control systems, Computer aided design of fluid power systems applying AUTOMATION STUDIO Software. Prerequisite: MECH 341, 352

MECH 400 Summer Internship (1 Cr.)

This is an eight to twelve-week professional training course in mechanical engineering. Prerequisite: Senior standing.

MECH 434 Mechanical Vibrations 3(3, 0, 0)

A course on free and forced response of non-damped and damped system; damping vibration absorption; response of discrete multi-degree of freedom systems; modal analysis; vibration measurement, case studies, vibration analysis with Matlab and Simulink. Prerequisite: MECH 220, MATH 202

MECH 437 Turbo Machinery 2(2,0,0)

This course applies the thermal and fluid sciences to the design of pumps, fans, compressors, and turbines. Similarity and scaling laws are developed. Radial and axial flow machines are analyzed. Blade design for both pumps and turbines are considered. Design of centrifugal pumps and axial flow compressors is studied, MECH 341, MECH 210.

MECH 442 Thermal Desalination Systems. 3(3,0, 0)

Seawater composition. The need for water desalination. Classification of desalination processes. Single effect evaporation. Thermal vapor compression systems. Multiple effect evaporation. Multistage flash distillation, once through MSF, Brine mixing and recirculation MSF. Reverse osmosis. Desalination using renewable energy sources. Economic analysis of desalination processes. Prerequisite: MECH 341, MECH 342.

MECH 443 Energy Conversion 3(3, 0, 0)

This course covers three aspects of energy: Energy resources, Energy Conversion, Development, and environment. Energy Sources: Fossil fuels including, petroleum, coal, oil shale and tar sand, natural gas and hydrogen power. Renewable energy sources including: solar, wind, biomass, hydroelectric and geothermal. Energy Conversion: Conversion of thermal energy into electrical power including thermoelectric converters and fuel cells, thermoelectric systems, electric generators and alternators. Development and environment: implications for sustainable development: Technical, economic, ethical and philosophical aspects of sustainable development, Environment and sustainable development at urban, national and international levels. Prerequisite: MECH 310, MECH 342

MECH 490 Dynamic Systems and Control 3(3, 0, 0)

This course is intended to provide students with the tools that enable them to model and control physical systems. It includes the
following: modeling of mechanical, fluid, electrical, and thermal systems; transfer function and block diagrams; time-domain analyses; root-locus; frequency-domain methods; stability analysis; design of PID controllers and dynamic compensators via the root locus and frequency methods. Prerequisites: MECH 308 and MECH 352.

MECH 491 Dynamic Systems and Control Lab. 1(0, 0, 2)

This course involves a series of hands-on experiments on modeling and design of control systems using Matlab, Simulink, and
LabVIEW. The course also includes a team project. Pre- or co-requisites: MECH 490.

MECH 498 Final Year Project I (1 Cr.)

A supervised project in groups of normally three students aimed at providing practical experience in some design aspects of
Mechanical engineering. Students are expected to complete a literature survey, to critically analyze, and to acquire the necessary material needed for their intended end product. Prerequisite: ENGL 206.

MECH 499 Final Year Project II (3 Crs.)

A course in which the student integrates his/her acquired knowledge to deliver the product researched and planned in MECH 401.
Prerequisite: MECH
498.

Elective Courses

1- MECHANICAL ENGINEERING / General Electives

MECH 430 Product Design and Development 3(3, 0, 0)

This course covers modern tools and methods for product design and development. Teams of students conceive, design, and prototype a new physical product. Topics include identifying customer needs, product planning, product specifications, concept generation, industrial design, product architecture, product development economics, and design-for-manufacturing. Prerequisites: MECH 320 and MECH 330.

MECH 431 Manufacturing Processes II 3(2, 0, 2)

A course on heat treatments, deformation, phase-change, and particulate consolidation processing of metals; fabrication processing of non-metallic engineering materials such as ceramics, polymers, and composites; emphasis on process capabilities and limitations, relative cost, and guidelines for process selection; the behavior of materials under processing conditions; design for manufacturing guidelines. This course emphasizes hands-on training exercises. Prerequisite: MECH 360.

MECH 432 Mechanical CAD/CAE/CAM 3(2, 0, 2)

This course seeks to expose the senior ME students to the realm of computer-aided design (CAD), computer-aided engineering (CAE), and computer-aided manufacturing (CAM); geometric modeling; numerical control; dimensioning and tolerance; statistical tolerancing; process selection; metrology. Prerequisites: MECH 330, and MECH 360.

MECH 444 Internal Combustion Engines 3(3,0, 0)

The course aims to give the student the theoretical background of internal combustion engines. It includes: description of engine classification and parts, Combustion and ignition processes, engine parameters and tests, analysis of two-stroke and four stroke internal combustion engines, rotary engines and thermodynamic cycle analysis, thermochemistry and fuel characteristics; Prerequisites: MECH 310

MECH 446 Gas Turbines 3(3, 0, 0)

A course that introduces the thermodynamic and aerodynamic theory forming the basis of gas turbine design: shaft power cycles; gas turbine cycles for aircraft propulsion; turbofan and turbojet engines; design and analysis of centrifugal and axial flow compressors and turbines. Prerequisite: MECH 310, MECH 342.

MECH 447 Steam Turbine **3(3, 0, 0)**

A course that deals with impulse and reaction steam turbines, steam turbine cycles, flow of steam in nozzles, design aspects of turbines stage losses and efficiency, velocity diagrams; and impulse and reaction blading velocities; nucleation, condensation, and two-phase phenomena in flowing steam; boiler room and its various equipment; the complete steam power plants; governors, electric generator, and power transmission lines. Prerequisite: MECH 310, MECH 342.

MECH 448 Refrigeration Systems **3(3, 0, 0)**

The course provides a thorough knowledge in the following subjects: review of basic concepts in thermodynamics and heat transfer in buildings, psychometric, human comfort, air-conditioning processes, ventilation and infiltration, heating and cooling load calculations, hot water heating systems, fans and duct design. Prerequisite MECH 341, MECH 342

MECH 449 Air Conditioning Systems **3(3, 0, 0)**

This course covers fundamental concepts and principles of mechanical vapor compression refrigeration cycles; gas cycle refrigeration; ultra-low- temperature refrigeration, cold storage refrigeration; functions and specifications of refrigeration equipment, applications. Prerequisite: MECH 341 and MECH 342.

MECH 451 Solar Energy **3(3, 0, 0)**

This course discusses the fundamentals of solar radiation, collectors and concentrators, energy storage, estimation and conversion formulas for solar radiation. Prerequisite: MECH 342, MECH 308

MECH 452 Power Plants **3(3, 0, 0)**

The course includes topics in steam turbine; coal and oil burners, waste heat recovery, efficiency improvement, steam condensers and cooling towers, gas turbines, hydraulic power plants and water turbines, Nuclear power plants, technology cooling, control and nuclear wastes management, power plants economics MECH 310, MECH 342.

MECH 453 Int. to Renewable Energy Systems **3(3, 0, 0)**

Introduction, Energy: Past, Today, and Future. Energy & Environment, Non-renewable energies. Solar Energy basics of Solar Energy, Photovoltaic, wind energy (resources, turbines, power calculations and Weibull distribution. Geothermal Energy, Ocean Energy. MECH 308, MECH 342.

MECH 460 Finite Element Methods in Mechanical Engineering **3(2, 0, 2)**

A course on the classification of machine components; displacement-based formulation; line elements and their applications in design of mechanical systems; isoperimetric formulation; plane stress, plane strain, axis-symmetric, and solid elements and their applications; modeling considerations and error analysis; introduction to ALGOR general formulation and Galerkin approach; and analysis of field problems. Prerequisites: MECH 231, and MECH 201.

MECH 470 Mechanics of Composite Materials **3(3, 0, 0)**

This course covers anisotropic elasticity and laminate theory, analysis of various members of composite materials, energy methods, failure theories, and micromechanics. Materials and fabrication processes are introduced. Prerequisites: MECH 231 and MECH 232.

MECH 496 Special Topics in Mechanical Engineering **3(3, 0, 0)**

Any selected topic in the state of the art of Mechanical Engineering

2- MECHANICAL ENGINEERING / Mechatronics & Robotics Electives

MECH 420 Advanced Mechatronics and Robotics **3 (2,0,2)**

Part of Mechatronics includes signal processing, logic and digital circuits, Data acquisition, Microprocessor and Microcontroller, and applications of mechatronics systems. Part of Robotics include kinematics and inverse kinematics, velocity kinematics – The manipulator Jacobian, manipulator dynamics, manipulator-mechanism design, different types of robots, and some cases studies. Executing some experiments in Mechatronics and Robotics Laboratory. Implementation of some mini projects. MECH 355.

MECH 430 Product Design and Development **3(3, 0, 0)**

This course covers modern tools and methods for product design and development. Teams of students conceive, design, and prototype a new physical product. Topics include identifying customer needs, product planning, product specifications, concept generation, industrial design, product architecture, product development economics, and design-for-manufacturing. Prerequisites: MECH 320 and MECH 330.

MECH 432 Mechanical CAD/CAE/CAM 3(2, 0, 2)
This course seeks to expose the senior ME students to the realm of computer-aided design (CAD), computer-aided engineering (CAE), and computer-aided manufacturing (CAM); geometric modeling; numerical control; dimensioning and tolerance; statistical tolerancing; process selection; metrology. Prerequisites: MECH 330, and MECH 360.

MECH 433 Mechatronics System Design 3(2, 0, 2)
A course that discusses mechatronics; data; numbering systems, architecture of microcontrollers, assembly language programming, A/D and D/A conversion; parallel I/O, programmable timer operation, interfacing sensors and actuators, applications; a team project on design and implementation of a mechatronic system. Prerequisites: MECH 355

MECH 440 Intelligent Control of Robotic Systems 3(2,0,2)
This course includes Introduction to classical and intelligent control systems, Intelligent systems and applied artificial intelligence, Intelligent control concepts, Artificial neural networks: Definition and structures, Introduction to fuzzy logic. Intelligent control in MATLAB/SIMULINK. Applications to mechanical, mechatronics and robotics systems. Executing some experiments in Mechatronics and Robotics Laboratory. Prerequisites: MECH 355, MECH 490

MECH 460 Finite Element Methods in Mechanical Engineering 3(2, 0, 2)
A course on the classification of machine components; displacement-based formulation; line elements and their applications in design of mechanical systems; isoperimetric formulation; plane stress, plane strain, axis-symmetric, and solid elements and their applications; modeling considerations and error analysis; introduction to ALGOR general formulation and Galerkin approach; and analysis of field problems. Prerequisites: MECH 331, and MECH 201.

MECH 470 Mechanics of Composite Materials 3(3, 0, 0)
This course covers anisotropic elasticity and laminate theory, analysis of various members of composite materials, energy methods, failure theories, and micromechanics. Materials and fabrication processes are introduced. Prerequisites: MECH 231 and MECH 232.

MECH 481 Computer-Integration Manufacturing Systems 3(3, 0, 0)
This course is intended to expose students to modern manufacturing and automation principles with a specific focus on CIM and engineering integration issues (both concepts as well as hands-on practice). CIM environment; CIM benefits; Business perspectives for CIM; objectives of manufacturing business; the business characteristics of CIM systems; components of a CIM architecture; simulation, group technology; networks; concurrent engineering; decision support systems; expert system; CAD/CAM; information and material flow in manufacturing; modeling methodology and related tools in analysis and design of CIM for medium size companies. Prerequisites: MECH 201, MECH 360

MECH 485 Industrial Robotics 3(2, 0, 2)
This course will cover the principles and techniques involved in industrial robotics. Emphasis will be placed on industrial robot applications, analysis of robot manipulators, components of industrial robots, robot programming and control. Students will explore the use of robotics and machine learning in the efficiency of industrial processes. Students will model, design, plan, program, select, and implement industrial robot systems. Prerequisites: MECH 355

MECH 492 Special Topics in Mechatronics & Robotics 3(2, 0, 2)
Any selected topic in the state of the art of Mechanical Engineering. Prerequisites: MECH 355

Course Descriptions

Required Courses:

[1] Credits hrs. (Lecture, Tutorial, Lab)

MECH 201 Mechanical Engineering Graphics 1(1, 0, 2)

Principles and techniques of 3D surface and solid modeling; Feature-based and constraint-based modeling systems; Data transfer between systems; Relationship of geometric modeling to manufacturing; Analysis and rapid prototyping; Development of 2D drawing from the solid model database: Design annotation including mechanical fastener specification, geometric Dimensioning and tolerance.

MECH 210 Thermodynamics I 3(3, 0, 0)

Thermodynamic concepts and definitions, states, properties, systems, control volume; processes, cycles, and units; pure substances, equation of states, table of properties; work and heat; the first law, internal energy and enthalpy; conservation of mass; SSSF and USUF processes; the second law, heat engines and refrigerators, reversible processes, Carnot cycle; entropy, Clausius inequality, principle of the increase of entropy, Efficiencies. Prerequisite: Discretion of advisor.

MECH 211 Thermodynamics (*for Civil Engineering*) 2(2, 0, 0)

Introduction to the thermodynamics: which include thermodynamics state and properties of a pure substance, system and control volume concepts, work and heat, the first law of thermodynamics, energy and mass conservation, entropy, the second law of thermodynamics; applications to closed setups and flow devices; simple vapor and gas cycles applications.

MECH 220 Dynamics 3(3, 1, 0)

Kinematics of particles; Rectilinear and curvilinear motion in various coordinate systems. Kinetics of particles; Newton's second law, Central force motion, Work-energy equation, Principle of impulse and momentum, Impact, Conservation of energy and momentum, Application to a system of particles. Kinematics of rigid bodies; Relative velocity and acceleration, Instantaneous center, Analysis in terms of a parameter. Plane kinetics of rigid bodies with application of Newton's second law, Energy and impulse-momentum. Prerequisites: MATH 201 and CIVE 210.

MECH 225 Engineering Mechanics *(for Electrical Engineering Students)* **(3, 0, 0)**

A course outlining vector mechanics of forces and moments; free-body diagrams; equilibrium of particles and rigid bodies in two and three dimensions; plane and space trusses. Kinematics of particles; Rectilinear and curvilinear motion in various coordinate systems, Kinetics of particles; Newton's second law, Central force motion. Axial loading, Material properties obtained from tensile tests, Stresses and strains due to axial loading. Thermal Stresses.

MECH 231 Strength of Materials 3(3, 0, 0)

Axial loading, Material properties obtained from tensile tests, Stresses and strains due to axial loading, Thermal Stresses, Elementary theory of torsion, Solid and hollow shafts, Thin-walled tubes, Rectangular cross-section, Stresses in beams due to bending, shear and combined forces. Composite beams, Analysis of plane stress, Mohr's Circle, Combined stresses, Thin-walled pressure vessels, Deflection of beams, Buckling of columns. Prerequisite: CIVE 210.

MECH 232 Engineering Materials 2(2, 0, 0)

Atomic structure and bonding. Crystalline structure. Imperfections in solids (defects in crystals). Diffusion. Mechanical properties of metals. Classification of materials (properties and applications). Failure; Phase diagram and alloy systems. The iron phase diagram. Phase transformations. Ferrous and non- ferrous metal alloys, ceramics, and polymers. Structure-property relationships. Material selection case studies. Prerequisite: CHEM 101

MECH 233 Engineering Materials Lab 1(0, 0, 2)

A laboratory course consisting of standard metallurgical and mechanical characterization tests on metals. Stress-strain plots, derived properties, fracture toughness, crystallography, hardness, and other properties. Ceramic flexure testing: Weibull plots. Polymers: stress-strain plots and derived properties, impact properties, creep, and relaxation. Prerequisite: MECH 230.

MECH 308 Electrical Circuits and Machines 3(3, 0, 0)

Introduction for DC circuit analysis, series and parallel, Ohm's law, KVL, KCL , Superposition theory and maximum power transfer , Introduction to analysis of AC circuit, Phasor analysis for single-phase , KVL and KCL in AC circuits, Analysis of three phase AC circuits, Transformers (construction, operation of single-phase transformers, equivalent circuit, voltage regulation and efficiency, auto-transformer, three-phase transformers), AC machinery fundamentals, three-phase induction machines (construction, operation, equivalent circuit, performance, calculations, starting of induction motors, speed control). Prerequisite: PHY 102

MECH 310 Thermodynamics II 3(3, 0, 0)

A course investigating the availability and work potential of systems; irreversibility; second law efficiency; availability; gas mixtures, air-conditioning; chemical reactions; high speed flow, nozzles and diffusers, environmental, economic, and social implications. Prerequisite: MECH 210.

MECH 320 Kinematics of Mechanical Systems 3(3, 0, 0)

Mechanisms and applications, mobility and linkages. Cams, gears and gear trains. Velocity and acceleration analysis in mechanisms. Inertia forces. Principles of balance in rotating & reciprocating masses. Prerequisite: MECH 220.

MECH 330 Mechanical Design 3(3, 0, 0)

Meaning and phases of design, considerations of design, stress analysis, deflection analysis, static strength and theories of failure, fatigue strength. Design of fasteners and connections; riveted joints, bolts and screws, force-deflection diagrams of bolted connections. Welded joints. Mechanical springs, helical, leaf, torsional spring Shafts. Prerequisites: MECH 200, MECH 230 and MECH 231.

MECH 341 Fluid Mechanics 3(3, 0, 0)

Basic and definitions, units, fluid proprieties, hydrostatics, basic control volume approach, continuity equation, Bernoulli equation, Euler's equation, energy equation, momentum principle and its applications, flow through orifice, pipe, major and minor losses in pipe. Prerequisite: MATH 202.

MECH 342 Heat Transfer 3(3, 0, 0)

Introduction to modes of heat transfer, one dimensional conduction; steady state and transient analysis, introduction to convection, forced and free convection analysis, internal and external flow, heat exchangers, introduction to thermal radiation heat transfer. Prerequisite: MATH 202, MECH 210

MECH 343 Heat Transfer Lab 1(0, 0, 2)

One-dimensional conduction heat transfer. Heat transfer through composite walls. Thermal conductivity of insulating material. Transient heat transfer. Forced convection heat transfer inside a heated tube. Forced convection from a circular cylinder subjected to cross flow. Natural convection from a vertical flat plate. Overall heat transfer coefficient in a double pipe heat exchanger. Heat exchanger test – shell and tube heat exchanger.

MECH 344 Fluid Lab 1(0, 0, 2)

Pressure Measurements: Manometers, Flow visualization: streak-lines and streamlines, Measurement of velocity distribution using Pitot-static tube. Jet impact on a flat plate- linear momentum. Volume flow measurements: orifice, nozzle and venture, Reynolds Experiment: Laminar and Turbulent flows. Losses in Pipes. Pumps.

MECH 352 Instrumentation and Measurements 2(2, 0, 0)

This course introduces general concepts of measurement systems; classification of sensors and sensor types; interfacing concepts; data acquisition, manipulation, transmission, and recording; introduction to LabVIEW; applications; team project on design, and implementation of a measuring device. Pre- or co-requisite: MECH 341.

MECH 353 Instrumentation and Measurements Lab 1(0, 0, 2)

Temperature Measurement and Calibration of Thermocouple, Pressure Measurement Calibration, Deflection Sensor, Force Sensor, Torque Sensor, Response of First Order Measuring System, Flow Sensor, Calibration of a Velocity Sensor Measurement of sound.

MECH 360 Manufacturing Processes I 3(3, 0, 0)

A course on material removal processes, processes both traditional and non-traditional. Assembly processes such as welding,

brazing, soldering, and fastening are also covered with an emphasis on process capabilities and limitations, relative cost, and guidelines for process selection. This course examines the behavior of materials under processing conditions and design for
manufacturing guidelines, and involves hands-on exercises in a machine shop environment. Prerequisite: MECH 230.

MECH 361L Manufacturing Processes Laboratory 1(0, 0, 2)
An introduction to the use and operation of selected industrial machinery, various machining operations, selected welding processes and precision measuring instruments. Laboratory projects will emphasize safety and apply selected manufacturing processes, various inspection processes, fixturing and engineering materials. Pre- or co-requisite: MECH 360.

MECH 400 Summer Internship (1 Cr.)
This is an eight to twelve-week professional training course in mechanical engineering. Prerequisite: Senior standing.

MECH 434 Mechanical Vibrations 3(3, 0, 0)
A course on free and forced response of non-damped and damped system; damping vibration absorption; response of discrete multi-degree of freedom systems; modal analysis; vibration measurement, case studies, vibration analysis with Matlab and Simulink. Prerequisite: MECH 220.

MECH 490 Dynamic Systems and Control 3(3, 0, 0)
This course is intended to provide students with the tools that enable them to model and control physical systems. It includes the
following: modeling of mechanical, fluid, electrical, and thermal systems; transfer function and block diagrams; time-domain analyses; root-locus; frequency-domain methods; stability analysis; design of PID controllers and dynamic compensators via the root locus and frequency methods. Prerequisites: MECH 220 and ELEE 210.

MECH 491 Dynamic Systems and Control Lab. 1(0, 0, 2)
This course involves a series of hands-on experiments on modeling and design of control systems using Matlab, Simulink, and
LabVIEW. The course also includes a team project. Pre- or co-requisites: MECH 350 and MECH 490.

MECH 498 Final Year Project I (1 Cr.)
A supervised project in groups of normally three students aimed at providing practical experience in some design aspects of
mechanical engineering. Students are expected to complete a literature survey, to critically analyze, and to acquire the necessary material needed for their intended end product. Prerequisite: Senior Standing.

MECH 499 Final Year Project II (3 Crs.)
A course in which the student integrates his/her acquired knowledge to deliver the product researched and planned in MECH 401.
Prerequisite: MECH 498.

Elective Courses

3- MECHANICAL ENGINEERING / General Electives

MECH 430 Product Design and Development 3(3, 1, 0)
This course covers modern tools and methods for product design and development. Teams of students conceive, design, and prototype a new physical product. Topics include identifying customer needs, product planning, product specifications, concept generation, industrial design, product architecture, product development economics, and design-for-manufacturing. Prerequisites: MECH 320 and MECH 330.

MECH 431 Manufacturing Processes II **3(2, 0, 2)**

A course on heat treatments, deformation, phase-change, and particulate consolidation processing of metals; fabrication processing of non-metallic engineering materials such as ceramics, polymers, and composites; emphasis on process capabilities and limitations, relative cost, and guidelines for process selection; the behavior of materials under processing conditions; design for manufacturing guidelines. This course emphasizes hands-on training exercises. Prerequisite: MECH 230.

MECH 432 Mechanical CAD/CAE/CAM **3(2, 0, 2)**

This course seeks to expose the senior ME students to the realm of computer-aided design (CAD), computer-aided engineering
(CAE), and computer-aided manufacturing (CAM); geometric modeling; numerical control; dimensioning and tolerance; statistical tolerancing; process selection; metrology. Prerequisites: MECH 200, MECH 330, and MECH 360.

MECH 442 Thermal Desalination Systems. **3(3,0, 0)**

Seawater composition. The need for water desalination. Classification of desalination processes. Single effect evaporation. Thermal vapor compression systems. Multiple effect evaporation. Multistage flash distillation, once through MSF, Brine mixing and recirculation MSF. Reverse osmosis. Desalination using renewable energy sources. Economic analysis of desalination processes

ENE443: Energy Conversion **3(3, 0, 0)**

This course covers three aspects of energy: Energy resources, Energy Conversion, Development, and environment. Energy Sources: Fossil fuels including, petroleum, coal, oil shale and tar sand, natural gas and hydrogen power. Renewable energy sources including: solar, wind, biomass, hydroelectric and geothermal. Energy Conversion: Conversion of thermal energy into electrical power including thermoelectric converters and fuel cells, thermoelectric systems, electric generators and alternators. Development and environment: implications for sustainable development: Technical, economic, ethical and philosophical aspects of sustainable development, Environment and sustainable development at urban, national and international levels. Prerequisite: MECH 342

MECH 444 Internal Combustion Engines **3(3,0, 0)**

The course aims to give the student the theoretical background of internal combustion engines. It includes: description of engine classification and parts, Combustion and ignition processes, engine parameters and tests, analysis of two-stroke and four stroke internal combustion engines, rotary engines and thermodynamic cycle analysis, thermochemistry and fuel characteristics; Prerequisites: MECH 210

MECH 446 Gas Turbines **3(3, 0, 0)**

A course that introduces the thermodynamic and aerodynamic theory forming the basis of gas turbine design: shaft power cycles; gas turbine cycles for aircraft propulsion; turbofan and turbojet engines; design and analysis of centrifugal and axial flow compressors and turbines. Prerequisite: MECH 341.

MECH 447 Steam Turbine **3(3, 0, 0)**

A course that deals with impulse and reaction steam turbines, steam turbine cycles, flow of steam in nozzles, design aspects of turbines stage losses and efficiency, velocity diagrams; and impulse and reaction blading velocities; nucleation, condensation, and two-phase phenomena in flowing steam; boiler room and its various equipment; the complete steam power plants; governors, electric generator, and power transmission lines. Prerequisite: MECH 341.

MECH 448 Refrigeration Systems **3(3, 0, 0)**

The course provides a thorough knowledge in the following subjects: review of basic concepts in thermodynamics and heat transfer in buildings, psychometric, human comfort, air-conditioning processes, ventilation and infiltration, heating and cooling load calculations, hot water heating systems, fans and duct design. Prerequisite ME 210, ME 342

MECH 449 Air Conditioning Systems **3(3, 0, 0)**

This course covers fundamental concepts and principles of mechanical vapor compression refrigeration cycles; gas cycle refrigeration; ultra-low- temperature refrigeration, cold storage refrigeration; functions and specifications of refrigeration equipment, applications. Prerequisite: MECH 210 and MECH 342.

MECH 451 Solar Energy **3(3, 0, 0)**

This course discusses the fundamentals of solar radiation, collectors and concentrators, energy storage, estimation and conversion formulas for solar radiation. Prerequisite: MECH 342.

MECH 452 Power Plants **3(3, 0, 0)**

The course includes topics in steam turbine; coal and oil burners, waste heat recovery, efficiency improvement, steam condensers and cooling towers, gas turbines, hydraulic power plants and water turbines, Nuclear power plants, technology cooling, control and nuclear wastes management, power plants economics MECH 342.

MECH 453 Int. to Renewable Energy Systems **3(3, 0, 0)**

Introduction, Energy: Past, Today, and Future. Energy & Environment, Non-renewable energies. Solar Energy basics of Solar Energy, Photovoltaic, wind energy (resources, turbines, power calculations and Weibull distribution. Geothermal Energy, Ocean Energy.

MECH 460 Finite Element Methods in Mechanical Engineering **3(3, 0, 0)**

A course on the classification of machine components; displacement-based formulation; line elements and their applications in design of mechanical systems; isoperimetric formulation; plane stress, plane strain, axis-symmetric, and solid elements and their applications; modeling considerations and error analysis; introduction to ALGOR general formulation and Galerkin approach; and analysis of field problems. Prerequisites: MATH 215, MECH 330, and MECH 342.

MECH 470 Mechanics of Composite Materials **3(3, 0, 0)**

This course covers anisotropic elasticity and laminate theory, analysis of various members of composite materials, energy methods, failure theories, and micromechanics. Materials and fabrication processes are introduced. Prerequisites: MECH 230 and MECH 231.

MECH 496 Special Topics in Mechanical Engineering **3(3, 0, 0)**

Any selected topic in the state of the art of Mechanical Engineering

4- MECHANICAL ENGINEERING / Mechatronics & Robotics Electives

MECH 413 Introduction to Mechatronics **3(3, 1, 3)**

This course will introduce you to Mechatronics as a multidisciplinary engineering discipline that includes electronics, electrical, mechanical, computer systems engineering, together with information technology. Theory lectures will introduce the core components of mechatronic systems: electrical and electronic components and circuits, sensors and actuators. In laboratory work, you will work on putting theory into practice in the context of a challenging project that is at the core of a national design and build competition. This course significantly develops the generic skills of teamwork, planning, leadership, and communication. Conventional lectures will be given on the theoretical aspects of these graduate capabilities. You will then apply these skills in the completion of specific learning activities such as design project, report, testing and prototyping. The dry run testing of the prototype Mechatronics mechanisms will provide an opportunity for you to receive feedback.

MECH 430 Product Design and Development **3(3, 1, 0)**

This course covers modern tools and methods for product design and development. Teams of students conceive, design, and prototype a new physical product. Topics include identifying customer needs, product planning, product specifications, concept generation, industrial design, product architecture, product development economics, and design-for-manufacturing. Prerequisites: MECH 320 and MECH 330.

MECH 432 Mechanical CAD/CAE/CAM **3(2, 0, 2)**

This course seeks to expose the senior ME students to the realm of computer-aided design (CAD), computer-aided engineering (CAE), and computer-aided manufacturing (CAM); geometric modeling; numerical control; dimensioning and tolerance; statistical tolerancing; process selection; metrology. Prerequisites: MECH 200, MECH 330, and MECH 360. ++++++++++++++++ **Lab**

MECH 433 Mechatronics System Design 3(2, 1, 2)

A course that discusses mechatronics; data; numbering systems, architecture of microcontrollers, assembly language programming, A/D and D/A conversion; parallel I/O, programmable timer operation, interfacing sensors and actuators, applications; a team project on design and implementation of a mechatronic system. Prerequisites: MECH 350.

MECH 435 Introduction to Robotics 3(3, 1, 0)

This course examines methods of specifying, designing, analyzing and testing robotics systems. The principles and processes of robotics systems engineering are introduced and applied to the development of robotic devices. The focus is on a robotic system engineered to perform complex behavior. Robotic systems embed computing elements, integrate sensors and actuators, operate in a reliable and robust fashion, and demand rigorous engineering from conception through production. The course is organized as a progression through the systems engineering process of conceptualization, specification, design, and prototyping with consideration of verification and validation. Students completing this course will engineer a robotic system through its compete design and initial prototype.

MECH 460 Finite Element Methods in Mechanical Engineering 3(3, 0, 0)

A course on the classification of machine components; displacement-based formulation; line elements and their applications in design of mechanical systems; isoperimetric formulation; plane stress, plane strain, axis-symmetric, and solid elements and their applications; modeling considerations and error analysis; introduction to ALGOR general formulation and Galerkin approach; and analysis of field problems. Prerequisites: MATH 215, MECH 330, and MECH 342.

MECH 470 Mechanics of Composite Materials 3(3, 0, 0)

This course covers anisotropic elasticity and laminate theory, analysis of various members of composite materials, energy methods, failure theories, and micromechanics. Materials and fabrication processes are introduced. Prerequisites: MECH 230 and MECH 231.

MECH 481 Computer-Integration Manufacturing Systems 3(3, 0, 0)

This course is intended to expose students to modern manufacturing and automation principles with a specific focus on CIM and engineering integration issues (both concepts as well as hands-on practice). CIM environment; CIM benefits; Business perspectives for CIM; objectives of manufacturing business; the business characteristics of CIM systems; components of a CIM architecture; simulation, group technology; networks; concurrent engineering; decision support systems; expert system; CAD/CAM; information and material flow in manufacturing; modeling methodology and related tools in analysis and design of CIM for medium size companies.

MECH 485 Industrial Robotics 3(2, 1, 2)

This course will cover the principles and techniques involved in industrial robotics. Emphasis will be placed on industrial robot applications, analysis of robot manipulators, components of industrial robots, robot programming and control. Students will explore the use of robotics and machine learning in the efficiency of industrial processes. Students will model, design, plan, program, select, and implement industrial robot systems. ++++++++++++++++ **Lab**

MECH 492 Special Topics in Mechatronics & Robotics 3(3, 0, 0)

Any selected topic in the state of the art of Mechanical Engineering