AGU Mechanical Engineering Courses

ME 101 Technical Drawing
Engineering drawing is taught for understanding the design process and making design models. In this context students will learn representing the design models by: hand sketching, projections, conventions, sections, dimensions, assemblies and other engineering drawing related topics. Students will also learn representing 3D models by using 3D CAD software as a tool. In this context they will learn how to use features, make parts and assemblies. They will also apply their knowledge to the project that has been specified throughout the semester. This project would also prepares students for project reporting, project specifications, design guidance and presentations.

ME 102 Engineering Innovation and Programming
This course aims to establish a fundamental knowledge on both the different areas of mechanical engineering and teach a computer programing language. Specifically, by the end of this course, students will be able learn the fundamentals of mechanics, thermodynamics, fluids, heat transfer, solid mechanics, vibration, robotics and MATLAB programming language. In particular MATLAB user interface, basic and commonly used commands, creating variables & matrix, vectors and matrices analysis automating commands, loops and functions will be covered during programming sessions. Therefore, by the end of this course, students will have fundamental knowledge about the different areas of mechanical engineering and MATLAB programming language.

ME 106 Mechanics I
This course will cover the Statics part of Engineering Mechanics. Statics is the branch of engineering mechanics that is concerned with the analysis of forces on physical systems in static equilibrium. It will also help students to interpret the forces supporting objects we encounter in our daily lives. Upon completion of this course you will be able to: calculate the moment of a force and couple vector in 3D-space using vector algebra; determine the resultants of force systems acting on rigid bodies; identify the types of contact between rigid bodies and draw the free body diagrams for a rigid body or for a group of rigid bodies; establish the equations of equilibrium for a rigid body or a group of rigid bodies; calculate the internal forces in engineering structures composed of simple trusses or beams; analyze the static problems involving friction; determine the geometric properties of surfaces and volumes; understand the basic principles that govern the static equilibrium of bodies under the action of forces; and apply the knowledge and tools of statics to solve engineering problems.

ME 108 Materials Sciences

Modern science and technology is highly dependent on materials whose properties can be controlled to accommodate a wide range of applications. The multidisciplinary field of materials science and engineering outlines approaches to enhance the manipulation of existing materials and synthesis of new materials. The purpose of this course is to present to students the basic principles necessary to understand not only an engineering materials but also basic level of composites. Classification of materials, atomic structure, periodic table, molecular structure, bonding in solid materials, structure of crystalline solids, mechanical properties and failure of materials, hydrogen embrittlement, dynamic strain aging, phase diagrams, properties and use of metal alloys and composites will be covered during the semester.

ME 202 Fluid System Design

The objective of this course is to integrate material learnt in prior themo-fluid courses, and to provide students with an introduction to system-oriented design methods. The design, operation and performance of mechanical equipment commonly used in thermo-fluid systems will be reviewed. Methods in system simulation (CFD) and optimization will be introduced. Students complete a series of design oriented projects in small teams to develop design methodology, recognizing and defining open-ended engineering problems, problem definition, concept generation, project planning, modelling, analysis, decision making, design synthesis, prototyping and testing, teamwork skills. Project topics involve design, analysis, and optimization of fluid flow, heat transfer and energy processes of ducts and piping, heat exchangers, fluid machinery, air-conditioning and heating systems, power generation, aerodynamics, and environmental control systems.

ME 204 Strength

This course aims to teach students the principles of Mechanics of Materials and to develop engineering problem solving skills in stress/strain/deflection analysis through application of related principles. Topics covered include: behavior of axially loaded members; torsion in circular shafts; stresses and deflections in beams with symmetric cross sections; stress and strain transformation when coordinate systems are rotated; principle stresses; triaxial stresses and maximum shear stress; response in thin walled pressure vessels. The course will rely on the students' prerequisite knowledge of mathematics and basic science in developing principles and analytical techniques of mechanics of materials.

ME 205 Mechanical Engineering Labs

In this course, students learn various measurement principles and get exposed to instrumentation practices in engineering perspective. The students train their test techniques and develop creative thinking and diagnostic skills. Students also improve their data analysis capabilities as well as deriving valuable information from experimental data.

ME 206 Mechanics II
In this course, students will learn about kinematics and kinetic analyses of a particle and a rigid body. In detail, the position, velocity and acceleration definitions will be done to analyze the geometry of the motion of a particle and a rigid body. For the kinetics, force analyses that causes this motion and concept of work and energy will be taught. In addition concepts of impulse and momentum will be introduced throughout the kinetics of a particle and a rigid body. In a summary throughout the course students will be able to conduct: Kinematics of particles, kinetics of particles, kinematics of rigid bodies, kinetics of rigid bodies.

ME 207 Fluid Mechanics
This class provides students with an introduction to principal concepts and methods of fluid mechanics. Topics covered in the course include pressure, hydrostatics, and buoyancy; open systems and control volume analysis; conservation laws for mass, momentum, and energy; viscous fluid flows, flow through pipes; flow similarity and dimensional analysis; boundary layers; laminar and turbulent flows, and lift and drag on objects. Students will learn to formulate the models necessary to study, analyze, and design fluid systems through the application of these concepts; to understand the importance of viscosity in real world applications; to use equations in combination with experimental and numerical data in determining dynamics of flow systems, and to develop the problem-solving skills essential to good engineering practice of fluid mechanics in practical applications.

ME 209 Materials Design
This course aims to establish a fundamental knowledge on the design and development of novel materials used in the broad range of technological applications from aerospace to bioscience. Therefore, by the end of this course, students will be able learn the principles behind the innovation and development of the novel materials used in the interdisciplinary fields, select the appropriate material which meets the desired mechanical, physical and chemical criteria, analyze the microstructural and mechanical properties of the materials by utilizing the mechanical test setups and characterization techniques, perform the knowledge gained in class through applying the theory into practice and incorporate the scientific innovations with real world applications to obtain the optimum result.

ME 301 Machine Elements I
This course provides students with the opportunity to develop and demonstrate an understanding of the basic procedures used in the design of mechanical systems. Topics covered include stress, deflection and stiffness analyses, statistical and reliability considerations, theories of failure for ductile and brittle materials, fatigue design and introduction to the design of mechanical elements. Therefore, by the end of this course, students will be able learn the load analysis, deflection analysis, static failures, fatigue failures, different machine elements and their usage areas and the design of mechanical elements will be introduced.

ME 302 Machine Elements II
This course is the continuation of the ME 301 course. Therefore, this course is aimed to teach an understanding of the design of different machine element, such as shafts, gears and bearings. Topics covered include design of shaft and shaft components, screws, fasteners and the design of nonpermanent joints, welding, bonding and the design of permanent joints, mechanical spring, rolling-contact bearings, lubrication and journal bearings, introduction of gears, spur and helical gears, bevel and worm gears, clutches, brakes, couplings and flywheels. Moreover, finite element analysis will be explained to the students. Therefore, by the end of this course, students will have fundamental knowledge about machine elements used in practical mechanical engineering applications.

ME 303 Manufacturing
In this course, students learn using various manufacturing tools and machinery as well as physical principles of forming. Starting from additive manufacturing, students learn forming engineering materials with a strong focus on metals. Metal forming, forging, metal machining, welding and casting are examples of many manufacturing processes used in engineering applications. Most of these methods are taught with hands-on experience with lab exercises.

ME 304 Mechatronics and Measurements
In this course, fundamental methods of analog circuit design and analysis are given for AC and DC domains. Methods for voltage and current analysis of nonlinear circuit components such as diodes, op-amps, and transistors are given. Simple filter design and signal conditioning techniques are provided. Fundamental methods for using measurement components are given along with amplifier circuit designs. The course is concluded with electrical power transmission and an introduction to electromechanical machines. Students are guided to complete a project to show their understanding.

ME 305 System Dynamics and Control
In "System Dynamics and Control" course, students learn how to create lumped model of linear engineering systems (mechanical, electrical, fluid, etc.) and represent these systems with dynamic equations. Using these dynamic equations, the transient and steady-state response of the modeled systems are analyzed for various input signals. Stability of the systems is analyzed using frequency response methods. Finally, an introduction to feedback control with an emphasis on the PID control is given.

ME 306 Machine Theory
In this course, students will learn about mechanisms, kinematics and dynamic analyses, machine dynamics, equation of motion, force/torque analysis on machines, analysis of parallel structured mechanisms and modeling of machines. In a summary throughout the course students will be able to conduct: kinematics analysis of mechanisms, dynamics analysis of mechanisms, analysis of conceptual design and system modeling, analyses of multi-degree of freedom multi-body mechanisms. Students will also apply their knowledge for analysis of several mechanisms in the simulation environment. For this purpose, students will be taught using vectoral analysis software, and computation software, like MATLAB.

ME 307 Thermodynamics and Heat Transfer
This course is an introduction to the principal concepts and methods of thermodynamics and heat transfer. Topics covered in the course include properties, property relationships, heat and work, first and second laws of thermodynamics, thermodynamic processes, introduction to ideal power cycles, introduction to heat transfer by conduction, convection, and radiation, steady and transient states, steady periodic states, and heat transfer in engineering apparatuses. The objectives of this integrated course are; to develop the fundamental principles and laws in thermal systems; to explore the implications of these principles for system behavior; to formulate the models necessary to study, analyze and design thermal systems through the application of these principles, and to develop the problem-solving skills essential to good engineering practice of thermodynamics and heat transfer in real-world applications.

ME 308 Thermo-fluid Design
The first part of this course involves practical implementations and design approach of Brayton, refrigeration, Rankine, Otto and Diesel cycles. Students will correlate basics of thermodynamics and perform analysis and designs of various thermodynamic cycles. The second part involves to understand and adapt the heat exchangers by applying apply analytical and numerical methods of the principles of heat transfer by conduction, convection, and radiation. This course will also enable students the basic of the heat transfer with mass transfer through experimental and numerical problem solving techniques.

ME 401 Capstone Design I
In this course, students find the opportunity of working on real-world applications. Students form teams and work on their preferred design projects. Starting from defining design requirements, students work on multiple stages of conceptual design of an engineering system or components. Students use CAD methods for conveying their ideas with others and use their prior engineering design methods in order to find solutions to their design problems and performance improvements.

ME 402 Capstone Design II
In this course, students find the opportunity of working on real-world applications. Following ME 401 Capstone Design I, students work on embodiment of their preferred projects. Being done with the conceptual design and the theoretical work, in this course, students focus on prototyping, manufacturing and conducting performance tests on their designs, and finally creating an end product which provides a solution to a real-world problem. In this course, students use their prior knowledge of machine design principles and interdisciplinary background. Students use their leadership and teamwork skills.

ME 403 Prototyping
This class gives students the opportunity of having hands-on experience on multiple stages of product design and embodiment. From conceptual design to final product, students work on bringing their ideas to life. From simple manufacturing techniques for rapid prototyping (such as additive manufacturing with 3D printers) to advanced manufacturing machinery (CNCs) are available to students for improving their hands-on experience on product design.

ME 404 Machine Design
"Machine Design" course covers the design and analysis of fundamental machine parts (shafts, cams, fasteners, gears, bearings, springs, etc.), their role in design of machines as well as analysis of static and dynamic loads on machine parts. This course also covers failure theories and calculation of components' expected life.

ME 405 Mechanism Design
In this course, students will apply their learnings from previous courses, especially theory of machines which is about mechanisms, kinematics and dynamic analyses, machine dynamics, equation of motion, force/torque analysis on machines, analysis of parallel structured mechanisms and modeling of machines. In a summary throughout the course students will be able to conduct: kinematics analysis of mechanisms, dynamics analysis of mechanisms, analysis of conceptual design and system modeling, analyses of multi-degree of freedom multi-body mechanisms for their design purposes. Students would eventually apply their knowledge into several mechanisms both in the simulation environment and their built prototypes. For this purpose, students will be taught using vectoral analysis software, and computation software, like MATLAB and prototyping with 3D-printers.

ME 421 Introduction to Robotics
In this course, fundamental mathematical tools for analysis and design of robot manipulators are given. Starting from simple spatial descriptions and transformations, forward and inverse kinematics of robot manipulators are given along with Jacobian calculation for velocities and static forces. Robot manipulator dynamics is given using rigid body dynamics approach. The course is concluded with introduction to trajectory generation and linear control of robot manipulators. Students will use an industrial robot to apply their theoretical knowledge.

ME 423 Microstructure Engineering
This course is aimed to teach the relationship between mechanical properties of materials and microstructure and obtain a good knowledge on crystal plasticity and multi-scale modeling. Therefore, by the end of this course, students will be able learn the defects in materials and their effects, the elastic deformation & plastic deformation at both micro and macro scales, the fracture mechanisms in materials, the effects of hydrogen interstitial on the microstructure of materials, the diffusion and localization of atomic hydrogen both close and far away from dislocations, the stacking faults in materials, the crystal plasticity modeling and multi-scale modeling approach.