MECHANICAL ENGINEERING (MEEN)

MEEN 5311 Dynamics and Control Systems I
3 Semester Credit Hours (3 Lecture Hours)
This course is designed to prepare students with the study of the intersection between dynamic systems and how to control them. Dynamics is a section of mechanics that deals with the accelerated motion of a body or system. Dynamics can be presented in two parts: kinematics (geometric aspects of motion) and kinetics (analysis of forces causing the motion). In order to analyze an enable dynamics on mechanical systems control systems theory can be implemented. Control systems consist of subsystems and processes assembled for the purpose of obtaining a desired output with desired performance, given and specified inputs. Control theory then enables the student with the knowledge to enable a desired output on dynamic systems based on inputs. Topics cover Planar Kinematics and Kinetics of a Rigid Body, Three-Dimensional Kinematics and Kinetics of a Rigid Body and Vibrations. That will be done with the complementary analysis and utilization of control systems tools such as Multidomain Modeling (frequency and time), Reduction of Multiple Subsystems, Stability, Steady-State Errors and Root Locus Techniques. (Cross-listed with EEEN 5311 Dynamics and Control Systems I.)

MEEN 5312 Mechatronics
3 Semester Credit Hours (3 Lecture Hours)
This course introduces a multidisciplinary field that combines electrical engineering, mechanical engineering, control systems and computer science. It presents key aspects in the design of systems, devices and products and it aims at the analysis of the behavior and control of the systems. Topics covered in this course bring together different areas of technology involving actuation systems, computer-aided design, sensors, signal conditioning, data acquisition, and programming. Course includes hands-on activities related to acquiring experience with electronics, computer-aided design, programming, and control systems. (Cross-listed with EEEN 5312 Mechatronics.)
Prerequisite: MEEN 5311.

MEEN 5313 Engineering System Design
3 Semester Credit Hours (3 Lecture Hours)
Application of systems engineering principles to mechanical engineering design. Determination of functional and performance requirements; optimization and trade-offs; conceptual design. Inclusion of life-cycle and manufacturability considerations in design. Principles will be applied in a design project in the course.
Prerequisite: ENGR 5302.

MEEN 5314 Robotics and Autonomous Systems
3 Semester Credit Hours (3 Lecture Hours)
Robots and Autonomous Systems are projected to benefit our society as new technologies are being developed. This course involves an introduction and survey of contemporary robotic mechanisms or systems, and field applications. This course includes the understanding of basic principles of robotics such as embedded systems in automated systems, manipulator kinematics and design, and principles of unmanned ground, aquatic, surface, and aerial vehicles. The student will be introduced to the Robotic Operating System (ROS) environment and its application in modern robotics. Also, there will be a survey in multi-agent modeling and its application on multi-robot systems. Other topics to be discussed are path-planning for navigation, task allocation and decision making, machine learning and artificial intelligence technologies with the complement of multi-sensor data fusion that can currently enable certain levels of autonomy in robots. (Cross-listed with EEEN 5314 Robotics and Autonomous Systems.)
Prerequisite: MEEN 5311.

MEEN 5321 Intermediate Fluid Mechanics
3 Semester Credit Hours (3 Lecture Hours)
Differential equations of fluid mechanics, Newtonian and non-Newtonian fluids, boundary-layer theory, similarity solutions and integral methods for laminar flows. Two-dimensional and axisymmetric boundary layers. Introduction to transition and turbulent flow.
Prerequisite: ENGR 5401.

MEEN 5322 Advanced Fluid Mechanics
3 Semester Credit Hours (3 Lecture Hours)
Equations of motion for compressible fluid flow; nozzle flows; shocks and expansions; flows with heat addition and friction; unsteady one-dimensional flows; method of characteristics for one-dimensional unsteady and two-dimensional steady flows; flows about two-dimensional and axisymmetric bodies.
Prerequisite: MEEN 5321.

MEEN 5323 Computational Fluid Dynamics I
3 Semester Credit Hours (3 Lecture Hours)
Classification of partial differential equations. Finite-difference and finite-volume discretization techniques and solution methods for linear and non-linear, steady and unsteady problems; accuracy, convergence, and stability. Multigrid methods, validation techniques. Current computational techniques and solution methods.
Prerequisite: ENGR 5302 and MEEN 5321.

MEEN 5324 Turbulent Flow
3 Semester Credit Hours (3 Lecture Hours)
Transition from laminar flow; turbulent wall-bounded flows, jets, and wakes. The nature of turbulent flow; Reynolds averaging and correlated variables; mixing length and integral scales; law of the wall and wake law; the Kolmogorov structure of turbulence, the energy cascade, diffusion; energy, mass, and momentum exchange; structure of turbulent flows; fundamentals of modeling turbulent flows.
Prerequisite: MEEN 5321.

MEEN 5331 Intermediate Heat and Mass Transfer
3 Semester Credit Hours (3 Lecture Hours)
Heat and mass transfer by diffusion in one-dimensional, two-dimensional, transient, periodic, and phase change systems. Convective heat transfer for external and internal flows. Similarity and integral solution methods. Heat, mass, and momentum analogies. Turbulence. Buoyancy driven flows. Convection with phase change. Radiation exchange between surfaces and radiation transfer in absorbing-emitting media. Fickian and non-Fickian diffusion, multi-component diffusion, and diffusional transport in porous media.
Prerequisite: ENGR 5401.

MEEN 5332 Advanced Heat Transfer
3 Semester Credit Hours (3 Lecture Hours)
An advanced treatment of conduction, convection, and radiation heat transfer from a Reynolds transport theorem perspective. Topics include: three dimensional steady-state and transient conduction, phase change; forced and free convection; internal and external flows; black body radiation; radiative exchange between nongray surfaces; radiative transfer equation; numerical modeling and simulation of heat transfer phenomena; term project.
Prerequisite: MEEN 5331.