ENMT - MECHATRONICS ENGINEERING

ENMT301 Structural Dynamics (3 Credits)
An introduction to modeling and structural analysis of mechatronic structures subject to dynamic loading. It deals with preliminary analysis of primary structure for mechatronics components, including such topics as load determination, torsion, bending, shear, buckling, fatigue and thermal analysis of thin-walled structures. Emphasis is placed on solving problems by finding the differential equations of motion of model systems and solving these equations analytically or numerically in Matlab.
Prerequisite: Minimum grade of C- in ENES220.
Restriction: Must be in the Mechatronics Engineering program.

ENMT313 Real Time Software Systems and Microprocessors (3 Credits)
Timing, synchronization and data flow; parallel, serial, and analog interfaces with sensors and actuators; microprocessor system architecture; buses; direct memory access (DMA); interfacing considerations. System simulation in CAD.
Prerequisite: Minimum grade of C- in ENMT322.
Restriction: Must be in the Mechatronics Engineering program.

ENMT322 Discrete Signal Analysis (3 Credits)
Analysis techniques for simulating resonances and impedances in systems that couple physical interactions electrical, mechanical, magnetic and piezoelectric domains. Analysis applied to modeling the electro-magneto-mechano-acoustic domain interactions in traditional loudspeaker designs, and can be extended to the design of sensors, energy harvesters and actuators.
Prerequisite: Minimum grade of C- in MATH246.
Restriction: Must be in the Mechatronics Engineering program.

ENMT332 Classical Control Theory (3 Credits)
An introduction to the feedback control of dynamic systems. Laplace transforms and transfer function techniques; frequency response and Bode diagrams. Stability analysis via root locus and Nyquist techniques. Performance specifications in time and frequency domains, and design of compensation strategies to meet performance goals.
Prerequisite: Minimum grade of C- in ENMT301.
Restriction: Must be in the Mechatronics Engineering program.

ENMT361 Mechatronics and Controls I (3 Credits)
Basic instrumentation electronics including DC electronics, AC electronics, semiconductors, electro-optics and digital electronics. Sensing devices used to carry out experiments including meteorology, machine tool measurements, bridge circuits, optical devices, and introduction to computer based data acquisition.
Prerequisite: Minimum grade of C- in PHYS270 and PHYS271.
Restriction: Must be in the Mechatronics Engineering program.

ENMT362 Mechatronics and Controls Lab II (3 Credits)
Focuses on designing mechanical motion transmission systems, including gearing, couplings, belts, and lead screws. Students will learn to measure and sense mechanical motion while selecting appropriate sensors and electromechanical actuators. Topics include programmable logic controllers (PLCs), sequential controller design, and digital input/output systems. Practical applications and case studies provide hands-on experience in integrating these components into functional systems.
Prerequisite: Minimum grade of C- in ENMT361.
Restriction: Must be in the Mechatronics Engineering program.

ENMT372 Robotic Systems (3 Credits)
General domain knowledge. Manipulators, rovers, flight vehicles/quadcopters. Constraint considerations and analysis. Introduces the Robot Operating System (ROS) framework.
Prerequisite: Minimum grade of C- in ENMT380.
Restriction: Must be in the Mechatronics Engineering program.

ENMT380 Intro to Robotics (3 Credits)
Introduces basic concepts for deployment of robotic systems in mechatronics. This course will introduce students to the elementary concepts in robotics, with emphasis on robotic manipulators. It will encompass both theory and laboratory components with programming on real manipulators.
Prerequisite: Minimum grade of C- in ENME202 or ENAE202; and minimum grade of C- in ENES221 and MATH246.
Restriction: Must be in the Mechatronics Engineering program.
Credit Only Granted for: ENMT380 or ENME480.

ENMT450 Robotics Programming (3 Credits)
Students continue to work within the Robot Operating System (ROS) as well as with many of the available tools commonly used in robotics. Lectures focus on theory and structure, whereas laboratory sections will focus on applications and implementations. Students learn how to create software and simulations, interface to sensors and actuators, and integrate control algorithms. Topics include ROS architecture, console commands, ROS packages, simulation environments, visualizations, autonomous navigation, manipulation, and robot vision.
Prerequisite: ENMT322.

ENMT471 Advanced Manufacturing and Automation (3 Credits)
Introduction to manufacturing processes and the methods for automating them. Introduces computer-aided design to model parts and assemblies. Theory and practice of additive and subtractive manufacturing processes. Introduction to composite materials. Integrating automated machining into factories.
Prerequisite: Minimum grade of C- in ENMT372.
Restriction: Must be in the Mechatronics Engineering program.
Credit Only Granted for: ENMT471 or ENMT487.
Formerly: ENMT487.

ENMT473 Motion Planning for Autonomous Systems (3 Credits)
Autonomous systems (e.g., aircraft, vehicles, manipulators, and robots) must plan long-term movement that respects environmental constraints such as obstacles, other actors, and wind; system constraints such as kinematics, dynamics, and fuel; as well as factors such as time and safety. Robust autonomy also requires dealing with environmental changes, new information, and uncertainty. This course provides an overview of such problems and the methods used to solve them.
Prerequisite: ENMT332.
Restriction: Must be in the Mechatronics Engineering program at the Universities at Shady Grove.

ENMT477 Machine Learning in Mechatronics Engineering (3 Credits)
Machine learning (ML) principles along with their application to mechatronic systems are introduced. Different ML paradigms, such as supervised, unsupervised, and reinforcement learning are covered. Topics include data pre-processing and feature engineering, linear and polynomial regression, anomaly detection, deep learning for computer vision, and reinforcement learning. Students learn to model, control, and optimize mechatronic systems using ML models through weekly labs, programming assignments, and a hands-on final project.
Restriction: Must be in the Mechatronics Engineering program.

ENMT483 Mechatronic Systems I (3 Credits)
Covers the principles of mechatronic systems analysis and design. Students will learn performance analysis and optimization, design of systems including avionics, power, propulsion, human factors, structures, actuators and mechanisms, and thermal control. The course will also cover design processes and design synthesis. The course will conclude with students applying what they have learned so far with a project in mechatronic systems design.
Prerequisite: ENMT362.
Restriction: Must be in the Mechatronics Engineering degree program at the Universities at Shady Grove.

ENMT484 Mechatronic Systems II (3 Credits)
Covers the principles of mechatronic systems analysis and design. Students will learn performance analysis and optimization, design of systems including avionics, power, propulsion, human factors, structures, actuators and mechanisms, and thermal control. The course will also cover design processes and design synthesis. The course will conclude with students applying what they have learned so far with a project in mechatronic systems design.
Prerequisite: Minimum grade of C- in ENMT380, ENMT362, and ENMT483.
Restriction: Must be in the Mechatronics Engineering program.

ENMT488 Topics in Mechatronics Engineering (1-4 Credits)
Technical elective taken with the permission of the student's advisor and instructor. Lecture and conference courses designed to extend the student's understanding of mechatronics engineering. Current topics are emphasized.
Restriction: Permission of Mechatronics Engineering program at Shady Grove.
Repeatable to: 6 credits if content differs.

ENMT499 Elective Research (3 Credits)
Independent research in the Department of Mechatronics Engineering
Restriction: Permission of department required.
Repeatable to: 6 credits.