

Mechanical Engineering (MECH)

MECH 500 Clean Energy Systems 3 Credits (3,0)

Energy systems for stationary and transportation applications; fuel cells, wind energy, wave energy, geothermal, solar; minimizing environmental effects; energy requirements for industrialized societies; waste energy and byproducts.

Course Offered at: Daytona Beach

MECH 501 Modeling Methods in Mechanical Engineering 3 Credits (3,0)

Vector field theory; curvilinear coordinate systems; solution methods for differential equations, eigenvalue problems, partial differential equations; applications to heat transfer, fluid flow, vibrations, solid mechanics.

Course Offered at: Daytona Beach

MECH 503 Introduction to Autonomous Vehicle Systems 3 Credits (3,0)

Overview of uncrewed and autonomous vehicle systems; locomotion platforms (land, air, marine); sensors (GPS, inertial, magnetic, vision); perception, planning, navigation; path algorithms (Dijkstra, A*); case studies, simulations.

Course Offered at: Daytona Beach

MECH 506 Design for Manufacturing and Assembly 3 Credits (3,0)

Manufacturing processes; lifecycle design; tolerances, material properties; machining, casting, manufacturing processes; assembly; total cost, case studies and simulations.

Course Offered at: Daytona Beach

MECH 508 Hybrid and Electric Vehicles 3 Credits (3,0)

Modeling and simulation of hybrid and electric vehicle systems; HEVs, PHEVs, BEVs; advanced internal combustion engines, powertrains, electrical components, energy storage; power management strategies; EPA drive cycles; hydrogen fuel cells, fuel cell vehicles.

Course Offered at: Daytona Beach

MECH 511 Computational Heat Transfer 3 Credits (3,0)

Finite element methods and computational fluid dynamics for heat transfer problems; heat conduction, convection, conjugate heat transfer, advanced meshing.

Course Offered at: Daytona Beach

MECH 513 Perception Methods for Autonomous Systems 3 Credits (3,0)

Techniques for autonomous system perception; sensor calibration, computer vision, point cloud segmentation, map construction; sensing modalities (LiDAR, radar, sonar); MATLAB, Python, C programming.

Prerequisites: MECH 503

Course Offered at: Daytona Beach

MECH 520 Sensor Processing with Applications 3 Credits (3,0)

Signal conditioning, system identification, controller design; Kalman filtering, neural networks, adaptive control systems; data collection and sensor processing using LabVIEW, MATLAB.

Course Offered at: Daytona Beach

MECH 521 HVAC Systems 3 Credits (3,0)

Thermodynamics, heat transfer, fluid flow; psychometric performance of HVAC systems; refrigeration, cooling coils, heat exchangers, ducts, fans, heat pumps; background in thermodynamics and heat transfer required.

Course Offered at: Daytona Beach

MECH 522 Mechanical System Design 3 Credits (3,0)

3D solid modeling theory and problem solving; CAD design principles; application to mechanical engineering challenges.

Course Offered at: Daytona Beach

MECH 523 Linear Systems 3 Credits (3,0)

Fundamentals of linear systems theory; simulation of free and controlled responses of linear dynamical systems; state space representations; linearization of nonlinear systems; linear vector spaces; norms and inner products; solution of linear time-invariant systems; matrix exponential; stability of linear time-invariant systems; eigenvalues and eigenvectors; coordinate transformations; Laplace transforms and transfer functions; controllability and observability; Kalman decompositions; MATLAB used for simulation and analysis.

Course Offered at: Daytona Beach

MECH 527 Modern Control Systems 3 Credits (3,0)

State-space system models, controllability, observability, stability; PID and state feedback controllers; z-transform; model predictive control, adaptive control, robust control, Kalman filters.

Course Offered at: Daytona Beach

MECH 530 Advanced Kinematics and Mechanics 3 Credits (3,0)

Modeling and design of robotic mechanisms; kinematic and dynamic models, Jacobian, coordinate transformations; design of wheeled, tracked, walking, biologically inspired systems; hands-on projects.

Course Offered at: Daytona Beach

MECH 532 Field Robotics 3 Credits (3,0)

Autonomous system development; CONOPs, autonomy architectures, vehicle safety, data streams, debugging; test design and analysis.

Course Offered at: Daytona Beach

MECH 542 Computational Biofluid Mechanics 3 Credits (3,0)

Numerical modeling of cardiovascular fluid mechanics; lumped parameter models, fluid-structure interactions, bioheat transfer.

Course Offered at: Daytona Beach

MECH 543 Kinetic Modeling of Thermo-Fluids Transport 3 Credits (3,0)

Kinetic theory basis and kinetic modeling principles; Boltzmann equation and its models; particle velocity discretization and lattice models; Boltzmann simulations for fluid mechanics and heat transfer problems; initial and boundary conditions; The treatment of curved and complex boundaries; code development and model validation. Ideal for students who are interested in fundamental concepts in kinetic modeling as well as hands-on skills in developing program codes of kinetic models for thermo-fluids transport problems.

Course Offered at: Daytona Beach

MECH 544 Computational Biomechanics 3 Credits (3,0)

Human musculoskeletal system simulations; kinematic and dynamic modeling; muscle forces, joint contact forces; applications to medicine, sports, rehabilitation; motion capture, force plates, electromyography.

Course Offered at: Daytona Beach

MECH 548 Introduction to Continuum Mechanics 3 Credits (3,0)

Analysis of stress and deformation at a point; derivation of basic equations of a continuous medium by applying conservation laws (mass, linear momentum, moment of momentum, thermodynamics); study of constitutive axioms and constitutive relations for fluids and solids; specialization of field equations to simple boundary-value problems of solid mechanics and fluid mechanics with solutions.

Course Offered at: Daytona Beach

MECH 550 Modeling Complex Systems 3 Credits (3,0)

Comprehensive introduction of the complex systems, basic mathematical methods for complex system analysis, network models, agent-based models, phase portraits, review of probability theory, Markov processes, information theory, data-driven modeling, modeling of disease/rumor spread, self-propelled particle systems, engineering networks, multiagent systems, coupled-oscillator dynamics.

Course Offered at: Daytona Beach

MECH 560 Tissue Biomechanics 3 Credits (3,0)

Mechanical behavior of biological tissues; stress-strain analysis; finite element analysis of biological structures; modeling viscoelastic behavior, structure-function relationships.

Course Offered at: Daytona Beach

MECH 592 Mechanical Engineering Practicum 3 Credits (3,0)

Supervised engineering practicum experience. Literature reviews. Generate technical publication meeting professional standards.

Course Offered at: Daytona Beach

MECH 599 Special Topics in Mechanical Engineering 1-6 Credit (1-6,0)

Individual, independent, or directed studies of selected topics in mechanical engineering.

Course Offered at: Daytona Beach, Prescott

MECH 601 Advanced Modeling Methods in Mechanical Engineering 3 Credits (3,0)

Weighted residuals for finite differences, volumes, elements, boundary elements, meshless methods; radial-basis functions, boundary element and meshless formulations for heat transfer, fluid flow, vibrations, solid mechanics.

Course Offered at: Daytona Beach

MECH 610 Automation and Additive Manufacturing 3 Credits (3,0)

Additive manufacturing principles; rapid prototyping methods; computer-aided tools; design process; problem-solving methods; interdisciplinary teamwork; industrial practices; manufacturing process capabilities; hands-on learning.

Prerequisites: MECH 522

Course Offered at: Daytona Beach

MECH 612 Computer Integrated Manufacturing 3 Credits (3,0)

Design for manufacturing and assembly principles; 3D solid modeling, additive and subtractive manufacturing; manufacturing drawings, machine operations, simulations.

Prerequisites: MECH 527

Course Offered at: Daytona Beach

MECH 613 Advanced Model-Based Control Design 3 Credits (3,0)

Rapid control prototyping, hardware-in-the-loop simulation; real-time model execution; hands-on projects with advanced tools like Simulink Coder, Realtime Windows Target.

Course Offered at: Daytona Beach

MECH 614 Multidisciplinary Design Optimization 3 Credits (3,0)

Structural optimization, parametric optimization, design of experiments, sensitivity, genetic algorithms, response surface approximation, multidisciplinary integration (structures, fluids, thermal, manufacturing, cost).

Course Offered at: Daytona Beach

MECH 615 Pattern Recognition and Machine Learning 3 Credits (3,0)

Classification, regression, reinforcement learning; Bayesian theory, support vector machines, hidden Markov models; statistical inference for pattern recognition and machine learning.

Prerequisites: MECH 520

Course Offered at: Daytona Beach

MECH 616 Design and Manufacturing of Biomedical Devices 3 Credits (3,0)

Manufacturing processes and lifecycle design for biomedical devices; biomaterials selection; machining, casting, 3D printing; lean six sigma concepts; case studies and simulations.

Course Offered at: Daytona Beach

MECH 620 Advanced Vehicle Dynamics 3 Credits (3,0)

Ground vehicle mobility simulation; 3D rigid body motion, orientation kinematics, tire contact forces; soft-soil terramechanics, Pacejka tire models; 3D terrain visualization, automated path navigation.

Course Offered at: Daytona Beach

MECH 622 Path Planning and Navigation 3 Credits (3,0)

Path planning for autonomous systems; dynamic models, RRTs, LPA, anytime planning; multi-agent control, particle swarm optimization, object segmentation; case studies and simulations.

Prerequisites: MECH 503

Course Offered at: Daytona Beach

MECH 631 Conduction and Radiation Heat Transfer 3 Credits (3,0)

Heat diffusion equations for Cartesian, cylindrical, spherical coordinates; thermal radiation, surface properties, view factors, integrodifferential equations, statistical methods.

Course Offered at: Daytona Beach

MECH 632 Convection Heat Transfer 3 Credits (3,0)

Fluid flow and heat transfer; internal and external convection, boundary layer theory; laminar, turbulent convection, viscous dissipation.

Course Offered at: Daytona Beach

**MECH 690 Graduate Research Project I 3 Credits
(3,0)**

Master's-level design project; final report and public presentation.

Prerequisites: ENGR 600

Course Offered at: Daytona Beach

**MECH 691 Graduate Research Project II 3 Credits
(3,0)**

Master's-level design project; final report and public presentation.

Prerequisites: MECH 690

Course Offered at: Daytona Beach

**MECH 699 Special Topics in Mechanical
Engineering 1-6 Credit (1-6,0)**

Individual, independent, or directed studies of selected topics in mechanical engineering.

Course Offered at: Daytona Beach, Prescott

MECH 700 Graduate Thesis 1-9 Credit (1-9,0)

A master-level research project in Mechanical Engineering conducted under the supervision of the student's advisor and thesis committee. Submission of a final report, approved by the thesis committee, and an oral defense of the research work are required for thesis credits to be earned.

Course Offered at: Daytona Beach

MECH 800 Dissertation 1-9 Credit (1-6,0)

Ph.D.-level research project; final report, committee approval, and oral defense required for credit.

Course Offered at: Daytona Beach