MECHANICAL ENGINEERING (M E)

M E 501 - Advanced Thermodynamics (3.0 hours)
Laws and concepts of classical thermodynamics: real gases and equations of state; availability; irreversibility; property relations; potential functions; equilibrium; multicomponent systems.
Prerequisite: ME 302; or graduate standing.

M E 502 - Problems in Advanced Dynamics (3.0 hours)
Application of analytical and graphical methods to problems involving velocities, accelerations, working and inertia forces.
Prerequisite: ME 341; or graduate standing.

M E 503 - Internal Combustion Engines (3.0 hours)
Thermodynamic analysis, thermo-chemistry, and performance characteristics of spark ignition and compression ignition engines.
Prerequisite: ME 301 and ME 302; or graduate standing.

M E 509 - Solar Engineering (3.0 hours)
Nature and characteristics of solar energy as a renewable energy resource. Solar geometry and radiation. Thermodynamics of solar systems; emphasis on 2nd Law considerations. Performance characteristics of collectors, storage systems, house heating systems, cooling and refrigeration, and photovoltaics. Comprehensive design project. Theory and performance characteristics of solar devices and application to design of a comprehensive solar energy system.
Prerequisite: ME 415 or consent of instructor.

M E 515 - Intermediate Heat Transfer (3.0 hours)
In-depth treatment of the three modes of heat transfer; design applications. Development of analytical and specific numerical skills needed for solving design problems involving heat transfer.
Prerequisite: ME 415; or graduate standing.

M E 520 - Gas Dynamics (3.0 hours)
One dimensional flow: wave and shock motion in subsonic and supersonic flow; flow with heat transfer and friction; viscosity effects; similarity. Introduction to multidimensional flow.
Prerequisite: ME 308; or graduate standing.

M E 521 - Intermediate Fluid Mechanics (3.0 hours)
Analysis of statics and dynamics of non-viscous and viscous fluids. Derivation of differential equations of motion. Potential flow; vortex motion; creeping motion; introduction to boundary layer theory; turbulence.
Prerequisite: MTH 224 and ME 308; or graduate standing.

M E 533 - Propulsion Systems (3.0 hours)
Gas turbine analysis; stationary power plants; turboprop, turbojet, and ramjet engines; rocket propulsion; application of thermodynamics.
Prerequisite: ME 308; or graduate standing.

M E 534 - Environmental Engineering-Air Conditioning (3.0 hours)
Core Curriculum: WI
Heating and cooling of moist air; solar radiation; computation of heating and cooling loads; study of heating, ventilating, and cooling systems and equipment; design project.
Prerequisite: ME 301.

M E 535 - Environmental Engineering-Refrigeration (3.0 hours)
Mechanical vapor compression refrigeration cycles; refrigerants; absorption refrigeration; miscellaneous refrigeration processes; cryogenics; semester design project.
Prerequisite: ME 301.

M E 536 - Industrial Pollution Prevention (3.0 hours)
Industrial pollution prevention for small quantity generators such as foundries, metal fabrication, electroplating, electronics, soldering, wood products, cleaning, degreasing, and coating. Study of emerging technologies for pollution prevention. Relationships among energy consumption, waste production, and productivity enhancement. Actual plant assessments.
Prerequisite: Consent of instructor; or graduate standing.

M E 537 - Building Energy Management (3.0 hours)
The energy problem. Energy consumption patterns in existing and new buildings. Analysis of energy saving strategies for existing buildings; developing designs for new, energy efficient buildings, including reliability, comfort, and economic considerations. Formal oral presentations.

M E 540 - Advanced Mechanical Vibrations (3.0 hours)
Principles of vibrations in one or more degrees of freedom; application to machine members.
Prerequisite: ME 341; MTH 224; or graduate standing.

M E 544 - Mechanical Systems Analysis (3.0 hours)
Mathematical modeling of mechanical, electrical, pneumatic, hydraulic, and hybrid physical systems emphasizing a unified approach such as the Bond graph technique. LaPlace, state-variable, and matrix formulation of models. Systems response characteristics, prediction, and analysis.
Prerequisite: ME 341; or graduate standing.

M E 547 - Fluid Power Control Systems (3.0 hours)
Definition and scope of fluid power control systems. Fluid properties. Continuity and power balance equations. Components function, operation, and dynamic performance. Use of perturbation theory for developing linearized transfer functions. Application of conventional control theory.
Prerequisite: ME 301, ME 308; or graduate standing.

M E 548 - Optimization of Mechanical Systems (3.0 hours)
Development and application of optimization techniques in design of engineering systems and elements; mathematical modeling and formulation of design problems for optimization; different optimization methods including linear, non-linear, geometric and dynamic programming; shape optimization. Emphasis on development and choice of appropriate search methods, sensitivity analysis, and programming.
Prerequisite: Senior standing in engineering or consent of department; or graduate standing.

M E 549 - Microprocessor Interfacing in Mechanical Systems (3.0 hours)
Principles of microprocessor hardware and software; integration of microprocessor hardware and software in mechanical systems for data acquisition and control purposes (e.g., robotics, internal combustion engine monitoring systems, and pneumatic controls). Intensive hands-on laboratory exercises and practical problem solving. Introduction of "mechatronics."
Prerequisite: ME 303; ECE 227; proficiency in at least one computer language; or consent of instructor.

M E 554 - Fracture of Solids (3.0 hours)
Mechanical failure caused by stresses, strains, and energy transfers in mechanical parts: conventional design concepts and relationship to occurrence of fracture; mechanics of fracture; fracture toughness; macroscopic and microscopic aspects of fracture; high and low cycle fatigue failures; creep; stress rupture; brittle fracture; wear; case studies of failure analysis. Emphasis on time-dependent failures.
Prerequisite: M E 354 and C E 270; or graduate standing.

M E 556 - Mechanics of Composite Materials (3.0 hours)
Mechanical behavior, analysis, and design of various advanced composite materials: introduction to composite materials and their applications; elasticity of anisotropic solids; micromechanics of fiber reinforced composites and particulate composites; short fiber composites; macromechanics of laminated composites; thermal stresses; failure criteria; fracture and fatigue, reliability, testing, and design of composite materials. Emphasis on developing simple microcomputer programs for analysis. Projects involve curing and testing composites.
Prerequisite: CE 270; or graduate standing.

M E 557 - Advanced Design of Machine Elements (3.0 hours)
Review of mechanical testing, 3-D stress-strain relationship, complex and principal states of stress, yielding and fracture under combined stresses, fracture of cracked members, stress and strain based approaches to fatigue, creep damage analysis, and plastic damage analysis as applied to the design of machine elements.
Prerequisite: ME 342 and ME 351, with a minimum grade of C; or graduate standing in ME. Requires consent of instructor if non-ME Student.

M E 560 - Principles of Robotic Programming (3.0 hours)
Programming of industrial robotic manipulators with external inputs, tactile sensing, and vision sensing. A design project is required. Cross-listed as IME 560.
Prerequisite: graduate or senior standing in engineering or computer science.

M E 561 - Introduction to Robotics (3.0 hours)
Coordinate transformation, forward & inverse kinematics, robot dynamics, robot control, motion planning, actuators and sensors, and robotic vision. A design project is required.
Prerequisite: Graduate or senior standing in engineering or computer science; consent of the instructor

M E 562 - Dynamics, Modeling, and Control of Robots (3.0 hours)
Fundamental concepts and methods to analyze, model, and control robotic systems. Kinematics/dynamics, modeling and controller design of robotic arms, mobile robots, and drones. Plant visits to observe robots in action; hands-on practice using Arduino or Raspberry-Pi.
Prerequisite: M E 344, ECE 227; or consent of instructor.

M E 564 - Sensor, Actuators, and Computer Vision (3.0 hours)
Fundamental principles of sensors, actuators, and computer vision; Image processing, image recognition, and face detection; Introduction to OpenCV and MATLAB computer vision;
Prerequisite: M E 273, M E 303; or consent of instructor

M E 568 - Motion planning (3.0 hours)
This course provides an in-depth treatment of path planning and motion in robotic systems. Common techniques and algorithmic procedures used for planning and decision-making are covered. Case studies include mobile manipulation platforms and multi-robot systems. The student evaluation will be done by tests, homework, and projects.
Prerequisite: Senior or Graduate Standing

M E 573 - Methods of Engineering Analysis (3.0 hours)
Application of principles of analog and digital computers and numerical methods to solve mechanical engineering problems.
Prerequisite: ME 341; ME 273; MTH 224; or graduate standing.

M E 577 - Finite Element Methods in Engineering (3.0 hours)
Theory of finite element methods and applications in mechanical engineering: review of matrix algebra and basic theorem of elasticity. Direct formulation of plane truss element and variational formulations of plane stress/strain, axisymmetric solids, flexural beam, and flat plate elements. Element analysis and isoparametric formulation. Applications to problems of stability, vibrations, thermal stress analysis, and fluid mechanics. Computer programming techniques.
Prerequisite: Senior standing in ME or consent of instructor; or graduate standing.

M E 580 - Biomechanics (3.0 hours)
Human body as a mechanical system. Biomechanics of cells, soft issue and hard tissue Biomechanics of movement. Laboratory exercises on design and analysis of implants.
Prerequisite: senior or graduate standing in engineering or consent of instructor.

M E 588 - Human Centered Design (3.0 hours)
Principles and practices of biomedical engineering for integration into design. The focus on human limits including physical, visual, cognitive and medical will serve as the basis for technology evaluations and case studies. Design and analysis with team-based, open ended client specific project.
Prerequisite: Senior or graduate standing and consent of instructor

M E 591 - Topics in Mechanical Engineering (3.0-9.0 hours)
Topics of special interest which may vary each time course is offered. Topic stated in current Schedule of Classes. Graduate students may repeat the course under different topic names up to a maximum of 9 credits.
Prerequisite: consent of instructor.

M E 604 - Design of Internal Combustion Engines (3.0 hours)
Detailed study of design of internal combustion engines. Gas-pressure and inertia-force diagrams; determination of bearing loads; torsional vibration analysis; stress analysis and design of components, including piston, connecting rod, crankshaft, flywheel, valve mechanism, and cam layout.
Prerequisite: undergraduate courses in dynamics of machines, internal combustion engines, and machine design, or consent of instructor.

M E 648 - Advanced Computer Aided Design (3.0 hours)
Augmentation of mechanical design through application of computer graphics. Hardware/software characteristics; elements of geometric/solid modeling. Emphasis on integration in the application of the design process through packages for geometric/solid modeling, finite element analysis, and mechanisms and system simulation.
Prerequisite: BSME; or background in mechanical and thermal systems and consent of department chair. Students without a BSME degree may take ME 342, ME 344, ME 415, and ME 411 to help develop an appropriate background for the course.

M E 681 - Research (0.0-6.0 hours)
Research on a project selected by student and advisor.

M E 682 - Research (0.0-6.0 hours)
Individual study on a topic selected by the student with advisor approval. Integration and application of research. Student must produce a product such as a software program or journal article
Prerequisite: consent of instructor.

M E 699 - Thesis (0.0-6.0 hours)
Maximum of 6 semester hours total of research and/or thesis may be applied toward the master's degree.
Prerequisite: consent of department.