# MECHANICAL ENGINEERING
# MATERIALS SCIENCE AND ENGINEERING

# GRADUATE COURSE INVENTORY 2020-21

Approved Courses for Students Seeking a Masters Degree

----------*Core Course Requirements*----------

**Thermal-Fluids . . . .three courses from: ME7300, ME7330, ME7340, ME7350, ME7400, ME7500, ME7520, ME7550**

**Mechanics . . . . . ME7100 and two courses from: ME7060, ME7080, ME7120, ME7160, ME7210, ME7690**

**Materials . . . . . .three courses from: ME7500, ME7720, ME7730, ME7750, ME7760, ME7780**

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***For future course offerings, see **Course Schedule Planning Guides** at (www.wright.edu/registrar/scheduling/course-schedule-planning-guides )***

## MATH COURSE (Required)

***MTH 6050 Advanced Engineering Mathematics 3 credits***
Topics include eigenvalues and eigenvectors, matrix factorizations, Fourier series, analytical and numerical solutions to the three classical partial differential equations, and complex functions, integration, and series and residues.
**Prerequisites:** MTH 2320 and (MTH 2350 or (MTH 2330 and MTH 2530))

## ENGINEERING COURSE OPTIONS *(Please note---6xxx courses cannot be repeated for credit if 4xxx equivalent course was taken)*

***ME 6010 Computational Methods for Mechanical Engineering 3 credits***
Combines material learned in statics, dynamics, thermodynamics, fluid mechanics, and heat transfer and applies them to the design of mechanical systems using numerical methods. **Prerequisites**: **Graduate level ME 5360 Minimum Grade of D and Graduate level ME 5210 Minimum Grade of D**

***ME 6080 Design Optimization 3 credits***
Graphic, analytical, numerical, and symbolic techniques are used in the kinematic and dynamic analysis of machines. Computer-aided design of mechanisms is introduced. Emphasis on the application of these techniques to planar mechanisms. **Prerequisites: (Undergraduate level MTH 2350 Minimum Grade of D or Undergraduate level MTH 2530 Minimum Grade of D) and Graduate level ME5210 Minimum Grade of D**
***(Please note that if you take ME 4080/6080, you are not eligible to take EGR 7040 for credit)***

***ME 6120 Finite Element Analysis 3 credits***
Fundamentals of finite element analysis as a general numerical method for the solution of boundary value problems in engineering, with an emphasis on structural and solid mechanics. **Prerequisites: (Undergraduate level MTH 2350 Minimum Grade of D or undergraduate level MTH 2530 Grade of D) and Graduate level ME5120 Minimum Grade of D**
**Co-requisite**: ***ME 6120L Finite Element Analysis Laboratory O Credits***

***ME 6140 Mechanical Design I 3 Credits***
Fundamental concepts in design for both static and fatigue loading, with application to selected mechanical components and systems. **Prerequisite: ME 5120 Minimum Grade of D**

***ME 6150 Mechanical Design II 3 Credits***
Analysis and design of mechanical elements including screws, welds, springs, bearings, gears, clutches, brakes, flywheels, pulleys and shafts. Students conduct a group design project. **Prerequisite**: **Graduate level ME 6140 Minimum Grade of D**

***ME 6180 Additive Manufacturing 3 Credits***
An introduction to additive manufacturing process. The course will address various additive manufacturing (AM) principles and concepts; Materials science for AM; Design for AM; Scope of additive manufacturing with application area; bio-manufacturing. **Prerequisite: None**

***ME 6190 Introduction to Engineering Lubrication 3 Credits***
Define various lubrication regimes where mechanical elements in automotive, aerospace, heavy machinery, wind turbine applications operate; introduce surface topography metrics & parameters; describe lubricant properties including viscosity & density dependences on pressure as well as temperature, non- & Newtonian behavior; derive Reynolds equation; solve governing equations for elasto & hydrodynamic lubrication; introduce egr approaches for lubrication performance assessment in machine elements. **Prerequisites: Graduate level 5350 Minimum Grade of D and (Undergraduate level MTH 2330 Minimum Grade of D and Undergraduate level MTH 2530 Minimum Grade of D) or (Undergraduate level MTH 2320 Minimum Grade of D and Undergraduate level MTH 2350 Minimum Grade of D)**

***ME 6210 Mechanical Vibrations 3 Credits***
Modeling and analysis of single and multi-degree freedom systems under free and forced vibration and impact. Lagrangian and matrix formulations, energy methods, and introduction to random vibrations. **Prerequisite: Graduate level ME5210 Minimum Grade of D**
**Co-requisite: *ME 6210L Mechanical Vibrations Laboratory O Credits***

***ME 6220 Mechanical System Modeling & Design 3 Credits***
Modeling of complex mechanical systems as a set of simple, linear or nonlinear components for the purpose of design. Introduces modern computational tools. **Prerequisite: ME 5210 Minimum Grade of D**

***ME 6240 Vehicle Engineering 3 Credits***
Develops students' abilities to derive and solve vehicle equations, and introduce dynamic analysis in vehicle design. Various performance criteria, control concepts, and HEVs will be studied. **Prerequisite: ME 2210 Minimum Grade of D**

***ME 6250 Kinematics and Design of Mechanisms 3 credits***
Graphic, analytical, numerical, and symbolic techniques are used in the kinematic and dynamic analysis of machines. Computer-aided design of mechanisms is introduced. Emphasis is on the application of these techniques to planar mechanisms. **Prerequisite: ME 2210 Minimum Grade of C**

***ME 6260 Introduction to Robotics 3 Credits***
(Also listed as CEG 6560 and ME 6560.) An introduction to the mathematics of robots. Topics covered include coordinate systems and transformations, manipulator kinematics and inverse kinematics, Jacobians, dynamic and trajectory planning.

***ME 6330 Compressible Fluid Flow 3 Credits***
Fundamentals of gas flow in the subsonic to supersonic flow regimes. Wave propagation in compressible medium, one-dimensional isentropic flow with area change, frictional effects, heat transfer effects and two-dimensional waves. **Prerequisite: Undergraduate level ME 3350 Minimum Grade of D or Undergraduate level ME 5350 Minimum Grade of D**

***ME 6340 Simulation of Thermal-Fluids Problems with Advanced Engineering Software Computational Fluid Dynamics 3 Credits***
Students will learn to use commercial computational fluid dynamics software to solve practical engineering problems, including fluid, heat and mass transfer. **Prerequisite: ME 6010 Minimum Grade of D**

***ME 6350 Mechanics of Viscous Fluids 3 Credits***
Fundamental equations of viscous flow for laminar and turbulent flows including the Navier Stokes equations. Boundary layer analysis. **Prerequisite: Undergraduate level ME 3350 Minimum Grade of D or Graduate level ME 5350 Minimum Grade of D**

***ME 6360 Principles of Internal Combustion Engines 3 Credits***
Thermodynamics of I.C. engines, combustion thermodynamics, friction, heat and mass losses, and computer control of the modern fuel-injected I.C. engine. **Prerequisite: Undergraduate level ME 3350 Minimum Grade of C or Graduate level ME 5350 Minimum Grade of C**

***ME 6430 Aeronautics 3 Credits***
Aviation history. Standard atmosphere, basic aerodynamics, theory of lift, airplane performance, principles of stability and control, astronautics, and propulsion concepts. **Prerequisite: Undergraduate level ME 3350 Min. Grade of D**

***ME 6440 Aerospace Propulsion 3 Credits***
Engine cycle analysis; combustion fundamentals; reciprocating engines and propellers; applications to turbojet, turbofan, turboprop, ramjet, SCRAM jet, and rocket engines. **Prerequisite: Undergraduate level ME 3350 Minimum Grade of D or Graduate level ME 5350 Minimum Grade of D**

***ME 6490 Aerospace Structures 3 Credits***
Analysis and design of flight structures. Stress, deformation, and stability analysis of aerospace structures. Thin-walled members bending, torsion, shear stresses calculation in multi-cell structures and buckling of thin plates.
**Prerequisite: Graduate level ME 5120 Minimum Grade of D**

***ME 6520 Hydropower 3 Credits***
Topics covered are hydraulics of turbomachines for power generation, hydrologic analysis for hydropower development for run-of the river systems and reservoir systems, dams and environmental impacts, environmental impact assessment, operations of reservoir systems, and economics of hydropower generation. **Prerequisites: Undergraduate level ME 3350 Minimum Grade of D or Undergraduate level ME 5350 Minimum Grade of D**

***ME 6530 Energy Conversion 3 Credits***
This course will study the fundamentals of energy and energy conversion, the conversion of energy from mechanical, thermal, chemical, and nuclear will be discussed. To demonstrate these energy forms generators, wind, ocean, turbines, direct energy conversion, fossil fuels, biofuels, and nuclear power will be presented. **Prerequisite: Undergraduate level ME 3310 Minimum Grade of D or Graduate level ME 5310 Minimum Grade of D**

***ME 6540 Solar Thermal Engineering 3 Credits***
Fundamentals of solar radiation and how it can be utilized as a thermal energy source. Solar insolation on a surface, flat plate collectors, concentrating collectors, thermal energy storage, and solar hot water heating will be discussed.
**Prerequisite: Undergraduate level ME 3360 Minimum Grade of D or Undergraduate level ME 5360 Minimum Grade of D**

***ME 6550 Geothermal Energy 3 Credits***
Techniques for tapping the energy of the earth will be discussed. This will include hot and cold geothermal energy. Use of geothermal energy to produce electricity, for space and district heating and cooling, and for industrial applications will be presented. Geothermal energy's effect on the environment and its economics will be discussed. **Prerequisite: Undergraduate level ME 3360 Minimum Grade of D or Undergraduate level ME 5360 Min. Grade of D**

***ME 6560 Wind Power 3 Credits***
Power in the wind, the wind turbine and its parts, performance of wind turbines, and economics of wind turbines will be presented. **Prerequisite: Undergraduate level ME 3350 Minimum Grade of D or Graduate level ME 5350 Minimum Grade of D**

***ME 6570 Energy Materials 3 Credits***
Students will understand the principles and the materials of advanced electrochemical energy storage systems including batteries, fuel cells, and super capacitors. In this course, students will gain an understanding of material structures, material composition, and material morphologies in relation to applicable properties for electrochemical energy storage and conversion systems. Students will also be introduced to state-of-the-art materials research and development in these systems. **Prerequisites: Undergraduate level ME 2700 Minimum Grade of D and ( Undergraduate level ME 3310 Minimum Grade of D or Graduate level ME 5310 Minimum Grade of D or Undergraduate level ME 3750 Minimum Grade of D or Undergraduate level ME 5750 Minimum Grade of D)**

***ME 6580 Fuel Cell Science and Technology 3 Credits***
This course will cover the fundamentals, technologies, and applications of various types of fuel cells. The fundamentals covered are thermodynamic prediction, electrolyte conduction, and electrode kinetics. The types of fuel cells covered are polymer electrolyte fuel cell, solid oxide fuel cell, and fuel cell stack. **Prerequisites: Undergraduate level ME 2700 Minimum Grade of D and (Undergraduate level ME 3310 Minimum Grade of D or Graduate level ME 5310 Minimum Grade of D or Undergraduate level ME 3750 Minimum Grade of D or Graduate level ME 5750 Minimum Grade of D)**

***ME 6585 Natural Gas Production Engineering 3 Credits***
Students will be able to demonstrate a knowledge of natural gas production and the associated separation processes to extract gas from oil, recognize the properties of natural gas, perform design calculations involved in production, development and distribution of natural gas, demonstrate a knowledge of effluent treatments in natural gas production and demonstrate a knowledge of the environmental impacts of natural gas. **Prerequisites: Undergraduate level CHM 1210 Minimum Grade of D and Undergraduate level PHY 2400 Minimum Grade of D and (Undergraduate level ME 3350 Minimum Grade of D or Graduate level ME 5350 Minimum Grade of D)**

***ME 6590 Advances in Clean Coal Technology 3 Credits***
Historical perspective on coal; sources of coal in the world; future dependence on coal for energy; power production using coal; general process description; principles of combustion, conventional combustion reactors, environmental impact; fluidized bed reactors, process improvements in minimizing emissions; and discussions on future innovations in for clean coal technology. **Prerequisite: Undergraduate level ME 3360 Minimum Grade of D or Graduate Level ME 5360 Minimum Grade of D**

***ME 6680 Experimental Nanomaterials and Nanoscience 3 Credits***
This course will provide a series of laboratory experiments similar to the state-of-the-art R&D in nanotechnology and nanoscience. The experiments include 1) fabrication of nanomaterials such as metal nanoparticles and graphene nano-platelets; 2) characterization of physical and chemical properties by using techniques such as Raman spectroscopy, atomic force microscopy, terahertz spectroscopy, electrochemical analyses etc; and 3) computational modeling of nanoscale physical phenomena. **Prerequisites: Undergraduate level CHM 1210 Minimum Grade of D and Undergraduate level CHM 1210L Minimum Grade of D and Undergraduate level PHY 2400 Minimum Grade of D and Undergraduate level PHY 2400L Minimum Grade of D**

***ME 6700 Structure & Properties Materials II 3 Credits***
Effect of microstructure, phase equilibrium, and processing on properties of structural materials including metallic alloys, polymers, and composites. **Prerequisite: Undergraduate level ME 2700 Minimum Grade of D and Undergraduate level MTH 2350 Minimum Grade of D and Undergraduate level MTH 2320 Minimum Grade of D**

***ME 6720 Engineering Polymers I 3 Credits***
Introduces polymers as engineering materials and covers fundamental concepts in polymer science and engineering. Includes polymerization processes, morphology and crystallinity, thermal transitions, viscoelasticity, rubber elasticity, aging, and contemporary issues in polymers. **Prerequisite: Undergraduate level ME 2700 Minimum Grade of D**

***ME 6730 Introduction to Ceramics 3 Credits***
Ceramic and refractory raw materials and products; processing techniques; atomic structure and bonding; structure of crystalline phases and glasses; structural imperfections; diffusion and kinetics in oxides; advanced ceramics. **Prerequisite: Undergraduate level ME 2700 Minimum Grade of D**

***ME 6740 Materials Selection and Failure Analysis 3 Credits***
Engineering aspects of failure analysis, failure mechanisms and relate environmental factors, analysis of actual service failure. **Prerequisites: Undergraduate level ME 2700 Minimum Grade of D and Undergraduate level ME 3120 Minimum Grade of D and Undergraduate level ME 4620 Minimum Grade of D (ME 4620 can be taken concurrently)**

***ME 6750 Materials Characterization 4 Credits***
Principals of characterizing materials with respect to crystal structure, micro/nana structure, and chemical composition using particle or wave-based probes (visible lights, X-rays and energetic electrons). The interactions between the probes and materials are discussed. Characterization at both qualitative and quantitative level will be elucidated. Laboratory exercises are included. **Prerequisites: Undergraduate level ME 2600 Minimum Grade of D and Undergraduate level ME 2700 Minimum Grade of D**

***ME 6770 Mechanical Behavior of Materials 3 Credits***
Crystal plasticity and single crystal behavior. Introduction to dislocation theory. Strengthening mechanisms in metals. Fracture, fatigue, and creep behavior of metals. **Prerequisites: Undergraduate level ME 2700 Minimum Grade of D and (Undergraduate level ME 3120 Minimum Grade of D or Graduate level ME 5120 Min. Grade of D**

***ME 6820 Corrosion 3 Credits***
Survey of the principles of corrosion processes with application to metallic and nonmetallic materials. Principles of electrochemistry are included. **Prerequisites: Undergraduate level ME 2700 Minimum Grade of D and (Undergraduate level ME 3310 Minimum Grade of D or Undergraduate level ME 3750 Min. Grade of D** )

***ME 6830 Computational Materials Science 3 Credits***
This course covers basic theories, methods and algorithms of atomsitic computer simulations of materials, using lectures and computer labs. Classical, semi-empirical, and ab initio quantum mechanical methods are explained. **Prerequisite: Undergraduate level ME2700 Minimum Grade of D**

***ME 6840 Materials Selection for Mechanical Design 3 Credits***
Principles of materials-limited design. Lectures, case histories, open-ended assignments and computer based materials selection tools. Procedures for selection of optimum material(s) under constraints resulting from functional, reliability, safety, cost and environmental issues. **Prerequisites: (Undergraduate level ME 2700 Minimum Grade of D and Graduate level ME 5120 Minimum Grade of D) or Undergraduate level ME 3120 Minimum Grade of D**

***ME 6850 Nano-scale Science and Engineering 3 Credits***
Students will be introduced to nano-scale science and engineering in terms of the nano-scale building blocks (emphasizing carbon based nano-species), the characterization techniques (emphasizing Raman Spectroscopy) and the nano-phenomena such as thermal, optical, electrical, chemical and mechanical phenomena observed on the nano-scale. **Prerequisites: Undergraduate level ME 2700 Minimum Grade of D and Graduate level ME 5750 Minimum Grade of D**

***ME 6860 Metal Forming 3 Credits***
Fundamentals of principal deformation processing systems including forging, extrusion, rolling, and sheet forming; material response and formability; and mechanics and analysis of selected processes. **Prerequisites: (Undergraduate level ME 2700 Minimum Grade of D and Graduate level ME 5120 Minimum Grade of D) or Undergraduate level ME 3120 Minimum Grade of D**

***ME 6880 Powder Processing of Materials 3 Credits***
Fundamental metallurgy and ceramic science of powder processing techniques. Details of current powder processing technology and methods. Hands-on laboratory experience with both metal & ceramic materials. **Prerequisite: Undergraduate level ME 2700 Minimum Grade of D and (Undergraduate level ME 3310 Minimum Grade of D or Graduate level ME 5310 Minimum Grade of D or Undergraduate level ME 3750 Minimum Grade of D or Graduate level ME 5750 Minimum Grade of D)**

***ME 7060 Structural Reliability 3 Credits***
Analyze the uncertainties associated with mechanical and structural design. Methods to model various uncertainties in a design using probabilistic analysis tools. Computation of safety index and structural reliability using efficient techniques for implicit functions. **Prerequisites: Graduate level ME 7100 Minimum Grade of D and Graduate level ME 6120 Minimum Grade of D**

***ME 7080 Multidisciplinary Structural Optimization 3 Credits***
Structural optimization of large scale systems with constraint approximations, sensitivity analysis, and design variable linking methods. Primal, dual, and optimality criteria methods for shape and size optimization. **Prerequisite: Graduate level ME 6080 Minimum Grade of D and Graduate level ME 6120 Minimum Grade of D and Graduate level ME 7100 Minimum Grade of D**

***ME 7100 Advanced Mechanics of Solids 3 Credits***
Introduction to solid mechanics at the graduate level. Topics include theory of elasticity, indicial notation and coordinate transformations, exact solutions to plane elasticity problems in Cartesian and polar coordinates, axisymmetric problems, torsion of noncircular sections and energy methods. **Prerequisite: Undergraduate level ME 3120 Minimum Grade of D or Graduate level ME 5120 Minimum Grade of D**

***ME 7120 Finite Element Method Applications 3 Credits***
Concepts of dynamic analysis using the finite element method (FEM). Application of various computational techniques to dynamic structures and thermal systems including vehicle dynamics. **Prerequisite: Graduate level ME 6120 Minimum Grade of D**

***ME 7140 Nonlinear Finite Element Analysis 3 Credits***
Nonlinear finite element analysis of elastic, plastic, and viscoplastic deformation. Flow formulation and solid formulation. Analysis and simulation of structures and metal forming processes. **Prerequisites: Graduate level ME 6120 Minimum Grade of D and Graduate level ME 7100 Minimum Grade of D**

***ME 7160 Nonlinear Dynamics and Vibrations 3 Credits***
The behavior of nonlinear mechanical systems is analyzed with numerical, symbolic, graphic, and analytical methods. Equal emphasis is placed on understanding nonlinear effects and methods of analysis. **Prerequisite: Undergraduate level ME 4210 Minimum Grade of D or Graduate level ME 6210 Minimum Grade of D**

***ME 7200 Mechanics of Composites 3 Credits***
The main objective of this course is to introduce composites as an engineering material and emphasize the basic concepts of their nature and mechanical properties. Micromechanics and macromechanics and lamination theory of composites will be emphasized. **Prerequisite: Undergradute Level ME 1020 Minimum Grade of D and Undergraduate level ME 5120 Minimum Grade of D**

***ME 7210 Computational Methods in Structural Dynamics 3 Credits***
Vibration of discrete and continuous systems. Computational methods for the eigenvalue problem. Large-dimensional systems. Approximate methods for continuous systems. Substructure synthesis. Response of vibrating systems.
**Prerequisite: Graduate level ME 6210 Minimum Grade of D**

***ME 7250 Advanced Dynamics 3 Credits***
Introduction to classical mechanics. Application of distributed and discretized approaches to dynamic systems with rigid and deformable members. Emphasis on the understanding of fundamental theory of mechanics and applications of different techniques to dynamics. **Prerequisite: Graduate level ME 5210 Minimum Grade of D**

***ME 7300 Advanced Fluid Dynamics 3 Credits***
Theory and application of conservation equations for fluid mechanics. Develops boundary layer equations for laminar and turbulent flows. Topics include incompressible, viscous, supersonic, and hypersonic flows. **Prerequisite: Undergraduate level ME 3350 Minimum Grade of D or Graduate level ME 5350 Minimum Grade of D**

***ME 7330 Convective Heat and Mass Transfer 3 Credits***
Heat and mass transfer analysis within conductors and over submerged objects for laminar and turbulent flows. Film condensation and boiling. **Prerequisite: Undergraduate level ME 3360 Minimum Grade of D or Graduate level ME 5360 Minimum Grade of D**

***ME 7340 Computational Fluid Dynamics 3 Credits***
Introduction to modern computational fluid dynamic (CFD) methods. Survey of current numerical procedures to solve fluid dynamic problems from incompressible to hypersonic flows. 3 hours lecture, 2 hours lab.
**Prerequisites: Graduate level ME 6010 Minimum Grade of C**

***ME 7350 Radiation Heat Transfer 3 Credits***
Fundamentals and application of radiation heat transfer, radiation between gray and non-gray bodies, network techniques, radiation through absorbing media, and radiation between gases and surrounding surfaces. Finite difference solution for radiation problem. **Prerequisite: Undergraduate level ME 3360 Minimum Grade of D or Graduate level ME 5360 Minimum Grade of D**

***ME 7360 Cardiovascular Biofluid Mechanics 3 Credits***
This course describes the intricate relations between the fluid mechanics and biomedical aspects of the cardiovascular system. Objectives: 1) Identify, recognize and define biofluid mechanics concepts in relation to the cardiovascular system; 2) Model cardiovascular fluid-structure interactions; 3) Apply this knowledge to analyze clinical problems.
**Prerequisite: ME 5350**

***ME 7390 Fundamentals of Plasma Science 3 Credits***
Properties, characteristics, and use of ionized gases. Fundamentals of gaseous electronics including kinetic theory, excitation, ionization, equilibrium, non-equilibrium, and local thermodynamic equilibrium. Plasma generation, glow discharge, rf-discharges, plasma torches, and free-burning arcs. **Prerequisite: Graduate level ME 7500 Minimum Grade of D**

***ME 7400 Hypersonic Flows 3 Credits***
Hypersonic flow is studied from the viewpoint of its unique fluid dynamic attributes with emphasis on classic inviscid theories, chemical kinetics, and state-of-the-art development. **Prerequisite: Undergraduate level ME 4330 Minimum Grade of D or Graduate level ME 6330 Minimum Grade of D**

***ME 7500 Advanced Thermodynamics 3 Credits***
Thermodynamics is studied from both the classical (macroscopic) and statistical (microscopic) viewpoints with emphasis on statistical thermodynamics. Property relationships, Maxwell relations, partition functions, distribution functions, kinetic theory and the Boltzmann transport equation are discussed. **Prerequisites: (Undergraduate level ME 3310 Minimum Grade of D or Graduate level ME 5310 Minimum Grade of D) Or (Undergraduate level ME 3750 Minimum Grade of D or Graduate level ME 5750 Minimum Grade of D)**

***ME 7520 Hydrogen Energy 3 Credits***
This course focuses on hydrogen as a renewable and clean means of energy storage, and discusses hydrogen production and storage, as well as an overview of hydrogen energy conversion. **Prerequisites: (Undergraduate level ME 3310 Minimum Grade of D or Undergraduate level ME 5310 Minimum Grade of D) and ( Undergraduate level ME 3750 Minimum Grade of D or Undergraduate level ME 5750 Minimum Grade of D)**

***ME 7550 Photovoltaics 3 Credits***
Basic principles of solar cells will be covered including semiconductors, electronics and holes, and p-n junctions. Different types of solar cell materials including crystalline and amorphous cells as well as techniques for increasing their efficiency will be presented. **Prerequisite: Graduate level ME 7500 Minimum Grade of D**

***ME 7690 Vibration Testing and Machine Health Monitoring 3 Credits***
Advanced theoretical and practical aspects of vibration testing including: signal analysis, windowing, transducers, exciters, modal identification techniques, rotor dynamics, and machine health monitoring. Includes extensive independent lab study.
**Prerequisite: Graduate level ME 6210 Minimum Grade of D**

***ME 7720 Engineering Polymers II 3 Credits***
Polymer physics including phase diagrams, phase separation, amorphous and crystalline states, liquid crystals, thermal transitions, viscoelasticity and rheology, as well as deformation and fracture. **Prerequisites: (Undergraduate level ME 4720 Minimum Grade of D or Graduate level ME 6720 Minimum Grade of D) and (Undergraduate level ME 3750 Minimum Grade of D or Graduate level 5750 Minimum Grade of D)**

***ME 7730 Advanced Physical Properties 3 Credits***
Focuses on some of the advanced physical properties of solid-state materials including thermoelectric energy conversion, optoelectronics, principles of lasers, high-k dielectrics, magnetoresistance, negative differential resistance and superconductivity. **Prerequisite: Undergraduate level ME 4700 Minimum Grade of D or Graduate level ME 6700 Minimum Grade of D**

***ME 7740 Quantitative Microscopy 3 Credits***
Deals with quantifying microstructural features, such as volume fraction, grain size, shape, and orientation of phases. The course covers stereology, the science of relating 2-dimensional images to 3-dimensional structure, and image analysis. **Prerequisites: None**

***ME 7750 Advanced Engineering Materials 3 Credits***
This course will define and explain crystalline structure of materials, different types of amorphous structures, polarization, band structures and thermal properties, nanostructures, magnetic behavior of materials, and optical phenomena. **Prerequisite: Undergraduate level ME 4700 Minimum Grade of D or Graduate level ME 6700 Minimum Grade of D**

***ME 7760 Transformations in Solids I 3 Credits***
This is the first course in a two course sequence. Covers the theory of homogenous and heterogeneous nucleation and diffusion nad interface controlled growth. **Prerequisite: Graduate level ME 5760 Minimum Grade of D**

***ME 7780 Ceramics for Advanced Applications 3 Credits***
Science and technology of ceramics and glasses and their use in modern technologies; atomic structure; bonding; defect-microstructure-property relations; thermal and structural ceramics; electronic, optical, dielectric and magnetic ceramics; and special applications. **Prerequisite: Undergraduate level ME 4730 Minimum Grade of D**

***ME 7950 Thesis 1 – 12 Credits***
Research on the Master's thesis topic. Instructor and Department approval required.

***ME 7990 Independent Study in Mech Egr, Mat Science & Egr, Renewable & Clean Energy 1 - 3 Credits***
Independent study in Mechanical Engineering, Materials Science and Engineering, and Renewable and Clean Energy. Topics vary. Instructor and Department approval required.

***ME 8950 PhD Dissertation Research 1 – 12 Credits***
Research on the Ph.D. dissertation topic. Instructor and Program/Department approval required.

## RELATED ENGINEERING COURSES

***EGR 7010 Linear Systems 3 Credits***
Graduate level linear engineering methods in finite and infinite dimensions.

***EGR 7020 Systems Engineering and Analysis 3 Credits***
Exposes students to the design of systems and tools for the analysis of complex technological systems. **Prerequisites: (Undergraduate level STT 3630 Minimum Grade of D or Graduate level IHE 6120 Minimum Grade of D) and Undergraduate level MTH 2310 Minimum Grade of D**

***EGR 7040 Design Optimization 3 Credits***
Concepts of minima and maxima; linear, dynamic, integer and nonlinear programming; variational methods. Interdisciplinary engineering applications are emphasized.
***** Please note--if you have taken ME 4080 or ME 6080, you are not eligible to take EGR 7040 for credit.***

***EGR 7050 Design and Analysis of Engineering Experiments 3 Credits***
Introduction to planning and analysis of engineering experiments. Topics include basic statistics review, linear models, regression, analysis of variance, experiment designs, response surface methods, and engineering applications. **Prerequisites:** MTH 2350 and (STT 3630 or IHE 6020)

## RELATED COURSES IN ELECTRICAL SYSTEMS ENGINEERING

***EE 6130 Continuous Control Systems 3 Credits***
Introductory course providing students with a general control background. Major topics include block diagrams and signal-flow graphs, electromechanical modeling, time response, root locus, and design of PID controllers.
**Co-requisite: *EE 6130L Continuous Control Systems Laboratory 1 Credit***

***EE 6170 Digital Control Systems 3 Credits***
Samples spectra and aliasing, analysis and design of digital control systems using root locus and transform techniques, discrete equivalents of continuous controller and quantization effects.
**Co-requisite: EE 6170L Digital Control Systems Laboratory 1 Credit**

***EE 7010 Linear Systems 3 Credits***
(Also listed as EGR 701 and BMS 705) Graduate level linear engineering methods in finite and infinite dimensions.

***EE 7020 Modern Control I 3 Credits***
State variable representations of continuous and discrete systems. Linear vector spaces and similarity transformations; elgen-analysis, time and transform domain solutions of linear state equations; controllability, observability, and stability of linear systems. **Prerequisite: (Undergraduate level EE 4310 Minimum Grade of D and Undergraduate level EE 4310L Minimum Grade of D) or (Graduate level EE 6130 Minimum level of D and Graduate level EE 6130L Minimum Grade of D)**