### OHIOU ME Advertised Tech Electives - Semesters:

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<td>ME 4130 Conduction, Convection and Radiation</td>
<td>•</td>
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<td>Spring (Every 2 years) ME 3122 &amp; (MATH 4600 OR ME 4970)</td>
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<tr>
<td>ME 4160 Combustion</td>
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<td>ME 4230 Fuel Cell Design</td>
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<td>ME 4290 Robotic Manipulators</td>
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<td>ME 4670 Engineering Biomechanics</td>
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**Note:** ME 4910 Design Project offers an individual mentored opportunity with selected faculty members that can be for 1-3 credits in any specialty area. Students are advised to approach faculty members 3 or more weeks before the start of a term to inquire about this course option.
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<th>Course Name (Instructors)</th>
<th>Course Outcomes</th>
<th>Assignments &amp; Grading</th>
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| ME 4130 Conduction, Convection and Radiation (Dr. Alam) | 1. Solve multi-dimensional, steady state and transient conduction problems.  
2. Use boundary layer approximation to find convection heat transfer.  
3. Use non-dimensional numbers in conduction and convection problems.  
4. Determine radiation from black bodies, and analyze solar radiation.  
5. Use shape factor for calculating diffuse radiation exchange between surfaces.  
6. Develop governing equations for modeling thermal energy transport.  
7. Use matrix method for solving radiation exchange among black and gray surfaces. | Weekly assignments, a midterm and a final exam |
| ME 4160 Combustion (Dr. Bayless) | 1. Perform calculations to balance reactions.  
2. Determine combustion thermodynamics such as flame temperature.  
3. Use software such as EES to perform combustion calculations.  
4. Account for the effect of chemical equilibrium and dissociation on reaction thermodynamics and combustion kinetics.  
5. Select the optimal technique for controlling combustion related pollution by understanding the pollutant formation process.  
6. Calculate the kinetically and diffusionally limited rates of char combustion. | |
| ME 4230 Fuel Cell Design (Dr. Trembly) | 1. Ability to predict fuel cell behavior (voltage, current, power, and impedance) using electrochemical and thermodynamic calculations.  
2. Ability to identify key design aspects of the major types of fuel cells.  
3. Ability to determine optimal fuel cell systems for various power applications.  
4. Ability to calculate thermodynamic effects of the fuel cell system balance of plant.  
5. Ability to demonstrate proper fuel cell testing laboratory skills. | |
| ME 4270 Power Station Engineering (Dr. Bayless) | 1. Ability to identify and describe methods of energy conversions to electricity.  
2. Ability to determine capital and operating costs of a typical power plant.  
3. Ability to determine optimal technique to control negative environmental aspects associated with the technique used to generate electricity.  
4. Perform cost-benefit analysis on alternative power generation or pollution control capital projects.  
5. Ability to maximize efficiency/power or minimize cost for generation of electricity. | |
| ME 4290 Robotic Manipulators (Dr. Bob) | 1. Familiarity with parallel robots, redundant robots, and robot dynamics.  
2. Ability to perform robot trajectory generation.  
3. Familiarity with pose (position and orientation) mathematics via transform matrices.  
4. Familiarity with applications, architectures, and control methods for serial robot arms.  
5. Ability to solve forward and inverse pose kinematics equations. | Course Grade based on mini-projects. Some are assigned weekly in class, others are based on lab exercises done every 2 weeks, and one is an oral presentation on a research paper. |
<p>| ME 4310 | 1. Tour a full-scale facility using state-of-the-art air pollution control devices. | |</p>
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| **Atmosphere Pollut Control** (Dr. Bayless)                                 | 2. Understand how engineering principles are used to control air pollution.  
3. Understand numerical models and principles pertinent to air pollution engineering  
4. Ability to perform calculations related to combustion thermodynamics (flame temp).  
5. Ability to account for the effect of chemical equilibrium and dissociation on reaction thermodynamics and combustion kinetics.  
6. Develop skills to impact the changing field of air pollution engineering. |
| **ME 4350 Energy Engineering and Management** (Dr. Womeldorf)             | 1. Ability to apply conservation laws, efficiency considerations, and economic and environmental impact to analyze the relative merits of conventional and alternative energy sources for industrial, residential and transportation use.  
2. Understand the chemical reactions and mechanical systems involved when specific conventional and alternative energy sources are developed and used in industrial, residential, and transportation contexts.  
3. Ability to compare and contrast the availability, efficiency, cost, and environmental impact of specific conventional and alternative energy sources used in industrial, residential, and transportation contexts.  
4. Ability to select an appropriate energy source or combination of energy sources for a specific industrial, residential, or transportation application, and to justify that selection.  
5. Understand, quantitatively, current and projected global energy usage and availability.  
6. Awareness of current U.S. and global political and legal issues related to energy usage.  
7. Ability to identify technological or technical issues that must be resolved in order to make specific conventional or alternative energy sources more attractive options for the future. |
| **ME 44XX Potential and Viscous Flow** (Dr. Womeldorf)                     | 1. Ability to interpret, explain and problem solve applying the continuity equation.  
2. Ability to use Navier-Stokes equations to find flow field in 1 and 2 dimensional flows.  
3. Ability to interpret, explain and problem solve applying Potential Flow Theory.  
4. Ability to interpret, explain and problem solve applying hydrostatics principles.  
5. Ability to use basic principles to formulate governing equations for viscous flow.  
6. Ability to determine qualitative results for flow field and wall friction by scale analysis.  
7. Ability to solve laminar and turbulent flow problems. |
| **ME 4620 Mechanics of Metal Forming** (Dr. Kraft)                         | 1. Understand concept of ideal, friction and redundant work in metal forming operations.  
2. Ability to solve metal forming problems using classical analytical techniques.  
3. Understand plastic material behavior, and strain rate and temperature effects.  
4. Ability to use basic friction models in metal working analyses.  
5. Understand basic concepts of stress and strain, and plasticity theory. |
| **ME 4630 (Topics in) Mechanics of Materials** (Dr. Kraft)                | 1. Determine and manipulate stress and strain tensors  
2. Ability to solve elastic and plastic stress/strain problems  
3. Understand basic mechanical properties of materials and testing methods  
4. Understand crystal defects and relationship to strengthening mechanisms  
5. Understand basic constitutive relationships |
<p>| <strong>ME 4660</strong>                                                               | 1. Describe the structure of specific biological tissues and relate the structure to | Homework: 30% |</p>
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| Mechanics of Biological Solids (Dr. Cotton) | mechanical properties.  
2. Plan a mechanical test for a biological tissue.  
3. Describe appropriate material models for biological tissues based upon the application.  
4. Apply principles of continuum mechanics, elasticity, energy methods, and beam theory to biological structures.  
5. Explain methods for medical imaging and identification of tissues, and describe techniques involved in computational modeling. | Mid-Term Exam: 30%  
Final Exam: 30%  
Term Paper : 10%  
Open-ended assignments where well-ra tioned opinion and creativity count as well as your technical ability. | |
| ME 4670 Engineering Biomechanics (Dr. Bob) | 1. Familiarity with the topics, conventions, and methods of biomechanics analysis.  
2. Working knowledge of human musculoskeletal system anatomy and physiology.  
4. Awareness of commercial biomechanics modeling and analysis software. | Weekly quizzes (40%),  
weekly lab reports (40%) , 3  
MATLAB Assignments (15%),  
and a journal article presentation (5%). | |
| ME 4760 Automotive Engineering (Dr. Kremer) | 1. An ability to model and simulate the longitudinal performance of a vehicle.  
2. A knowledge of future vehicles and advanced automotive technologies.  
3. A knowledge of testing of vehicle performance and fuel economy.  
4. An expertise in at least one aspect of automotive engineering.  
5. A knowledge of basic automotive systems and subsystems. | Case Study Discussions and Summary Reports: 33%  
Area of Expertise Project and Presentation: 34%  
Labs/Simulation Project:33% | |
| ME 4950 Kinetic Theory & Statistical Thermo (Dr. Bayless) | 1. Ability to use software such as EES to perform combustion calculations.  
2. Ability to account for the effect of chemical equilibrium and dissociation on reaction thermodynamics and combustion kinetics.  
3. Ability to identify applications of quantum mechanics to real systems.  
4. Ability to utilize statistical thermodynamics to predict properties.  
5. Ability to determine techniques of spectroscopy through application of statistical thermodynamics.  
6. Ability to perform calculations to balance reactions.  
7. Ability to determine combustion thermodynamics, such as flame temperature. | Weekly quiz and a final exam | |
| ME XXXX Composite Materials (Dr. Alam) | 1. Knowledge of matrix materials including thermosets and thermoplastics.  
2. Knowledge of reinforcement materials with focus on glass and carbon fibers.  
3. Calculate thermo-mechanical properties of a simple composite structure.  
4. Knowledge of different processes used to manufacture composites.  
5. Ability to select matrix and reinforcement for a composite application. | | |
| Education Abroad / International projects (Dr. Kremer) | 1. An awareness of how cultural and business practices differ in places outside the US  
2. Ability to plan and complete logistical arrangements for an international project  
3. An ability to communicate and work effectively with diverse individuals and groups  
4. Project specific outcomes, related to design, business, leadership, etc. | Project-based experiences, with grading criteria dependent on the experience. | |