MASTER OF SCIENCE, MECHANICAL ENGINEERING

http://mechse.illinois.edu

For more details of the degree requirements for both M.S. programs, visit the department’s Graduate Program Web site (p. 1).

### Thesis Option

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>ME 599</td>
<td>Thesis Research (min-max applied toward the degree)</td>
<td>4-8</td>
</tr>
<tr>
<td>MSE 492</td>
<td>Lab Safety Fundamentals (credit does not apply toward the degree)</td>
<td>0</td>
</tr>
<tr>
<td>ME 590</td>
<td>Seminar (registration for 1 hour every term while in residence; credit does not apply toward the degree)</td>
<td>0</td>
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</tbody>
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Elective courses (formal graded coursework) – chosen in consultation with advisor (subject to Other Requirements and Conditions below) 24-28

Total Hours 32

### Other Requirements and Conditions

Other Requirements and Conditions may overlap

A minimum of 8 ME or TAM credit hours with 4 at the 500 level.

A minimum of 12 500-level credit hours applied toward the degree.

Departmental approval is required to pursue the non-thesis option.

Minimum GPA: 3.0

1 For additional details and requirements refer to the department’s graduate program requirements (http://mechanical.illinois.edu/graduate/mechse-graduate-degrees) and the Graduate College Handbook (http://grad.illinois.edu/gradhandbook).

### Non-Thesis Option

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<tr>
<td>MSE 492</td>
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<td>ME 590</td>
<td>Seminar (registration for 1 hour every term while in residence; credit does not apply toward the degree)</td>
<td>0</td>
</tr>
<tr>
<td>ME 597</td>
<td>Independent Study</td>
<td>4</td>
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</table>

or TAM 597 Advanced Independent Study

Elective courses – chosen in consultation with advisor (subject to Other Requirements and Conditions below) 32

Total Hours 36

### Courses

ME 501 Combustion Fundamentals  credit: 4 Hours.
Fundamentals of kinetic theory, transport phenomena, chemical equilibria, and reaction kinetics; flames, their gross properties, structure, and gas dynamics including oscillatory and turbulent burning; solid and liquid propellant combustion; one-dimensional detonation theory including structure and initiation; three-dimensional and other complex detonation waves; supersonic burning. Same as AE 538. Prerequisite: AE 311 or ME 410.

ME 510 Advanced Gas Dynamics  credit: 4 Hours.
Theoretical gas dynamics; fundamental laws and basic equations for subsonic, transonic, and supersonic steady and unsteady flow processes. Same as AE 510. Prerequisite: ME 410.

ME 502 Thermal Systems  credit: 4 Hours.
Steady-state simulation and optimization of thermal systems, dynamic performance, and probabilities in system design. Prerequisite: ME 402.

ME 503 Design of IC Engines  credit: 4 Hours.
Design of internal combustion engines, including gas forces, inertia loads, bearing analysis, torsional vibration, balance, lubrication, valve and cam design, and stress analysis of major engine components. Prerequisite: ME 403.

ME 504 Multiphase Systems & Processes  credit: 4 Hours.
Dynamics and thermodynamics of multiphase and multicomponent systems with special relevance to air-pollution control and energy conversion; relaxation phenomena; general motion of systems of disparate elemental masses; diffusion in gravitational and electric fields, and boundary-layer motion with mass transport; dispersion and collection of particulate matter; transport with surface reactions. Prerequisite: ME 404.

ME 510 Advanced Gas Dynamics  credit: 4 Hours.
Theoretical gas dynamics; fundamental laws and basic equations for subsonic, transonic, and supersonic steady and unsteady flow processes. Same as AE 510. Prerequisite: ME 410.
ME 520  Heat Conduction  credit: 4 Hours.
Fundamentals of heat conduction in isotropic and anisotropic materials; methods of solution to steady and transient heat conduction problems in one, two, and three dimensions; internal heat sources; periodic flow of heat; problems involving phase change; approximate analytical techniques; numerical methods; study of current articles on the subject. Prerequisite: ME 420.

ME 521  Convective Heat Transfer  credit: 4 Hours.
Fundamentals of convective heat transfer; calculation of heat transfer within ducts and over submerged objects for laminar and turbulent flow; natural convection; film condensation and boiling; liquid metals. Prerequisite: ME 411.

ME 522  Thermal Radiation  credit: 4 Hours.
Fundamentals of radiant-energy transport in absorbing and nonabsorbing media; pyrometry; applications to selected problems involving combined energy-transport mechanisms. Prerequisite: ME 420.

ME 523  Nanoscale Energy Transport  credit: 4 Hours.
An advanced treatment of diverse transport phenomena at the nanometer scale involving solids, liquids and gases emphasizing common features in transport by molecules, electrons, phonons, photons, and other quasi-particles of interest, oriented toward applied research in the areas of nanoscale heat transfer and nanoscale energy conversion. Topics include intermolecular forces at surfaces and in the bulk, momentum and species transport in microfluidics, linear response theory, free molecular flow in gases, electron and phonon transport in crystals, Boltzmann equation and its moments, ballistic and diffusive transport, thermoelectric energy conversion, interfacial transport, energy transport in nanostructures and radiative transport in the near-field. Approved for letter and S/U grading.

ME 530  Fatigue Analysis  credit: 4 Hours.
Fatigue analysis methods for the design of structures and components: stress-life, strain-life, and crack-propagation approaches; multiaxial and high-temperature fatigue; interference relationship among material properties, geometry, and design methodology appropriate for a wide range of mechanical engineering components. Prerequisite: ME 430.

ME 531  Inelastic Design Methods  credit: 4 Hours.
Material deformation under combined mechanical and thermal loading: constitutive equations and their application in engineering design and in inelastic finite element methods; material and structural degradation under fatigue and creep conditions. Prerequisite: ME 471 and ME 430.

ME 532  Fracture Resistant Design  credit: 4 Hours.
Application of fracture mechanics and microstructural behavior to materials selection for design; practical approximation of linear and inelastic fracture parameters for evaluation of complex components; destructive and nondestructive tests for control of toughness in manufacture; residual life assessment involving time-dependent fracture (creep, fatigue, stress, corrosion); case studies; design project. Prerequisite: ME 430.

ME 533  Physical Basis for Plasticity  credit: 4 Hours.
Physical and mathematical foundation for plasticity in crystalline materials, with application to deformation processes. Metal forming; deformation processes in other materials, such as slip in geological materials and polymers; rate dependence of plastic flow, with underlying physical mechanisms; kinetics of dislocation motion, mechanisms of work hardening, and crystallographic texture; theoretical framework for modeling the constitutive response of rate-dependent materials undergoing crystallographic slip, and allied computational procedures. Prerequisite: TAM 445.

ME 540  Control System Theory & Design  credit: 4 Hours.
Same as ECE 515. See ECE 515.

ME 541  Control of Machine Systems  credit: 4 Hours.
Modeling machining processes and machine tools. Mechanistic modeling of machining processes, machine-tool errors, characterization of machined surfaces, machine-tool system dynamics and stability, and topics in motion control. 4 graduate hours. No professional credit. Prerequisite: ME 340 and ME 270.

ME 544  Dynamic System Reliability  credit: 4 Hours.
Same as ECE 554. See ECE 554.

ME 546  Analysis of Nonlinear Systems  credit: 4 Hours.
Same as ECE 528 and SE 520. See ECE 528.

ME 550  Solidification Processing  credit: 4 Hours.
Principles of control of structure, properties, and shape in processes involving liquid-solid transformations; stresses, heat flow, mass transport, solute redistribution, and nucleation and growth kinetics; relationship between process variables and structures and properties in the resultant material; examples are drawn from existing commercial and new developing processes. Prerequisite: ME 450.

ME 554  Computational Process Modeling  credit: 4 Hours.
Development and application of computer models to solve practical problems involving fluid flow, heat transfer, and deformation phenomena. Advanced topics in computational methods for materials process modeling; case studies. Same as CSE 561. Prerequisite: ME 412 or ME 471; ME 450.

ME 555  Computational Process Modeling  credit: 4 Hours.
Use of convex optimization in analysis and control of dynamical systems; robust control methods and the use of semidefinite programming; linear matrix inequalities, operator theory, model reduction, H-2 and H-infinity optimal control, S-procedure and integral quadratic constraints, structured singular value and mu-synthesis, and Markovian jump systems; applications in control design. Prerequisite: ECE 515.

ME 561  Convex Methods in Control  credit: 4 Hours.
Mathematical foundation for synthesis and analysis of adaptive control systems: Lyapunov stability theory; methods of direct and indirect model reference adaptive control; recent methods, such as L1 adaptive control, that enable adaptive control with desired transient and steady-state performance specifications. Prerequisite: Any of ECE 486, ECE 515, ECE 528, GE 424, ME 460.

ME 562  Robust Adaptive Control  credit: 4 Hours.
Same as ECE 528 and SE 520. See ECE 528.

ME 570  Nonlinear Solid Mech Design  credit: 4 Hours.
Optimality conditions; finite element methods; design sensitivity analysis; nonlinear analysis; transient analysis; thermo-mechanical solid mechanics. Same as AE 524. 4 graduate hours. No professional credit. Prerequisite: One of AE 420, CEE 470, ME 471, TAM 470; TAM 445, TAM 551.

ME 586  Mechanics of MEMS  credit: 4 Hours.
Mechanics and dynamics of microelectromechanical systems (MEMS); scaling laws in electrostatics, magnetics, and fluids; analytical models for thin-film growth and etching; effect of surface tension in small dimensions in relations to stability of MEMS during web fabrication; size effects on mechanical properties of MEMS materials; equations of motion for MEMS, involving coupled elastic and electric fields that give rise to nonlinear dynamical behavior; Mathieu behavior and chaotic systems. Prerequisite: ME 485.

ME 590  Seminar  credit: 1 Hour.
Presentation and discussion of significant developments in mechanical engineering. Approved for S/U grading only. May be repeated.
ME 591  Interest Group Seminar  credit: 1 Hour.
Seminars on current topics in mechanical science and engineering. May be repeated in the same term if topics vary. May be repeated in separate terms.

ME 597  Independent Study  credit: 1 to 4 Hours.
Independent study of advanced problems related to mechanical engineering. May be repeated in the same term or in separate terms if topics vary to a maximum of 12 hours. Prerequisite: Consent of instructor.

ME 598  Special Topics  credit: 1 to 4 Hours.
Subject offerings of new and developing areas of knowledge in mechanical engineering intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. May be repeated in the same or separate terms if topics vary.

ME 599  Thesis Research  credit: 0 to 16 Hours.
Approved for S/U grading only. May be repeated.