and Space Mechanics. In addition to writing to the Graduate School, prospective students should contact the departmental director of graduate studies for information related to the various programs and financial assistance.

Course Descriptions

221 *Statics.* (3)
Study of force systems on bodies at rest: description of force systems; principles of statics; equipollent forces systems; distributed forces; internal forces. Application to hydrostatics, frame and trusses, beams. Prereq: MA 213 or concur.

302 *Mechanics of Deformable Solids.* (3)
A study of stress and strain in deformable solids with application primarily to linear elastic materials. Topics covered include simple tension and compression of axial members, torsion of shafts, bending of beams, combined loading of members, and buckling of columns. Prereq: EM 221 and MA 214 or MA 214 concur.

303 *Strength of Materials Laboratory.* (1)
Experimental studies of the mechanical properties of materials and structural elements. Three laboratory hours per week. Prereq: EM 302 or concur.

313 *Dynamics.* (3)
Motion of a particle, dynamics of moving bodies, impulse and momentum, work and energy, balancing, gyroscopy, advanced dynamics of rigid bodies. Prereq: EM 221.

351 *Experimental Solid Mechanics.* (3)
The fundamentals of mechanical measurement with illustrative experiments; an introduction to Photoelasticity with laboratory demonstrations; the design and performance of relatively complex Solid Mechanics Experiments. Lecture, two hours; laboratory, three hours. Prereq: EM 313.

503 *Introduction to Continuum Mechanics.* (3)
An introduction to the mathematical description and continuum concepts of deformable materials. Review of linear algebra and Cartesian tensor analysis. Finite deformation and rate of deformation. Balance principles. Principle of material indifference. Study of constitutive equations of linear elasticity, Newtonian fluids, linear viscoelasticity, hyperelastic materials and special non-Newtonian fluids. Sample problems. Prereq: MA 433 or consent of instructor.

513 *Mechanical Vibrations.* (3)
Vibrations of systems of one and several degrees of freedom, critical speeds and torsional and lateral vibrations of shafts. Lecture and recitation, three hours. Prereq: EM 313.

531 *Advanced Strength of Materials.* (3)
Unsymmetrical bending of beams, thin plates, stress analysis of thick walled cylinders, and rotating discs. Theory of elastic energy, curved beams, stress concentration and fatigue. Lecture and recitation, three hours. Prereq: EM 302.

532 *Experimental Stress Analysis.* (3)
Experimental stress analysis from an engineering viewpoint. Preliminary optics; stress-optic law; isoclinics and stress trajectories; strain gauges; rosettes; miscellaneous experimental techniques. Prereq: EM 531.

533 *Aircraft and Missile Structural Analysis.* (3)
Analysis of semi-monocoque structures in bending and torsion. Energy and approximate method; shear lag; and thermal effects. Introduction to creep and plasticity. Three class hours per week. Prereq: EM 313.

585 *Fourier Series and Boundary Value Problems.* (3)
An introductory treatment of Fourier series and its application to the solution of boundary value problems in the partial differential equations of physics and engineering. Orthogonal sets of functions, Fourier series and integrals, solution of boundary value problems, theory and application of Bessel functions and Legendre polynomials. Prereq: MA 432 or equivalent. (Same as MA 485.)

603 *Theoretical Plasticity I.* (3)
An introductory mathematical treatment of the perfectly plastic solid. Real and idealized materials; yield criteria; flow rules; experimental basis of the theory; contained plastic flow; some two-dimensional problems. Connection with dislocation theory. Prereq: MA 433 or consent of instructor.

604 *Theoretical Plasticity II.* (3)
Continuation of EM 603. Limit analysis; plastic bending and torsion; structures and shells; thermoplasticity; plastic wave propagation. Prereq: EM 603.

605 *Foundations of Inelasticity.* (3)
A critical and constructive discussion of the assumptions and experimental evidence for inelastic material response from a viewpoint of the mechanist. Lecture, three hours. Prereq: EM 604 and 662.

606 *Theoretical Elasticity.* (3)
A mathematical account of the linear elastic solid as special continuum. Solution of boundary value problems; two-dimensional examples; torsion and bending; stress concentrations; strain energy; thermoelasticity. Some direct methods of solution for difficult problems, and introduction to dynamic elasticity. Lecture and recitation, three hours. Prereq: EM 503 or consent of instructor.

607 *Advanced Inelasticity.* (3)
A continuation of EM 605 with a study of the latest research results in the area inelasticity. Lecture, three hours. Prereq: EM 605.

613 *Nonlinear Oscillations.* (3)
Analysis of various nonlinear oscillatory mechanical systems. Solutions of the differential equations of motion; response curves for forced oscillations; determination of stability criteria. Three class hours per week. Prereq: EM/ME 646 or permission of instructor.

614 *Mechanics of Space Vehicles.* (3)
Description of rigid body orientation, angular velocity, and angular acceleration in terms of Euler angles, Euler parameters, and direction cosines. Gravitational forces and torques and their effect on the attitude motions of symmetrical and unsymmetrical near-earth satellites. Effects of gyroscopic devices, energy dissipation, and elastic flexibility on the stability of space vehicles. Three class hours per week. Prereq: EM 613 or consent of instructor.

632 *Theory of Elastic Stability.* (3)
Buckling of centrally compressed bars. Detailed consideration of elastic and plastic buckling of prismatic bars under simultaneous action of axial and lateral loads. Buckling of frames, lateral buckling of beams, shear effect, energy methods. Lecture, three hours. Prereq: EM 531.

644 *Advanced Dynamics I.* (3)
Generalized rigid body kinematics, concept of reference frames, generalized forces for holonomic and non-holonomic systems, inertia properties of rigid bodies, and energy functions. Lagrange's form of D'Alembert's principle for holonomic and non-holonomic systems. Prereq: Consent of instructor. EM 313, MA 432. (Same as ME 644.)

646 *Advanced Dynamics II.* (3)
Continuation of EM/ME 644. Application of Lagrange's equations in deriving equations of motion; first integrals and conservation theorems; Hamiltonian formalism. Applications to engineering systems. Prereq: EM or ME 644. (Same as ME 646.)

651 *Numerical Methods in Potential Theory.* (3)
A modern numerical treatment of some classical problems in potential theory. Prereq: MA 433.

652 *Numerical Methods in Elasticity.* (3)
Continuation of EM 651. A modern numerical treatment of some difficult problems in classical elasticity. Prereq: EM 651.

653 *Methods of Applied Differential Equations.* (3)
Integrals of nonlinear partial differential equations; similarity variables and other transformations; perturbation methods; weighted residual methods; numerical methods; selected topics. Prereq: MA 432 or consent of instructor.

661 *Nonlinear Continuum Mechanics I.* (3)
An introduction to the continuum physics and mathematical theory of the nonlinear mechanical behavior of materials. Review mathematical background. Principles of continuum mechanics. Principles of constitutive equations. Lecture and recitation, three hours. Prereq: EM 503 or MA 462 or consent of instructor.