E M - Engineering Mechanics

Engineering Mechanics: E M

Lower-Division Courses

E M 306 (TCCN: ENGR 2301). Statics.

Vector algebra, force systems, free-body diagrams; engineering applications of equilibrium, including frames, friction, distributed loads; centroids, moments of inertia. Three lecture hours and two discussion hours a week for one semester. Prerequisite: Mathematics 408D, 408L, 408M, or 408S, and Physics 301 or 303K with a grade of at least C- in each.

E M 311M (TCCN: ENGR 2302). Dynamics.

Kinematics, dynamics, and energy and momentum methods for points as well as 2D/3D rigid bodies. Describe and predict the motion of different types of rigid bodies in space and time. Vibrations of simple systems. Three lecture hours and two discussion hours a week for one semester. Prerequisite: Engineering Mechanics 306, and Mathematics 408D or 408M with a grade of at least C- in each.

E M 319 (TCCN: ENGR 2332). Mechanics of Solids.

Internal forces and deformations in solids; stress and strain in elastic and plastic solids; application to simple engineering problems. Three lecture hours a week for one semester, with discussion hours if necessary. Prerequisite: Engineering Mechanics 306, and Mathematics 408D or 408M with a grade of at least C- in each.

E M 119S, 219S, 319S, 419S, 519S, 619S, 719S, 819S, 919S. Topics in Engineering Mechanics.

Used to record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office or the school's International Engineering Education programs. Credit is recorded as assigned by the study abroad adviser in the Department of Aerospace Engineering and Engineering Mechanics. University credit is awarded for work in an exchange program; it may be counted as coursework taken in residence. May be repeated for credit when the topics vary. Offered on the letter-grade basis only.

Upper-Division Courses

E M 339. Advanced Strength of Materials.

Same as Aerospace Engineering 339. Curved beams, shear deformation, beam columns, beams on elastic foundations; inelastic behavior of members; elementary plate bending. Three lecture hours a week for one semester. Prerequisite: Engineering Mechanics 319 with a grade of at least C-.

E M 360. Studies in Engineering Mechanics.

Advanced work in the various areas of engineering mechanics, based on recent developments. Three lecture hours a week for one semester. May be repeated for credit when the topics vary. Prerequisite: Upper-division standing in engineering and consent of instructor.

Topic 4: Theory of Material Science.
Topic 13: Applications of Finite Element Methods.

E M 179S, 279S, 379S, 479S, 579S, 679S, 779S, 879S, 979S. Topics in Engineering Mechanics.

Used to record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office or the school's International Engineering Education Programs. Credit is recorded as assigned by the study abroad adviser in the Department of Aerospace Engineering and Engineering Mechanics. University credit is awarded for work in an exchange program; it may be counted as coursework taken in residence. May be repeated for credit when the topics vary. Offered on the letter-grade basis only.

Graduate Courses

E M 380. Theory of Plasticity.

Physical basis of plastic deformation; mathematical theory of incremental plasticity; total theories; numerical implementation; slip and physical theories of plastic deformation; rate dependent (viscoplastic) models; applications to several engineering problems. Three lecture hours a week for one semester. Prerequisite: Graduate standing, and Engineering Mechanics 388 or the equivalent.

E M 381. Advanced Dynamics.

Dynamics of systems of particles and rigid bodies; vibration theory; analytical dynamics, including Lagrangian and Hamiltonian formulations; dynamic stability; continuous systems. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

E M 382. Nonlinear Analysis.

Methods for analyzing various types of nonlinear differential equations of dynamical systems; exact methods, perturbation and averaging techniques, direct method of Liapunov. Three lecture hours a week for one semester. Prerequisite: Graduate standing and consent of instructor.

E M 384K. Continuum Mechanics.

Foundations of the general nonlinear theories of continuum mechanics; general treatment of motion and deformation of continua, balance laws, constitutive theory; particular application to elastic solids and simple materials. Three lecture hours a week for one semester. Prerequisite: Graduate standing, and Engineering Mechanics 386K or consent of instructor.

E M 384L. Structural Dynamics.

Same as Aerospace Engineering 384P (Topic 3: Structural Dynamics). Free and forced vibration of single-degree-of-freedom, multiple-degree-of-freedom, and continuous systems. Lagrange's equations and Hamilton's principle; discretization of continuous systems; numerical methods for response and algebraic eigenvalue problems. Three lecture hours a week for one semester. Prerequisite: Graduate standing and consent of instructor.

E M 386K. Analytical Methods I.

Basic topics in real and complex analysis, ordinary and partial differential equations, and other areas of applied mathematics with application to applied mechanics. Three lecture hours a week for one semester. Aerospace Engineering 380P (Topic 1) and Engineering Mechanics 386K may not both be counted. Prerequisite: Graduate standing.

E M 386L. Analytical Methods II.

Continuation of Engineering Mechanics 386K. Three lecture hours a week for one semester. Only one of the following may be counted: Aerospace Engineering 380P (Topic 2), Computational Science, Engineering, and Mathematics 386L, Engineering Mechanics 386L. Prerequisite: Graduate standing, and Engineering Mechanics 386K or consent of instructor.

E M 386M. Functional Analysis in Theoretical Mechanics.

Same as Computational Science, Engineering, and Mathematics 386M. An introduction to modern concepts in functional analysis and linear operator theory, with emphasis on their application to problems in theoretical mechanics; topological and metric spaces, norm linear spaces, theory of linear operators on Hilbert spaces, applications to boundary value problems in elasticity and dynamical systems.

Three lecture hours a week for one semester. Computational Science, Engineering, and Mathematics 386M and Engineering Mechanics 386M may not both be counted. Prerequisite: Graduate standing, Engineering Mechanics 386L, and Mathematics 365C.

E M 386N. Qualitative Methods in Nonlinear Mechanics.

A study of methods for assessing the qualitative behavior of solutions to equations governing nonlinear continuum mechanics. Three lecture hours a week for one semester. Prerequisite: Graduate standing and Engineering Mechanics 386M.

E M 387. Foundations of Fluid Mechanics.

Governing equations in differential and integral forms; applications to both inviscid and viscous flow problems. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

E M 388. Solid Mechanics I.

Same as Aerospace Engineering 384P (Topic 1: Solid Mechanics I). Mathematical description of stress, deformation, and constitutive equations of solid mechanics; boundary value problems of elasticity. Three lecture hours a week for one semester. Prerequisite: Graduate standing and consent of instructor.

E M 388F. Fracture Mechanics.

Griffith theory of brittle crack propagation, other theories, crack toughness testing concepts. Three lecture hours a week for one semester. Prerequisite: Graduate standing, and Engineering Mechanics 388 or consent of instructor.

E M 388L. Solid Mechanics II.

Same as Aerospace Engineering 384P (Topic 2: Solid Mechanics II). Continuation of Engineering Mechanics 388. Additional topics in elasticity, plasticity, viscoelasticity, variational methods, and other areas of solid mechanics. Three lecture hours a week for one semester. Prerequisite: Graduate standing, Engineering Mechanics 388 or Aerospace Engineering 384P (Topic 1), and consent of instructor.

E M 388M. Micromechanics.

Constitutive characterization of materials based on their microstructure. Relationships between internal structure and mechanical properties for composites, polycrystals, and polymers on the basis of linear elasticity, plasticity, and theories that account for rate-dependence. Three lecture hours a week for one semester. Prerequisite: Graduate standing and a graduate course in solid mechanics.

E M 388V. Theory of Viscoelasticity.

Introduction to linear viscoelasticity; methods of characterizing viscoelastic material behavior; analytical and approximate solution techniques for engineering problems, including contact, wave propagation, and thermoviscoelastic problems. Three lecture hours a week for one semester. Prerequisite: Graduate standing, and Engineering Mechanics 388 or consent of instructor.

E M 389J. Experimental Mechanics.

Principles and techniques of measurement in mechanics; includes discussion of strain gauges, optical interference methods, photoelasticity, and dynamic measurements. Two lecture hours and three laboratory hours a week for one semester. Prerequisite: Graduate standing.

E M 391. Behavior and Mechanics of Active/Smart Materials.

Continuum physics and thermodynamics including thermal, mechanical, electrical and magnetic behaviors of active/smart materials. Linear and non-linear behavior of ferroelectrics, ferromagnetic materials, and shape memory alloys. Crystal symmetry, domain structure, phenomenological constitutive models, phase-field modeling, and dielectric elastomers. Three lecture hours a week for one semester.

E M 392R. Random Vibrations.

Introduction to probability theory and its application to random excitation of linear and nonlinear systems; a probabilistic discussion of failure and fatigue in structures. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

E M 393N. Numerical Methods for Flow and Transport Problems.

Approximate solution methods for flow and transport problems in engineering and applied science. Finite element, finite difference, and residual methods for linear and nonlinear problems. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

E M 394. Structural Stability.

Fundamental theory of buckling of elastic structural elements such as bars, frames, rings, plates, and shells; also special stability topics including inelastic buckling, creep buckling, and buckling under dynamic loading. Three lecture hours a week for one semester. Prerequisite: Graduate standing, and Engineering Mechanics 388 or consent of instructor.

E M 394F. Finite Element Methods.

Same as Aerospace Engineering 384P (Topic 4) and Computational Science, Engineering, and Mathematics 393F. Derivation and implementation of the finite element method; basic coding techniques; application to problems of stress and diffusion. Three lecture hours a week for one semester. Only one of the following may be counted: Aerospace Engineering 384P (Topic 4), Computational Science, Engineering, and Mathematics 393F, Engineering Mechanics 394F. Prerequisite: Graduate standing and consent of instructor.

E M 394G. Computational Techniques in Finite Elements.

Organization and data management in finite element codes; element models and calculations; equation solving; preprocessing and postprocessing. Three lecture hours a week for one semester. Prerequisite: Graduate standing and Engineering Mechanics 394F.

E M 394H. Advanced Theory of Finite Element Methods.

Contemporary topics in the theory and application of finite element methods. Three lecture hours a week for one semester. Prerequisite: Graduate standing, Engineering Mechanics 394F, and Engineering Mechanics 386L or the equivalent.

E M 394V. Wave Propagation I.

Solutions of linear wave equations; waves in elastic media, including plates and cylinders; transient waves, transform methods, asymptotic approximation. Three lecture hours a week for one semester. Prerequisite: Graduate standing, and Engineering Mechanics 388 or consent of instructor.

E M 397, 697, 997. Advanced Studies in Engineering Mechanics.

For each semester hour of credit earned, one lecture hour a week for one semester. May be repeated for credit when the topics vary. Prerequisite: Graduate standing and consent of instructor.

Topic 1: Advanced Topics in Viscoelasticity.
Topic 2: Individual Research.
Topic 3: Advanced Computational Flows and Transport.
Topic 4: Grid Generation and Adaptive Grids.
Topic 5: Adaptive Boundary/Finite Element Methods.

E M 397R, 697R, 997R. Individual Research.

Must be arranged by mutual agreement between student and faculty member. Individual research. May be repeated for credit. Offered on the credit/no credit basis only. Prerequisite: Graduate standing.

E M 397S. Mechanics Seminar.

Current topics in mechanics. Conference course. All engineering mechanics graduate students are required to register for either Engineering Mechanics 397S or 397T each semester. May be repeated for credit. Offered on the credit/no credit basis only. Prerequisite: Graduate standing.

E M 397T. Computational Mechanics Seminar.

Current topics in computational mechanics. Conference course. All engineering mechanics graduate students are required to register for either Engineering Mechanics 397S or 397T each semester. May be repeated for credit. Offered on the credit/no credit basis only. Prerequisite: Graduate standing.

E M 698. Thesis.

The equivalent of three lecture hours a week for two semesters. Offered on the credit/no credit basis only. Prerequisite: For 698A, graduate standing in engineering mechanics and consent of the supervising professor and the graduate adviser; for 698B, Engineering Mechanics 698A.

E M 398R. Master's Report.

Preparation of a report to fulfill the requirement for the master's degree under the report option. The equivalent of three lecture hours a week for one semester. Offered on the credit/no credit basis only. Prerequisite: Graduate standing in engineering mechanics and consent of the graduate adviser.

E M 398T. Supervised Teaching in Engineering Mechanics.

Teaching methods and objectives, criteria for evaluating teaching effectiveness, procedures and regulations, laboratory teaching. Three lecture hours a week for one semester. Offered on the credit/no credit basis only. Prerequisite: Graduate standing and appointment as a teaching assistant.

E M 399W, 699W, 999W. Dissertation.

May be repeated for credit. Offered on the credit/no credit basis only. Prerequisite: Admission to candidacy for the doctoral degree.

Professional Courses