Courses primarily for undergraduates:

**E M 274. Statics of Engineering.**
(3-0) Cr. 3. F.S.SS. Prereq: Credit or enrollment in MATH 166; credit or enrollment in PHYS 111 or PHYS 221

Vector and scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, second moments of areas, principal second moments of area, radius of gyration, internal forces, shear and bending moment diagrams.

**E M 274H. Statics of Engineering: Honors.**
(3-0) Cr. 3. F.S.SS. Prereq: Credit or enrollment in MATH 166; credit or enrollment in PHYS 111 or PHYS 221

Vector and scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, second moments of areas, principal second moments of area, radius of gyration, internal forces, shear and bending moment diagrams.

**E M 324. Mechanics of Materials.**
(3-0) Cr. 3. F.S.SS. Prereq: E M 274

Plane stress, plane strain, stress-strain relationships, and elements of material behavior. Application of stress and deformation analysis to members subject to centric, torsional, flexural, and combined loadings. Elementary considerations of theories of failure, buckling. Nonmajor graduate credit.

**E M 327. Mechanics of Materials Laboratory.**
(0-2) Cr. 1. F.S.SS. Prereq: Credit or enrollment in E M 324


**E M 345. Dynamics.**
(3-0) Cr. 3. F.S.SS. Prereq: E M 274, credit or enrollment in MATH 266 or MATH 267

Particle and rigid body kinematics, Newton’s laws of motion, kinetics of plane motion, rigid body problems using work-energy, linear, and angular impulse-momentum principles, vibrations. Nonmajor graduate credit.

**E M 350. Introduction to Nondestructive Evaluation Engineering.**
(3-0) Cr. 3. S. Prereq: E M 324, MATH 266 or MATH 267, PHYS 222

The physics of ultrasonic, eddy current, and x-ray testing. Introduction to linear system concepts, wave propagation, electromagnetics and radiation. Models of the generation, scattering and reception of waves in ultrasonics, the electrical impedance changes of eddy current testing, and image formation process for x-rays. Pattern recognition methods for the interpretation of measured responses. Nonmajor graduate credit.

**E M 362. Principles of Nondestructive Testing.**
(Cross-listed with MAT E), (3-0) Cr. 3. S. Prereq: PHYS 112 or PHYS 222

Radiography, ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection, and other techniques. Physical bases of tests; materials to which applicable; types of defects detectable; calibration standards, and reliability safety precautions. Nonmajor graduate credit.

**E M 362L. Nondestructive Testing Laboratory.**
(Cross-listed with MAT E), (0-3) Cr. 1. S. Prereq: Credit or enrollment in MAT E 362

Application of nondestructive testing techniques to the detection and sizing of flaws in materials and to the characterization of material’s microstructure. Included are experiments in hardness, dye penetrant, magnetic particle, x-ray, ultrasonic and eddy current testing. Field trips to industrial laboratories. Nonmajor graduate credit.

**E M 378. Mechanics of Fluids.**
(2-2) Cr. 3. F.S.SS. Prereq: E M 274


**E M 417. Experimental Mechanics.**
(Cross-listed with AER E), (2-2) Cr. 3. Alt. F., offered 2012. Prereq: E M 324

Introduction of different aspects of measuring deformation, strains, and stress for practical engineering problems. Strain gage theory and application. Selected laboratory experiments. Nonmajor graduate credit.

Courses primarily for graduate students, open to qualified undergraduates:

**E M 510. Continuum Mechanics.**
(3-0) Cr. 3. F. Prereq: MATH 385


**E M 514. Advanced Mechanics of Materials.**
(Cross-listed with AER E), (3-0) Cr. 3. F. Prereq: E M 324


(3-0) Cr. 3. S. Prereq: E M 510

Fundamental mechanics of linear elasticity, formulation and solution of simple elastostatic boundary value problems. Kinematics of small deformations, constitutive equations for isotropic and anisotropic media. Field equations for elastic solids, plane strain/plate strain and some classic analytical solutions such as Boussinesq, Hertz, Kirsch, Lamé&acutef, and Mitchell. Stress functions and potential methods and introduction to finite elements.

**E M 517. Experimental Mechanics.**
(Cross-listed with AER E), (3-0) Cr. 4. Alt. S., offered 2012. Prereq: E M 510 or E M 514 or E M 516

Fundamental concepts for force, displacement, stress, and strain measurements. Strain gages. Full field deformation measurements with laser interferometry and digital image processing. Advanced experimental concepts at the micro and nano scale regimes.

**E M 518. Waves in Elastic Solids with Applications to Ultrasonic Nondestructive Evaluation.**
(3-0) Cr. 3. F. Prereq: MATH 385

E M 525. Finite Element Analysis. (Cross-listed with AER E) (3-0) Cr. 3. S. Prereq: E M 425, MATH 385
Variational and weighted residual approach to finite element equations. Emphasis on two- and three-dimensional problems in solid mechanics. Isoparametric element formulation, higher order elements, numerical integration, imposition of constraints and penalty, convergence, and other more advanced topics. Use of two- and three-dimensional computer programs. Dynamic and vibrational problems, eigenvalues, and time integration. Introduction to geometric and material nonlinearities.

E M 526. Boundary Element Methods in Engineering. (3-0) Cr. 3. Alt. F., offered 2012. Prereq: E M 514 or E M 516

E M 543. Introduction to Random Vibrations and Nonlinear Dynamics. (Cross-listed with M E) (3-0) Cr. 3. Alt. S., offered 2013. Prereq: 444
Vibrations of continuous systems. Nonlinear vibration phenomena, perturbation expansions; methods of multiple time scales and slowly-varying amplitude and phase. Characteristics of random vibrations; random processes, probability distributions, spectral density and its significance, the normal or Gaussian random process. Transmission of random vibration, response of simple single and two-degree-of-freedom systems to stationary random excitation. Fatigue failure due to random excitation.

E M 548. Advanced Engineering Dynamics. (3-0) Cr. 3. Alt. S., offered 2012. Prereq: E M 345, MATH 266 or MATH 267
3-D kinematics and dynamics of particles and rigid bodies. Coordinate systems, calculus of variations. Lagrange’s equations with constraints, modified Euler’s equations, torque-free motion of rigid bodies in 3-D, moment equations with constraints.

E M 550. Fundamentals of Nondestructive Evaluation. (Cross-listed with M S E, M E, AER E) (3-2) Cr. 3. S. Prereq: E M 324, MATH 385
Principles of five basic NDE methods and their application in engineering inspections. Materials behavior and simple failure analysis. NDE reliability, and damage-tolerant design. Advanced methods such as acoustic microscopy, laser ultrasonics, thermal waves, computed tomography, and thermoelectrics are analyzed. Laboratory experiments on all basic methods: ultrasonics, eddy currents, x-ray, liquid penetrants, magnetic testing, and visual inspection are performed.

Theoretical acoustics: wave propagation in fluids; acoustic radiation, diffraction and scattering; nonlinear acoustics; radiation force; cavitation; and ray acoustics.

E M 564. Fracture and Fatigue. (Cross-listed with M S E, M E, AER E) (3-0) Cr. 3. Alt. F., offered 2012. Prereq: E M 324 and either MAT E 216 or MAT E 273 or MAT E 392. Undergraduates: Permission of instructor
Materials and mechanical approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics, fracture of thin films and layered structures. Fracture and fatigue tests, mechanics and materials designed to avoid fracture or fatigue.

E M 566. Phase Transformation in Elastic Materials. (Cross-listed with M E) (3-0) Cr. 3. S. Prereq: EM 510 or EM 516 or EM 514