THEORETICAL AND APPL MECHANICS (TAM)

TAM Class Schedule (https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/TAM)

Courses

TAM 195 Mechanics in the Modern World credit: 1 Hour. (https://courses.illinois.edu/schedule/terms/TAM/195)
Freshman introduction to engineering mechanics and its role in modern engineering analysis and design. Project activity.

TAM 199 Undergraduate Open Seminar credit: 1 to 5 Hours. (https://courses.illinois.edu/schedule/terms/TAM/199)
May be repeated.

TAM 201 Mechanics for Technol & Mgmt credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/201)
Engineering mechanics (statics, dynamics, solid mechanics, and fluid mechanics) and the role that mechanics plays in engineering analysis and design. For Technology and Management majors only.

TAM 210 Introduction to Statics credit: 2 Hours. (https://courses.illinois.edu/schedule/terms/TAM/210)
Forces, moments, couples; resultants of force systems; equilibrium analysis and free-body diagrams; analysis of forces acting on members of trusses, frames, etc.; shear-force and bending-moment distributions; Coulomb friction; centroids and center of mass; applications of statics in design. Credit is not given for both TAM 210 and TAM 211. Prerequisite: PHYS 211; credit or concurrent registration in MATH 241.

TAM 211 Statics credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/211)
Forces, moments, and couples; resultants of force systems; equilibrium analysis and free-body diagrams; analysis of forces acting on members of trusses, frames, etc.; shear-force and bending-moment distributions; Coulomb friction; centroids, center of mass, moment of inertia, polar moment of inertia, and product of inertia; virtual work; hydrostatic pressure; applications of statics in design. Credit is not given for both TAM 211 and TAM 210. Prerequisite: PHYS 211; credit or concurrent registration in MATH 241.

TAM 212 Introductory Dynamics credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/212)
Kinematics and dynamics of the three-dimensional motion of particles; kinematics and dynamics of the plane motion of rigid bodies; methods of work energy and impulse momentum; moving reference frames. Prerequisite: TAM 210 or TAM 211.

TAM 251 Introductory Solid Mechanics credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/251)
Relationship between internal stresses and deformations produced by external forces acting on deformable bodies, and design principles based on mechanics of solids: normal stresses, shear stresses, and deformations produced by tensile, compressive, torsional, and bending loading of members; beam deflections; elastic energy and impact; multi-dimensional stress states; buckling of columns. Prerequisite: TAM 210 or TAM 211.

TAM 252 Solid Mechanics Design credit: 1 Hour. (https://courses.illinois.edu/schedule/terms/TAM/252)
Design problems and projects intended to accompany TAM 251. Prerequisite: Credit or concurrent registration in TAM 251.

TAM 270 Design for Manufacturability credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/270)
Same as ME 270. See ME 270.

TAM 297 Introductory Independent Study credit: 1 to 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/297)
Independent study and/or individual projects related to engineering mechanics. Approved for Letter and S/U grading. May be repeated to a maximum of 6 credit hours for letter grade; no limit for S/U grade mode. Prerequisite: Consent of Instructor.

TAM 302 Engineering Design Principles credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/302)
Examples of mechanical design problems that occur in engineering practice and the procedures and issues involved in solving them; technical aspects and societal ramifications of the design process; intellectual property, ethics, and contemporary issues; probability and statistics; computational mechanics; case studies; student discussion of design-related issues at different levels; design project reports and presentations; student teams.

TAM 324 Behavior of Materials credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/324)
Same as CEE 300. See CEE 300.

TAM 335 Introductory Fluid Mechanics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/335)
Fluid statics; continuity, momentum, and energy principles via control volumes; ideal and real fluid flow; introduction to the Navier-Stokes equation; similitude; laminar and turbulent boundary layers; closed-conduit flow, open-channel flow, and turbomachinery. Prerequisite: TAM 212.

TAM 412 Intermediate Dynamics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/412)
Lagrangian mechanics of dynamical systems with an emphasis on vibrations; constraints and generalized coordinates; motion in accelerating frames; conservation laws and invariance of the Lagrangian; particle motion in one dimension, the two-body problem, and central-force motion; free and forced vibration of linearized single-degree-of-freedom and multi-degree-of-freedom discrete systems; weakly nonlinear vibrations; parametric resonance; introduction to Hamiltonian dynamics; rigid-body motions. 4 undergraduate hours. 4 graduate hours. Credit is not given for both TAM 412 and AE 352. Prerequisite: MATH 225 or MATH 415; MATH 285; TAM 212.

TAM 413 Fund of Engrg Acoustics credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/413)
Same as ECE 473. See ECE 473.

TAM 416 Intro to Nonlinear Dyn & Vib credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/416)
Single- and multi-degree-of-freedom oscillators; asymptotic methods; forced, internal and combination resonances; time-discrete dynamical systems (maps); complex dynamics; parametric vibrations and resonances; introduction to nonlinear localization and nonlinear targeted energy transfer; nonlinear vibrations of elastic continua; application in mechanics and engineering. 4 undergraduate hours. 4 graduate hours. Prerequisites: MATH 285 OR MATH 441; MATH 415; TAM 212.

TAM 424 Mechanics of Structural Metals credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/424)
Micromechanisms at the atomic, single-crystal, and polycrystal levels and their use in explaining the deformation and failure characteristics of metals; elastic deformation, dislocation mechanics, plastic deformation and strengthening mechanisms, fracture mechanics and fracture mechanisms, fatigue, and creep; design criteria; special topics. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 300 or ME 330.

TAM 427 Mechanics of Polymers credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/427)
Mechanical behavior of amorphous and semi-crystalline polymers; overview of polymer structure, properties, and processing; polymer linear viscoelasticity using Boltzmann superposition and mechanical models; measurement of viscoelastic properties; polymeric yield phenomena; fracture and craze formation; impact and fatigue. Same as AE 427 and MSE 454. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 300 or ME 330.

TAM 428 Mechanics of Composites credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/428)
Same as AE 428 and MSE 456. See MSE 456.

TAM 435 Intermediate Fluid Mechanics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/435)
Analytical solution methods for problems involving ideal and real fluids: potential flow theory, boundary-layer theory; surface waves, vortex dynamics, and compressible flows. 4 undergraduate hours. 4 graduate hours. Prerequisite: One of AE 312, ME 310, TAM 335.

TAM 445 Continuum Mechanics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/445)
Tensor algebra and analysis; kinematics of continua; mass, force, stress, and the general balance laws of continuum mechanics; introduction to constitutive equations. 4 undergraduate hours. 4 graduate hours. Prerequisite: TAM 251.

TAM 451 Intermediate Solid Mechanics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/451)
Analysis of stress and strain (definitions, transformation of axes, equilibrium equations, and symmetry of the stress tensor); linear materials, Hooke's law; strain energy, potential energy, energy principles and methods; two-dimensional problems in elasticity (torsion, axisymmetric problems); the finite-element method for two- and three-dimensional boundary-value problems in linear elasticity; plasticity (introduction, yield criteria, elastic-plastic behavior, and limit-load calculations); linear-elastic fracture mechanics (introduction, Griffith's approach, stress intensity factor, and energy release rate). 4 undergraduate hours. 4 graduate hours. Prerequisite: TAM 251.

TAM 456 Experimental Stress Analysis credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/456)
Basic theories for measuring stresses and deformations in load-carrying engineering components; use of optical, electrical, and mechanical instrumentation; laboratory sessions on brittle coatings, electrical resistance strain gages, photoelasticity, and moire interferometry. 3 undergraduate hours. 3 graduate hours. Prerequisite: TAM 251.

TAM 461 Cellular Biomechanics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/461)
Mechanics of biological cells and tissues: cell structure; mechanics of biomembranes; the cytoskeleton and cortex; dynamic cell processes; cell motility and control of cell shape and proliferation; experimental approaches and theoretical models. Same as BIOE 461. 4 undergraduate hours. 4 graduate hours. Prerequisite: TAM 251.

TAM 470 Computational Mechanics credit: 3 or 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/470)
Modercomputational mechanics: mappings and iterative methods; stability; convergence; consistency; numerical and symbolic solutions of ordinary and partial differential equations; finite-difference methods; the finite-element method; spectral methods. Applications to problems in solid mechanics, fluid mechanics, and dynamics. Same as CSE 450. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CS 101 and MATH 285.

TAM 497 Independent Study credit: 1 to 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/497)
Individual studies in any area of theoretical and applied mechanics. 1 to 3 undergraduate hours. No graduate credit. May be repeated to a maximum of 6 hours in separate terms as topics vary. Prerequisite: Consent of Instructor. Students with Junior or Senior standing.

TAM 498 Special Topics credit: 1 to 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/498)
Subject offerings of new and developing areas of knowledge in theoretical and applied mechanics intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. 1 to 4 undergraduate hours. 1 to 4 graduate hours. May be repeated in the same or separate terms if topics vary to a maximum of 9 undergraduate hours or 12 graduate hours.

TAM 499 Senior Thesis credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/TAM/499)
Thesis investigation of special subjects in mechanics, including theoretical or experimental research. 3 undergraduate hours. No graduate credit. Prerequisite: Department and instructor approval required.

TAM 500 Seminar credit: 1 Hour. (https://courses.illinois.edu/schedule/terms/TAM/500)
Lectures and discussion on current topics in theoretical and applied mechanics. Approved for S/U grading only.

TAM 514 Elastodynamics and Vibrations credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/514)
Review of theory of multi-degree-of-freedom systems; problems in the free and forced vibration of continuous linear elastic structures, rods, beams, membranes, plates, and three-dimensional solid and fluid bodies; Lagrangian densities, Sturm-Liouville problems, time and frequency domains, damping, Green's functions, and elastic waves; propagation and modal analysis; modeling of damping in structures; response of complex structures. Same as AE 551. 4 graduate hours. No professional credit. Prerequisite: TAM 412, TAM 542, and TAM 551.

TAM 518 Wave Motion credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/518)
Linear waves in one-dimensional homogeneous and inhomogeneous media (both solids and fluids), linear elastic waves in a homogeneous halfspace, scalar waves in a layer and in a layered halfspace, nonlinear diffusive waves, nonlinear dispersive waves, and the inverse scattering transform. Prerequisite: TAM 541 or MATH 556; one of TAM 514, TAM 531, TAM 551.

TAM 524 Micromechanics of Materials credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/524)
Advanced analysis of modern engineering materials with emphasis on relating microstructural phenomena to the mechanics of material behavior: prediction of elastic and thermal properties of materials with heterogeneous microstructure (such as composites), micromechanics of failure and damage, toughening mechanisms, mechanics of phase transformations; current topics in materials research (such as high-temperature response and ferroelasticity). Prerequisite: CEE 300 or ME 330; TAM 551.

TAM 529 Viscoelasticity Theory credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/529)
Same as AE 529. See AE 529.

TAM 531 Inviscid Flow credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/531)
Dynamics of fluids in the limit of zero viscosity: governing equations of motion, kinematics, and vorticity transport; general theory of irrotational flow, including two-dimensional potential flow, the complex potential, and three-dimensional potential flow; applications to thin airfoil theory and free streamline theory; inviscid flows with vorticity; vortex dynamics; water wave theory; aspects of inviscid compressible flow. Prerequisite: MATH 285 and TAM 435.

TAM 532 Viscous Flow credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/532)
Dynamics of flow in which viscosity is significant or dominant, and the development and use of theoretical and numerical tools for practitioners of modern fluid mechanics; physics of viscous layers that arise in both high- and low-Reynolds-number flows; dimensional analysis, exact solutions to the Navier-Stokes equations; jets and wakes; microhydrodynamics; fluid stability; turbulence. Prerequisite: MATH 285 and TAM 435.

TAM 536 Instability and Transition credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/536)
Stability of fluid motion: linearized flow equations and normal-mode analysis, Kelvin-Helmholtz instability, inviscid and viscous theory of parallel shear flow, Squire's and Rayleigh's inflection-point theorems, secondary instability theory; critical layers; boundary-layer stability; Orr-Sommerfeld equations, Tollmien-Schlichting waves; non-parallel theory, centrifugal instabilities, and Benard convection; nonlinear theory and transition to turbulence; bifurcations, Landau's theory; routes to chaos, strange attractors; transition modeling, prediction, and control; boundary-layer receptivity, experimental evidence. Prerequisite: TAM 532.

TAM 537 Experimental Fluid Mechanics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/537)
Methods and techniques for measurement and analysis of data used in experimental fluid mechanics: signal processing, electronics, and electro-optics; fluid mechanical properties; experimental signal processing; random data and signal analysis; analog and digital data processing; dynamic similarity, self-preservation; pressure measurement, thermal anemometry, and laser-Doppler velocimetry; flow visualization, particle-image velocimetry. Prerequisite: TAM 531 or TAM 532.

TAM 538 Turbulence credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/538)
Instability and origins of chaotic motion in fluid flow; Reynolds averaging and statistical description of turbulence, correlations and spectral dynamics of homogeneous turbulence, anisotropic flows, coherent structures, inhomogeneous turbulence, transport models, and large-eddy simulations. Prerequisite: TAM 532.

TAM 539 Fluid Mechanics Seminar credit: 1 Hour. (https://courses.illinois.edu/schedule/terms/TAM/539)
Weekly seminar on current research topics in turbulent and other complex flows: theoretical modeling, numerical analysis, computational techniques, and experimental investigations. Approved for S/U grading only.

TAM 541 Mathematical Methods I credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/541)
Vector and tensor algebra and complex-variable methods; ordinary differential equations, qualitative questions of existence and uniqueness; analytic solution methods, numerical methods, power-series solution and special functions; eigenvalue problems, Green's functions, Laplace transforms, stability of solutions; engineering applications drawn from mechanics. Prerequisite: MATH 285 and TAM 251.

TAM 542 Mathematical Methods II credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/542)
Continuation of TAM 541. Modeling, inequalities, elements of functional analysis; partial differential equations, existence and uniqueness, second-order equations; hyperbolic conservation laws; numerical methods, eigenfunction expansions, integral transforms, and fundamental solutions; engineering applications drawn from mechanics. Prerequisite: TAM 541.

TAM 545 Advanced Continuum Mechanics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/545)
Unified treatment of modern continuum mechanics: mathematical preliminaries; review of kinematics and general balance laws; general theory of mechanical constitutive equations, including material constraints and material symmetry. Prerequisite: TAM 551.

TAM 549 Asymptotic Methods credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/549)
Advanced methods of perturbation theory and asymptotic analysis, with examples drawn from classical dynamics, fluid mechanics, and wave propagation: asymptotics of integrals, singular perturbation theory (boundary layers, matched asymptotic expansions, and composite expansions), multiple scales, summation of series; special topics. Prerequisite: MATH 446 and TAM 541.

TAM 551 Solid Mechanics I credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/551)
Mechanics of elastic deformable bodies, based on the fundamental concepts of modern continuum mechanics: kinematics, balance laws, constitutive equations; classical small-deformation theory; formulation of initial boundary-value problems of linear elastodynamics and boundary-value problems of linear elastostatics; variational formulations, minimum principles; applications of theory to engineering problems. Prerequisite: MATH 285.

TAM 552 Solid Mechanics II credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/552)
Continuation of TAM 551. Selected topics in linear elasticity (including St. Venant beam theory and plane problems of elastostatics), plasticity (including yield surfaces, von Mises and Tresca yield criteria, Drucker's stability postulate, J-flow theory, perfect plasticity, limit analysis, and slip-line theory), and fracture mechanics (including linear elastic analysis, fracture criteria for elastic brittle fracture, and elastic-plastic fracture). Prerequisite: TAM 551.

TAM 554 Plasticity credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/554)
Phenomenological and mathematical formulation of the constitutive laws of plasticity; yield criteria and their experimental verification; plastic stress-strain relations and their associated flow rules; correspondence between rate-independent and rate-dependent plasticity; solutions to basic boundary-value problems, including plane problems and those involving cylindrical and spherical symmetries; variational and minimum principles; limit analysis; plane-strain problems and crystal plasticity; finite-strain theory. Prerequisite: TAM 552.

TAM 555 Fracture Mechanics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/555)
Unified analytical treatment of modern fracture problems: macroscopic theories used to determine the static strength of bodies containing cracks; Griffith criterion, linear-elastic fracture mechanics, elastic-plastic fracture mechanics models; small-scale yielding results and their implications; general yielding; interfacial fracture; fracture control; micromechanisms of fracture. Prerequisite: TAM 424 or MSE 440; TAM 541; TAM 552.

TAM 557 Mechanics of Random Media credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/557)
Methods to study mechanics of complex/random microstructures involving several scales: random geometry and stochastic processes and fields, including spatial point processes, mathematical morphology, geodesics, ergodicity, entropy; (non)stationary and (an)isotropic tensor random fields for fluids (turbulence) and solids (microstructures), representations and spectra; truss- and beam-lattices and corresponding (non-)classical continua for modeling crystals, cellular media (e.g. metallic foams), and granular matter; geometric and rigidity percolation; plasticity, fracture, slip statistics, and fractals in disordered media; scaling to Representative Volume Element (RVE) in conductivity, (non)linear elasticity, elasto-plasticity, flow in porous media, and coupled field phenomena; statistical continuum theories for problems without RVE (i.e., lacking separation of scales); stochastic finite elements; effects of microscale randomness on waves and wavefronts in (non)linear elastic/dissipative solid or fluid media; fractional calculus and mechanics of fractal media. Prerequisite: TAM 445 or TAM 551; MATH 362.

TAM 570 Computational Fluid Mechanics credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/570)
Highly accurate and reliable techniques for large-scale numerical simulations of fluid flows: spectral numerical methods, including Fourier and other functional expansions, Galerkin and collocation projections, domain decompositions and the solution of partial differential equations, especially the Navier-Stokes equations; high-resolution methods for the solution of hyperbolic conservation laws with discontinuous solutions, and issues related to implementation on supercomputers. Same as CSE 560. Prerequisite: TAM 470 and TAM 542.

TAM 574 Adv Finite Element Methods credit: 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/574)
Advanced theory and applications of the finite-element method, as needed for research in computational science and engineering: applications to mechanics of solids and fluids, thermal problems, etc.; variational foundations of the finite-element method, error estimates, and adaptive analysis; finite-element methods for parabolic and hyperbolic problems; mixed finite-element methods; applications to systems of equations. Same as CSE 517. Prerequisite: One of TAM 470, CEE 570, CS 555, ME 471.

TAM 597 Advanced Independent Study credit: 1 to 8 Hours. (https://courses.illinois.edu/schedule/terms/TAM/597)
Analytical, experimental, or computational studies in one or more areas of theoretical and applied mechanics, including solid mechanics, behavior of materials, fluid mechanics, dynamics, applied mathematics, and computational science and engineering. May be repeated. (Summer session, 1 to 4 hours). Prerequisite: Consent of instructor.

TAM 598 Advanced Special Topics credit: 1 to 4 Hours. (https://courses.illinois.edu/schedule/terms/TAM/598)
Subject offerings of new and developing areas of knowledge in theoretical and applied mechanics 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 to a maximum of 12 hours.

TAM 599 Thesis Research credit: 0 to 16 Hours. (https://courses.illinois.edu/schedule/terms/TAM/599)
Approved for S/U grading only. May be repeated.