

Mechanical and Aerospace Engineering
Undergraduate Catalog Course Descriptions

Updated Spring 2008

Please refer to [TritonLink](#) for the most up to date list of pre-requisites and course scheduling.

LOWER DIVISION

MAE 02. Introduction to Aerospace Engineering (4)

An introduction to topics in aeronautical and astronautical engineering including aerodynamics, propulsion, flight mechanics, structures, materials, orbital mechanics, design, mission planning and environments. General topics include historical background, career opportunities, engineering ethics and professionalism. Engineering majors must take this course for a letter grade. *Prerequisite: none.*

MAE 03. Introduction to Engineering Graphics and Design (4)

Introduction to design process through a hands-on design project performed in teams. Topics include problem identification, concept generation, project management and risk reduction. Engineering graphics and communication skills are introduced in the areas of: Computer-Aided Design (CAD), hand sketching and technical communication. *Prerequisite: grade of C- or better in Physics 2A or 4A (or concurrent enrollment).*
Priority enrollment given to engineering majors.

MAE 05. Quantitative Computer Skills (4)

Introductory course for non-engineering majors. Use of computers in solving problems; applications from life sciences, physical sciences and engineering. Students run existing computer programs and complete some programming in BASIC. *Prerequisite: none.*

MAE 09. C/C++ Programming (4)

C/C++ computer programming under the UNIX environment with applications to numerical problems fundamental to computational mechanics. Arithmetic operations, branches, arrays, data structures, and use of pointers are introduced. In addition, programming ethics are discussed. *Priority enrollment given to engineering majors.*

MAE 20. Elements of Materials Science (4)

The structure and control of materials: metals, ceramics, glasses, semiconductors and polymers to produce desired, useful properties. Atomic structures. Defects in materials, phase diagrams, micro structural control. Mechanical, rheological, electrical, optical and magnetic properties are discussed. Time temperature transformation diagrams. Diffusion. *Prerequisites: Phys. 2A or 4A, Chem. 6A, Math 20D. Math 20D may be taken concurrently.*

MAE 87. Freshman Seminar (1)

The Freshman Seminar Program is designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small seminar setting. Freshman seminars are offered in all campus departments and undergraduate colleges.

Topics vary from quarter to quarter. *Enrollment is limited to fifteen or twenty students, with preference given to entering freshmen. Prerequisite: none.*

MAE 92A/SE 10A. Design Competition – Design, Build, and Fly Aircraft (1)

Student teams design, build and fly unmanned aircraft for a national student competition. Students concentrate on vehicle system design including aerodynamics, structures, propulsion and performance. Teams engineer, fabricate the aircraft, submit a design report and prop aircraft for competition. *Prerequisites: consent of instructor.*

MAE 99R. Independent Study (1)

Independent study or research under direction of a member of the faculty. *Prerequisites: Student must be of Freshman class standing and a Regent's Scholar and submit a approved Special Studies form.*

MAE 101A. Introductory Fluid Mechanics (4)

Fluid statics; fluid kinematics; integral and differential forms of the conservation laws for mass, momentum and energy; Bernoulli equation; potential flows; dimensional analysis and similitude. *Prerequisites: admission to the engineering major and grades of C- or better in Phys. 2A, Math 20D and Math 20E or consent of instructor.*

MAE 101B. Advanced Fluid Mechanics (4)

Laminar and turbulent flow. Pipe flow including friction factor. Boundary layers, separation, drag and lift. Compressible flow including shock waves. *Prerequisites: grades of C- or better in MAE 101A or CENG 101A and MAE 110A (or CEN G 102) or consent of instructor.*

MAE 101C. Heat Transfer (4)

Extension of fluid mechanics in MAE 101A-B to viscous, heat-conducting flows. Application of the energy conservation equation to heat transfer in ducts and external boundary layers. Heat conduction and radiation transfer. Heat transfer coefficients in forced and free convection. Design applications. *Prerequisites: grade of C- or better in MAE 101A and MAE 101B (or CENG 101A) or consent of instructor.*

MAE 104. Aerodynamics (4)

Basic relations describing flow field around wings and bodies at subsonic and super-sonic speed. Thin-wing theory. Slender-Body Theory. Formulation of theories for evaluation forces and moments on aircraft geometries. Application to the design of high-speed aircraft. *Prerequisites: Admission to Aerospace, Mechanical or Engineering Science major and a grade of C- or better in MAE101A and MAE 101B or consent of instructor.*

MAE 105. Introduction to Mathematical Physics (4)

Fourier series, Sturm Liouville theory, elementary partial differential equations, integral transforms with applications to problems in vibration, wave motion, and heat conduction. *Prerequisites: engineering majors only and grades of C- or better in Phys. 2A-B and Math 20D.*

MAE 107. Computational Methods in Engineering (4)

Introduction to computers and computing with Matlab; numerical linear algebra; linear equations, nonlinear equations and iterative methods with engineering applications; function interpolation, differentiation, approximation and integration, data regression, numerical solution of ordinary differential equations. *Prerequisites: engineering majors only and grades of C- or better in MAE 9 (or MAE 10) and Math 20F.*

MAE 110A Thermodynamics (4)

Fundamentals of engineering thermodynamics: energy, work, heat, properties of pure substances, first and second laws for closed systems and control volumes, gas mixtures. Application to engineering systems, power and refrigeration cycles, combustion. *Prerequisites: engineering majors only and grades of C- or better in Phys. 2C and Chem. 6A.*

MAE 110B. Thermodynamic Systems (4)

Thermodynamic analysis of power cycles with application to combustion driven engines: internal combustion, diesel, and gas turbines. Thermodynamics of mixtures and chemical and phase equilibrium. Computational methods for calculating chemical equilibrium. *Prerequisite: grade of C- or better in MAE 110A.*

MAE 113. Fundamentals of Propulsion (4)

Compressible flow, thermodynamics, and combustion relevant to aircraft propulsion as well and space vehicle propulsion. Analysis and design of components for gas turbines including: turbines, inlets, combustion chambers and nozzles. Fundamentals of rocket propulsion. *Prerequisites: Admission to Aerospace, Mechanical or Engineering Science major and grades of C- or better in MAE 110A (or CENG 102), MAE 101A-B (or CENG 101A-C).*

MAE 118A. Introduction to Energy Systems (4)

Overview of present-day primary energy sources and availability; stationary and mobile power plant technologies; air pollution and controls; introduction to climate change; overview of renewable energy resources and technologies. *Prerequisites: MAE 101A (or CENG 101A) or consent of instructor.*

MAE 118B. Twenty-First Century Energy Technologies I (4)

A survey of projected energy demands and resources. Climate change physics and impacts on energy systems. Basic physics of photovoltaics, fuel cells, wind power producing fusion reactor physics. Survey of fusion technology issues, status and prospects for fusion energy. *Prerequisite: MAE 101A (or CENG 101A) or consent of instructor.*

MAE 118C. Twenty-First Century Energy Technologies II (4)

Overview of basic fusion processes and fusion processes. Elementary fission reactor physics and engineering; environmental and waste disposal issues. Introduction to power producing fusion reactor physics. Survey of fusion technology issues, status and

prospects for fusion energy. *Prerequisites: MAE 101A (or CENG 101A) or consent of instructor.*

MAE 124. The Human Earth: Introduction to Environmental Engineering & Policy (4)
(Cross-listed with ESYS 103)

This course explores the impacts of human social, economic and industrial activity on the environment. It highlights the central roles in ensuring sustainable development played by market forces, technological innovation and governmental regulation on local, national and global scales. *Prerequisites: grade of C- or better in Math 20B (or Math 10A-C), Phys. 2B (or Phys. 1A-C) and Chem. 6B or consent of instructor.*

MAE 125A. Flow and Transport in the Environment (4)

Study of river flow and hydraulic control; surface waves; applications to reservoirs and estuaries. Introduction to stratification and buoyancy; applications to atmospheric surface layer and the ocean mixed layer. Ideas behind turbulent dispersion. Turbulent and scaling laws. Gravity currents and katabatic flows. *Prerequisites: engineering majors and a grade of C- or better in MAE 101A (or CENG 101A).*

MAE 125B. Fluid-Solid Interactions in Environment Engineering (4)

Introduction to groundwater flow. Pollution transport through the water table. Chemical processes in ozone hole. Fundamentals of flow. Darcy flow. Diffusion and dispersion. Gravity currents and plumes in porous media. Mushy layers. Chemistry of fluid-solid interactions. Fundamentals of adsorption and surface reactions. *Prerequisites: engineering majors and a grade of C- or better in MAE 125A.*

MAE 125C. Case Studies In Environmental Engineering (4)

This course is project-oriented. Students will conduct research in small groups, give oral presentations and write reports. Topics reflect material in MAE 125A and MAE 125B. Possible topics: air pollution modeling, building ventilation, wetland preservation. *Prerequisites: Engineering majors a grade of C- or better in MAE 125A-B.*

MAE 126A. Environmental Engineering Laboratory I (4)

Design and analysis of experiments in environmental engineering. Experiments in wind tunnel, water tunnel and other equipment. Use of instrumentation. Laboratory report writing; error analysis; engineering ethics. *Prerequisites: grade of C- or better in MAE 101A (or CENG 101A) and MAE 125A.*

MAE 126B. Environmental Engineering Laboratory II (4)

Design and analysis of original studies in environmental engineering. Students work on environmental projects and use computational and laboratory facilities. Students propose and design studies, collect and analyze data and prepare a major report. *Prerequisite: grade of C- or better in MAE 126A.*

MAE 127. Statistical Methods for Environmental Sciences and Engineering (4)

Methods for evaluating environmental data including probability distributions, confidence intervals, functional fitting, spectral analysis and programming methods for data analysis. *Prerequisite: grade of C- or better in MAE 126A.*

MAE 130A/SE 101A: Mechanics I: Statics (4)

Statics of particles and rigid bodies in two and three dimensions. Free body diagrams. Internal forces. Static analysis of trusses, frames, and machines. Shear force and bending moment diagrams in beams. Equilibrium problems with friction.

MAE 130B/SE 101B: Mechanics II: Dynamics (4)

Kinematics and kinetics of particles in 2D and 3D motion. Newton's equations of motion. Energy and momentum methods. Impulsive motion and impact. Systems of particles. Kinematics and kinetics of rigid bodies in 2D. Introduction to 3D dynamics of rigid bodies.

MAE 130C/ SE 101C: Mechanics III: Vibrations (4)

Free and forced vibrations of undamped and damped single degree of freedom systems. Harmonically excited vibrations. Vibrations under general loading conditions. Vibrating systems with multiple degrees of freedom. Modal analysis with application to realistic engineering problems. Vibration of continuous systems.

MAE 131A / SE 110A: Solid Mechanics I (4)

Concepts of stress and strain. Hooke's law. Axial loading of bars. Torsion of circular shafts. Shearing and normal stresses in beam bending. Deflections in beams. Statically determinate and indeterminate problems. Combined loading. Principal stresses and design criteria. Buckling of columns.

MAE 131B: Solid Mechanics II (4)

Analysis of 3D states of stress and strain. Governing equations of linear elasticity. Solution of elasticity problems in rectangular and polar coordinates. Stress concentration. Failure criteria. Torsion of noncircular and thin walled members. Energy methods. Plastic collapse and limit analysis.

MAE 131C. Solid Mechanics III (4)

Small deflection theory of plates. Solutions for rectangular and circular plates. Buckling of rectangular plates. Large deflections and shear deformations. Energy methods and finite element method of analysis. *Prerequisites: admission to the engineering major and grade of C- or better in MAE 131A.*

MAE 133. Finite Element Methods in Mechanical and Aerospace Engineering (4)

Development of stiffness and mass matrices based upon variational principles and application to static, dynamic, and stability design problems in structural and solid mechanics. Architecture of computer codes for linear and nonlinear finite element analysis and basic computer implementation. The use of general purpose finite element structural analysis computer codes. *Prerequisites: admission to the engineering major and grades of C- or better in MAE 131A (or SE110A).*

MAE 135. Computational Mechanics (4)

Mathematical modeling in terms of systems of algebraic and differential equations. Overview of numerical methods. Problem statement, boundary, and initial conditions. Overview of commercial packages for solving the equations of Mathematical and Engineering Physics. Numerical solutions of selected examples drawn from real-life applications of fluid flow, solid mechanics, and heat transfer with emphasis on design. *Prerequisite: consent of instructor.*

MAE 140. Linear Circuits (4)

Steady-state and dynamic behavior of linear, lumped-parameter electrical circuits. Kirchoff's laws. RLC circuits. Node and mesh analysis. Operational amplifiers. Signal acquisition and conditioning. Electric motors. Design applications in engineering.

Prerequisites: grades of C- or better in Math 20D, 20F and Phys. 2B.

MAE 142. Dynamics and Control of Aerospace Vehicles (4)

The dynamics of vehicles in space or air are derived for analysis of the stability properties of spacecraft and aircraft. The theory of flight, lift, drag, dutch roll and phugoid modes of aircraft are discussed. Optimal state space control theory for the design of analog and digital controllers (autopilots). *Prerequisites: admission to Aerospace or Mechanical Engineering major and grades of C- or better in MAE 104 and MAE 143B (or ECE 171A).*

MAE 143A. Signals and Systems (4)

First-order vector ordinary differential equations, concepts of state, input and output. Linearity and linearization concepts introduced with solutions. Laplace and Fourier transforms are defined for signals. Transfer functions and frequency responses for systems. Spectra and filtering for deterministic signals, probability and statistics of random signals and treatment. *Prerequisites: Admission to MAE or bioengineering major and grade of C- or better in Math 20D-E-F.*

MAE 143B. Linear Control (4)

Analysis and design of feedback systems in the frequency domain. Transfer functions. Time response specifications. PID controllers and Ziegler-Nichols tuning. Stability via Routh-Hurwitz test. Root locus method. Frequency response: Bode and Nyquist diagrams. Dynamic compensators, phase-lead and phaselag. Actuator saturation and integrator windup. *Prerequisite: grade of C- or better in MAE 143A (or CENG 100).*

MAE 143C. Digital Control Systems (4)

Discrete time systems: sampling, aliasing, stability, Z-transform, discrete time signals, state space models; state equations, canonical forms, observability, controllability. Pole placement design, observer design, output feedback, linear quadratic regulator design. Implementation: digital approximation, computational and numerical issues.

Prerequisite: grade of C- or better in MAE 143B.

MAE 149. Sensor Networks (4) (Cross-listed with ECE 156 and SIO 238)

Characteristics of chemical, biological, seismic and other physical sensors; signal processing techniques supporting distributed detection of salient events; wireless

communication and networking protocols supporting formation of robust sensor fabrics; current experience with low power, low cost sensor deployments. *Prerequisite: Upper division standing and consent of instructor or graduate student in science and engineering.*

MAE 150. Computer-Aided Design and Fracture Mechanics (4)

Design methodology, tolerance analysis, Monte Carlo analysis, kinematics and computer-aided design of linkages, numerical calculations of moments of inertia, design of cams and cam dynamics; finite element analysis, design using Pro-E, Mechanica Motion and Mechanica Structures. *Prerequisites: grade of C- or better in MAE 3, MAE 107 (or SE 121) and MAE 130A (or SE 101A or BENG 110).*

MAE 152. Computer Graphics for Engineers and Scientists (4)

Computer graphics algorithms using C programming and Ironcad. Applications in engineering and science. Line-drawing algorithms. Area fill algorithms, color, CAD user interface, spline curves and surfaces, 2-D and 3-D transformations, wireframe and solid models. Hidden-surface elimination. *Prerequisites: grade of C- or better in MAE 3 and MAE 9 or 10.*

MAE 155A. Aerospace Engineering Design I (4)

Fundamental principles of aerospace systems design including the conceptual, preliminary and detailed design phases. Aeronautical or astronautical design projects that integrate all appropriate engineering disciplines as well as issues associated with optimization, teamwork, manufacturability, reporting and professionalism. *Prerequisites: grade of C- or better in SE 2, SE 160B, MAE 2, MAE 104, MAE 113, MAE 130C, MAE 142 and MAE 150 or consent of instructor. MAE 113, 142 and 150 may be taken concurrently.*

MAE 155B. Aerospace Engineering Design II (4)

Fundamental principles of aerospace vehicle design including the conceptual, preliminary and detailed design phases. Aeronautical or astronautical design project that integrates all appropriate engineering disciplines as well as issues associated with optimization, teamwork, manufacturability, reporting and professionalism. *Prerequisites: grade of C- or better in MAE 113, MAE 142, MAE 150 and MAE 155A or consent of instructor.*

MAE 156A. Fundamental Principles of Mechanical Design I (4)

Fundamental principles of mechanical design and the design process. Application of engineering science to the design and analysis of mechanical components. Initiation of team design projects that culminate in MAE 156B with a working proto-type designed for a real engineering application. *Prerequisites: grade of C- or better in MAE 3, MAE 101C, MAE 130C, MAE 131A, MAE 150, MAE 160 and MAE 170 or consent of instructor.*

MAE 156B. Fundamental Principles of Mechanical Design II (4)

Fundamental principles of mechanical design and the design process. Culmination of a team design project initiated in MAE 156A, which results in a working prototype

designed for a real engineering application. *Prerequisites: grade of C- or better in MAE 156A from the immediately preceding quarter, MAE 101C and MAE 150 or consent of instructor.*

MAE 160. Mechanical Behavior of Materials (4)

Elasticity and anelasticity, dislocations and plasticity of crystals, creep and strengthening mechanisms. Mechanical behavior of ceramics, composites and polymers. Fracture: mechanical and microstructural. Fatigue. Laboratory demonstrations of selected topics. *Prerequisites: grade of C- or better in MAE 20, MAE 130A (or SE 101A) and MAE 131A or consent of instructor.*

MAE 165. Fatigue and Failure Analysis of Engineering Components (4)

The engineering and scientific aspects of crack nucleation, slow crack growth and unstable fracture in crystalline and amorphous solids. Microstructural effects on crack initiation, fatigue crack growth and fracture toughness. Methods of fatigue testing and fracture toughness testing. Fractography and microfractography. Design safe methodologies and failure prevention. Failure analysis of real engineering structures. *Prerequisite: consent of instructor.*

MAE 166. Nanomaterials (4)

Basic principles of synthesis techniques, processing, microstructural control and unique physical properties of materials in nano-dimensions. Nanowires, quantum dots, thin films, electrical transport, optical behavior, mechanical behavior and technical applications of nanomaterials. *Prerequisite: consent of instructor.*

MAE 167. Wave Dynamics in Materials (4)

Pressure and shear waves in infinite solids. Reflection and diffraction. Rayleigh and Love waves in semi-infinite space. Impulse load on a half space. Waveguides and group velocity. *Prerequisite: consent of instructor.*

MAE 168. MEME Materials, Fabrication and Applications (4)

The principles of micro-electro-mechanical systems (MEMS) fabrication, materials involved, actuation principles utilized and the fundamentals of MEMS operation in relations to stresses and deformation. Novel device applications, future trends and nano-electro-mechanical (NEMS) systems. *Prerequisite: consent of instructor.*

MAE 170. Experimental Techniques (4)

Principles and practice of measurement and control and the design and conduct of experiments. Technical report writing. Lectures relate to dimensional analysis, error analysis, signal-to-noise problems, filtering, data acquisition and data reduction, as well as background of experiments and statistical analysis. Experiments relate to the use of electronic devices and sensors. *Prerequisite: admission to an engineering major and grade of C- or better in Phys. 2CL.*

MAE 171A. Mechanical Engineering Laboratory I (4)

Design and analysis of experiments in fluid mechanics, solid mechanics and control engineering. Experiments in wind tunnel, water tunnel, vibration table and material testing machines, and refined electromechanical systems. Laboratory report writing; error analysis; engineering ethics. *Prerequisites: Grade of C- or better in MAE 101C (or CENG 101B); MAE 130C or SE 101C, MAE 160 or MAE 131B, MAE 143B or CENG 120, MAE 140, MAE 170 and senior standing in engineering major or consent of instructor.*

MAE 171B. Mechanical Engineering Laboratory II (4)

Design and analysis of original experiments in mechanical engineering. Students research projects using experimental facilities in under-graduate laboratories: wind tunnel, water channel, vibration table, and testing machine and control systems. Students propose and design experiments, obtain data, complete engineering analysis and write a major report. *Prerequisite: grade of C- or better in MAE 171A.*

MAE 175A. Aerospace Engineering Laboratory (4)

Analysis of aerospace engineering systems using experimental facilities in undergraduate laboratories: wind tunnel, water channel, vibration table, and testing machine. Students operate facilities, obtain data, complete engineering analysis and write major reports. *Prerequisites: grade of C- or better in MAE 101C or CENG 101B, MAE 130C or SE 101C, MAE 140, MAE 143B or CENG 120, MAE 170 or consent of instructor.*

MAE 180A. Space Science and Engineering I (4)

Astrodynamics, orbital motion; perturbations; coordinate systems and frames of reference. Geosynchronous orbits, stationkeeping. Orbital maneuvers, fuel consumption, guidance systems. Observation instrument point, tracking, control. Basic rocket dynamics. Navigation, telemetry, re-entry and aero-assisted maneuvers. Mission design. Students perform analyses based on mission requirements. *Prerequisite: upper-division standing in physics, engineering or mathematics department.*

MAE 181. Space Mission Analysis and Design (4) (formerly MAE 180B)

Space mission concepts, architectures, and analysis. Mission geometry. Astrodynamics. Orbit and constellation design. Space environment. Payload and spacecraft design and sizing. Power sources and distribution. Thermal management. Structural design. Guidance and navigation. Space propulsion. Orbital debris and survivability. Cost modeling and risk analysis. *Prerequisite: upper-division standing in engineering. Students may not also receive credit for MAE 180B.*

MAE 192. Senior Seminar in Aerospace, Environmental or Mechanical Engineering (1)

The Senior Seminar Program is designed to allow senior undergraduates to meet with faculty members in a small group setting to explore an intellectual topic in Aerospace, Environmental or Mechanical engineering (at the upper-division level). Senior Seminar may be offered in all campus departments. Topics will vary from quarter to quarter. Senior seminars may be taken for credit up to four times, with a change in topic and permission of the Department. Enrollment is limited to twenty students, with a preference given to seniors. *Prerequisite: varies by seminar and/or instructor permission.*

MAE 195. Teaching (2-4)

Teaching and tutorial assistance in an MAE course under supervision of instructor. Not more than four units may be used to satisfy graduation requirements. P/NP grades only. *Prerequisites: junior status and a B average in major and consent of department chair.*

MAE 197. Engineering Internship (1-4)

Coordinated through UCSD Academic Internship Program, this course provides work experience through industry, government offices, hospitals and their practices. Students will work in local industry or hospital under faculty supervision. Units may not be applied toward major graduation requirements. Internship is unsalaried. *Prerequisites: completion of ninety units with 2.5 GPA and consent of faculty adviser.*

MAE 198. Directed Group Study (1-4)

Directed group study on a topic or in a field not included in the regular Department curriculum, by special arrangement with a Faculty member. May be taken P/NP only. *Prerequisite: consent of instructor.*

MAE 199. Independent Study for Undergraduates (4)

Independent reading or research on a problem by special arrangement with a faculty member. P/NP grades only. *Prerequisite: consent of instructor.*