Civil Engineering and Applied Mechanics

College of Engineering and Computer Science

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Programs

Undergraduate:
- B.S., Civil Engineering
- B.S., Construction Management Technology
- Minor in Construction Management Technology

Graduate:
- M.S., Engineering with Option in Structural Engineering

Mission Statement

To provide our students with a sound basic civil engineering education and to prepare them for entry into the professional practice of civil engineering, as well as to inculcate in them a recognition that civil engineering is a people serving profession. In keeping with these goals, we aim to develop in them an understanding that a successful professional career is one that addresses the needs of society and requires a lifetime of learning and leadership.

The Major

Department faculty provide instruction in statics and strength of materials, dynamics and mechanics lab, as well as our degree programs.

Civil Engineers design the infrastructure of our world, from bridges and freeways, to sewer systems and libraries. Their work touches nearly every facet of our society's every-day lives, including but not limited to structures, water supply, waste management, materials, construction, geotechnical, the environment and transportation. Their work is vital, particularly in Southern California, where environmental, transportation, and water issues are of major importance and where structural problems, especially related to earthquakes, demand sound engineering solutions.

Civil Engineering majors at Cal State Northridge receive a solid, broad-based education. During the first two years and into the third year, all Engineering majors complete a common engineering core curriculum. Among the many topic areas in the core curriculum are mathematics, physics, chemistry, engineering materials, electrical circuits, engineering mechanics, thermodynamics, engineering economy.

The junior and senior years in Civil Engineering are built upon the common engineering core curriculum. These two years include instruction in structures, vibration analysis, hydraulics, soil mechanics, surveying, computer-aided design and graphics, strength of materials, concrete and steel design, statistics, and senior design.

Civil Engineering students take classes and work in the following facilities: the Applied Mechanics Lab, where students apply engineering techniques to the static and dynamic behavior of mechanical systems; the Civil Engineering Senior Design Laboratory is used in a two-semester course that simulates a professional civil engineering environment; the Geotechnical Laboratory, where students look at the behavior of soil as an engineering material; and the Structural Analysis Research Center, where students have the opportunity to work with faculty on such diverse projects as dams, buildings, towers, and spacecraft.

Besides these facilities, students use Los Angeles itself as a laboratory, studying buildings, spacecraft, dams, and other structures.

With the broad-based education students receive at Cal State Northridge, it is highly recommended that students prepare themselves to take the EIT (Engineering in Training), now commonly referred to as the FE (Fundamentals in Engineering) Exam, before graduation. This is a national exam, 8 hours in length, covering the basic topics that comprise the common core in engineering. The EIT or FE exam is the first of 2 exams that are required in order to become a registered engineer in the State of California. To sit for the second exam, additional work experience is required beyond the bachelor's degree. In today's society, it is almost imperative that students, preparing for the Civil Engineering profession, become registered. Cal State Northridge has an excellent reputation of preparing students for this goal.

Civil Engineering students have opportunities to participate in student chapters of professional societies such as ASCE (American Society of Civil Engineers) and AWMA (Air and Waste Management Association), as well as, interdisciplinary student organizations in the College, such as Tau Beta Pi, the Society of Women Engineers, the National Society for Black Engineers, and the Society for Hispanic Professional Engineers.

The Civil Engineering program is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET), 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: (410) 347-7700.

Academic Advisement

The Graduate Coordinator, Roger DiJulio, can be contacted at (818) 677-3904

Educational Objectives

To carry out the mission of the civil engineering program, the faculty have established the following educational objectives. During the first few years following graduation, the graduates of the Civil Engineering program will have the following qualities:

1. Graduates will be able to apply basic mathematics, science and engineering principles to the solution of problems.
2. Graduates will be able to solve practical problems.
3. Graduates will be able to communicate effectively and to work as a member of team.
4. Graduates will have a breadth of technical and non-technical knowledge and an understanding of professional practice that will prepare them to practice as civil engineers.
5. Graduates will be prepared for a professional engineering position, to accept increasing levels of responsibility over time, to obtain professional registration, and to continue studies in engineering and other professional disciplines.

Student Learning Outcomes of the Undergraduate Program

a. an ability to apply knowledge of mathematics, science, and engineering;
b. an ability to design and conduct experiments, as well as to analyze and interpret data;
c. an ability to design a system, component, or process to meet desired needs;
d. an ability to function on multi-disciplinary teams;

e. an ability to identify, formulate, and solve engineering problems;
f. an understanding of professional and ethical responsibilities;
g. an ability to communicate effectively;
h. the broad education necessary to understand the impact of engineering solutions in a global and societal context;
i. a recognition of the need for, and an ability to engage in lifelong learning;
j. a knowledge of contemporary issues;
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;
l. a proficiency in a minimum of four (4) recognized major civil engineering areas;
m. an ability to perform civil engineering design by means of design experiences integrated throughout the professional component of the curriculum; and
n. an understanding of professional practice issues such as: procurement of work; bidding versus quality based selection processes; how the design professionals and the construction professions interact to construct a project; the importance of professional licensure and continuing education; and/or other professional practice issues.

Careers

Civil Engineering is the oldest of the engineering disciplines, responsible for projects dating back more than 5,000 years. Rebuilding and expanding the civil engineering infrastructure of the United States –including roads, bridges, rail networks, sewage treatment plants, deep-water ports, and municipal water systems–is one of the technology areas that has been targeted for rapid development by the National Science Foundation.

Most practicing Civil Engineers are employed in the areas of structural engineering, transportation engineering, environmental engineering, water resources engineering, geotechnical engineering, construction engineering, or surveying. Many of these areas, such as structural engineering, encompass the design of such seemingly diverse items as spacecraft and office buildings. Although the majority of Civil Engineers are employed in private industry, many are involved in consulting or own their own firms, and a significant number are employed in the government sector, where they are involved in the provision of highways and other public works for state and local government.

The degree can be used as a stepping-stone to graduate work in engineering, law, business, or even medicine. Many Civil Engineering graduates return to Cal State Northridge to earn their M.S. degree in the Structural Engineering program.

Requirements for the Bachelor of Science in Civil Engineering Degree

The High School Preparation program is based upon an expectation of adequate high school preparation in science, mathematics, and English. High school courses should include algebra, plane geometry, trigonometry, and chemistry or physics (both desirable), and 4 years of English. Beginning engineering students must take the Entry Level Mathematics Test (ELM) and the Mathematics Placement Test (MPT), Chemistry Placement Test (CPT), and English Placement Test (EPT) before registration in basic courses will be permitted.

Required test scores are presented below:

1. ELM (Entry Level Mathematics) A passing score is required to earn college credit for mathematics. Students are exempt from this exam if they score 550 or above on the SAT, 23 or above on the enhanced ACT, or a 3, 4, or 5 on the AP (Advanced Placement) Calculus AB or BC.
2. MPT (Mathematics Placement Test) is required to enroll in MATH 150A. Students with scores of 3, 4, or 5 on the AP Calculus AB or BC are eligible for MATH 150B and exempt from the MPT.
3. CPT (Chemistry Placement Test) a minimum score of 40 is required to enroll in CHEM 101. All students who had high school chemistry and expect to enroll in CHEM 101 must take this test regardless of score on the AP Chemistry exam.
4. EPT (English Placement Test) a score of 151 or above is required to enroll in ENGL 155. Students with scores of 3, 4, or 5 on AP English Language and Composition receive college credit for ENGL 155, and a score of 3, 4, or 5 on the AP English Literature and Composition receive credit for ENGL 155 and 255.

Students are referred to Appendix A of this Catalog for rules and regulations as to earned college credit. Students who have not had an adequate background of pre-engineering work in high school may be required to take some additional work in their first year and may not be able to complete an engineering program in eight semesters.

Special Grade Requirements

1. All students must pass the English Placement Test with a score of 151 or higher before enrolling in 200-level engineering courses.
2. All students must complete the Lower Division Writing Requirement before enrolling in 300-level engineering courses.
3. All students must attempt the Upper Division Writing Proficiency Exam before enrolling in 400-level engineering courses.
4. Grade of C- or better is required in all courses in the major.
5. Senior level courses cannot be taken unless the student has previously completed, or is concurrently completing, all freshman, sophomore, and junior level core requirements.

1. Lower Division Required Courses (44 Units)

Freshman Year

CE	101/L	Introduction to Civil Engineering and Lab (1/1)
CHEM	101/L	General Chemistry and Lab (4/1)
MATH	150A	Mathematical Analysis I (5)
MATH	150B	Mathematical Analysis II (5)
PHYS	220A/L	Mechanics and Lab (3/1)
BIOL	106	Biological Principles I and Lab (3)
or	GEOL 101	Geology of Planet Earth (3)

Sophomore Year

CE	240	Engineering Statics (3)
CE	280/L	Computer Applications in Civil Engineering (1/1)
ECE	240	Electrical Engineering Fundamentals (3)
MATH	250	Calculus III (3)
MATH	280	Applied Differential Equations (3)
MSE	227/L	Engineering Materials and Lab (3/1)
PHYS	220B/L	Electricity and Magnetism and Lab (3/1)

2. Upper Division Required Courses (56 Units)

Junior Year

AM	316	Engineering Dynamics (3)
AM	317	Mechanics Lab (1)
CE	308/L	Surveying and Lab (2/1)
CE	340	Strength of Materials (3)
CE	335	Structures I (3)
CE	335L	Structure I Computational Lab (1)
CE	408/L	Surveying with GPS Applications and Lab (1/1)
ME	370	Thermodynamics (3)
ME	390	Fluid Mechanics (3)
MSE	304	Engineering Economy (3)
CE	315/L	Construction Engineering and Lab (2/1)

Senior Year

AM	410	Vibration Analysis (3)

CE	426/L	Soil Mechanics and Lab (3/1)
CE	438	Reinforced Concrete Design (3)
CE	439	Structural Steel Design (3)
CE	460/L	Engineering Hydrology and Lab (2/1)
CE	488A/L	Civil Senior Design I and Lab (1/1)
CE	488B	Civil Senior Design II (2)
CE	526	Geotechnical Foundation Design (3)
ME	493	Hydraulics (3)

General Education (27 Units):

Civil Engineering majors have to follow a modified general education program depending upon the year and enrollment status as a college student. Returning and transfer students should consult an advisor before planning their general education programs.

Civil Engineering students are required to take courses in the following GE sections: Analytical Reading and Expository Writing (3 units), Oral Communication (3 units), Social Sciences (3 units), Arts and Humanities (6 units), Comparative Cultures (6 units), U.S. History and Local Government (6 units). All other GE requirements are met through completion of courses in the major.

CE majors may count CE 101/L and CE 280/L in Lifelong Learning. A one (1) unit waiver in GE requirements, Arts and Humanities.

Total Units Required for the Degree	126

Bachelor of Science in Construction Management Technology

Mission Statement

To prepare students for success within the professional practice of construction management. This preparation includes an understanding of the design, engineering, business, and technical principles and practices used in the construction industry. It also includes an awareness of the ethical, social, and legal responsibilities of practicing professionals.

The Major

The construction industry is the single largest industry in America, accounting for 14 percent of our nation's Gross National Product (GNP). Students interested in becoming a construction manager need a solid background in building science, business, and management. They need to understand contracts, plans and specifications, and to be knowledgeable about construction methods, materials, and laws and regulations. Familiarity with computers and software programs for job costing, scheduling, and estimating is also important.

Construction Management Technology students have the opportunity to participate in the student chapter of the CMAA (Construction Management Association of America), as well as, interdisciplinary student organizations in the College, such as the Society of Women Engineers, the National Society for Black Engineers, and the Society for Hispanic Professional Engineers.

Special Grade Requirements for the CMT Major

1. All students must attempt the Upper Division Writing Proficiency Exam before enrolling in any 400-level engineering courses.
2. A grade of C- or better is required in all courses in the major.
3. Senior level (400+) courses cannot be taken unless the student has previously completed, or is concurrently completing, all freshman, sophomore, and junior level core requirements.

Educational Objectives

The Bachelor of Science in Construction Management Technology at California State University Northridge will prepare graduates for lifelong careers in the construction industry that will allow them to make productive contributions to society and to gain personal job satisfaction. To accomplish these overall objectives, graduates of this program will have the following qualities:

1. Technical skills necessary to enter careers in construction, operation, and/or maintenance of the built environment and supporting infrastructure;
2. The ability to thoroughly comprehend, manage, and utilize basic construction documents used in construction;
3. The ability to specify and optimize utilization of project methods and materials;
4. The ability to perform reliable cost estimates and analyses;
5. The ability to effectively manage construction projects using state-of-the-art planning, scheduling, and monitoring tools;
6. Working knowledge of the management technology tools that are widely used for cost and schedule management in the construction industry;
7. The ability to communicate well, both orally and in writing, and the ability to work as a productive member of a construction team; and
8. A sense of exploration and the ability to maintain life long learning in the areas of emerging construction methods and management technologies.

Student Learning Outcomes of the Undergraduate Program

a. utilize modern instruments, methods and techniques to implement construction contracts, documents, and codes;
b. evaluate materials and methods for construction projects;
c. utilize modern surveying methods for construction layout;
d. determine forces and stresses in elementary structural systems;
e. employ productivity software to solve technical problems;
f. estimate material quantities and costs;
g. produce and utilize design, construction, and operational documents;
h. perform economic analyses and cost estimates related to design, construction, and maintenance of systems in the construction technical specialties;
i. select appropriate construction material and practices;
j. apply principles of construction law and ethics;
k. apply basic technical concepts to the solution of construction problems involving hydraulics, hydrology, geotechnics, structures, construction scheduling and management, and construction safety;
l. perform standard analysis and design in at least one recognized technical specialty within construction engineering technology that is appropriate to the goals of the program.

Careers

Graduates from the B.S. in Construction Management Technology will be able to fill many government jobs in the construction industry at the local, state and federal levels. Roughly 59 percent of construction managers are employed in the construction industry; about 24 percent are employed by specialty trade contractors, engineering, architectural, and construction management service firms, as well as local government and educational institutions, and real estate developers employ the rest.

Large construction projects, such as office buildings or industrial complexes, are too complicated for one person to manage. These projects are divided into many segments: site preparation, including land clearing and earth moving; sewage systems; landscaping and road construction; building construction, including excavation and laying foundations, erection of structural framework, floors, walls, and roofs; and building systems, including fire-protection, electrical, plumbing, air-conditioning, and heating. Construction managers may be in charge of one or more of these activities. Construction managers often team with workers in other occupations, such as engineers and architects.

Construction managers direct and monitor the progress of construction activities, at times through other construction supervisors. They oversee the delivery and use of materials, tools, and equipment; the quality of construction, worker productivity, and safety.

Construction managers regularly review engineering and architectural drawings and specifications to monitor progress and ensure compliance with plans and schedules. They track and control construction costs against the project budget to avoid cost overruns. They meet regularly with owners, engineers, architects, trade contractors, and others to monitor and coordinate all phases of a construction project.

Requirements for Admission to the Construction Management Technology (CMT) Program

1. 60 to 70 units of transferable courses.
2. Completion of a minimum 1 year of lower division math courses including college algebra, trigonometry and analytic geometry. A minimum grade of C must be attained in each course.
3. Complete General Education Breadth Requirements in written and oral communication.
4. Completion of at least one lower division transferable course in each of the following areas: 1) physics with lab; 2) science elective with lab; 3) accounting, business law, or micro-economics. A minimum grade of C must be attained in each course.
5. Required advisement session.

Requirements for the Bachelor of Science in Construction Management Technology (CMT)

1. Lower Division Required Courses (48 Units)

Freshman Year

GEOL	101/102	Science Elective with Lab (3/1)
or BIOL	106	Biological Principles I and Lab (3)
or GEOL	101	Geology of Planet Earth (3)
COMP	100	Computers: Their Impact and Use (3)
ECON	160	Microeconomic Principles (3)
PHYS	100A/L	General Physics I/Lab (3/1)
PHYS	100B/L	General Physics II/Lab (3/1)
CMT	110/L	Construction Drawings (1/1)

Sophomore Year

ACCT	220	Introduction to Financial Accounting (3)
BLAW	280	Business Law I (3)
CMT	208/L	Construction Site Surveying/Lab (2/1)
CMT	210/L	Construction Contract Documents/Lab (2/1)
CMT	240/L	Building Construction (2/1)
MATH	255A	Calculus I(3)
MATH	255B	Calculus II (3)
MSE	220/L	Construction Materials/Lab (2/1)

2. Upper Division Required Courses (52 Units)

Junior Year

CMT	309	Computer Applications in Construction Management (2)
CMT	310/L	Construction Estimating/Lab (2/1)
CMT	312/L	Project Cost Control, Planning and Scheduling/ Lab (2/1)
CMT	321	Introduction to Mechanical and Electrical Installation (2)
CMT	326/L	Soil Mechanics for Technology/Lab (2/1)
CMT	334/L	Construction Equipment and Methods (2/1)
MGT	360	Management & Organizational Behavior (3)
CMT	340	Statics and Strength of Materials for Technology (3)
ENGL	306	Report Writing (3)
MSE	300	Construction Technology Economy (3)

Senior Year

BLAW	481	Real Estate Law (3)
CMT	401/L	Construction Contract Administration/Lab (2/1)
CMT	415/L	Fundamentals of Construction Management/ Lab (2/1)
CMT	434/L	Site Planning and Logistics/Lab (2/1)
CMT	440/L	Structural Design/Lab (2/1)
CMT	441/L	Highway Design/Lab (2/1)
CMT	449	Dispute Resolution (1)
CMT	480	Construction Law (3)
CMT	488A	Construction Senior Design I (2)
CMT	488B	Construction Senior Design II (2)
CMT	494	Cooperative Educational Experience (2)

Total Units in the Major	100

General Education (24 Units):

Construction Management Technology majors have to follow a modified general education program depending upon the year and enrollment status as a college student. Returning and transfer students should consult an advisor before planning their general education programs. The requirements for students entering in Fall 2006 under the new PLAN R is described here. Continuing students and some first time transfer students may elect to continue with the former GE Plan C. Students should refer to prior catalog editions and consult with an academic advisor in selecting their required GE courses.

Construction Management Technology students are required to take courses in the following GE sections: Analytical Reading and Expository Writing (3 units), Oral Communication (3 units), Arts and Humanities (6 units), Comparative Cultures (6 units), U.S. History and Local Government (6 units). All other GE requirements are met through completion of courses in the major.

Nine of the General Education Plan R units must be at the upper-division level and two courses must meet the Information Competency requirement.

Total Units Required for a Bachelor of Science Degree in Construction Management Technology	124

Minor in Construction Management Technology

1. Lower Division Courses (6 units)

ACCT	220	Introduction to Financial Accounting (3)
CMT	210/L	Construction Contract Documents (2/1)

Note: BLAW 280, Business Law I, which satisfies Lifelong Learning of General Education, and ECON 160, Microeconomic Principles, which satisfies the Social Sciences of General Education are both required prerequisite courses to be included in this minor; thus students seeking this minor should consult with an academic advisor early in the planning stages of his/her General Education Requirements.

2. Upper Division Courses (17 units)

CMT	312/L	Project Cost Control, Planning, and Scheduling (2/1)
CMT	415/L	Fundamentals of Construction Management (2/1)
CMT	309	Computer Applications in Construction Management (2)
CMT	401/L	Construction Contract Administration (2/1)
CMT	480	Construction Law (3)
MSE	300	Construction Technology Economy (3)

Note: This minor program in Construction Management Technology will not seek accreditation by the Accreditation Board for Engineering and Technology.

Total Units in the Minor	23

Requirements for the Master of Science Degree in Engineering with an Option in Structural Engineering

General Requirement For Admission To The Program:

1. Satisfaction of all requirements for admission to the University (see University catalog section regarding Graduate Programs).
2. A bachelor's degree in Engineering or in an allied field with some equivalency to Engineering from an accredited university or college.
3. Approval by the College of Engineering and Computer Science and the Department.

For Advancement To Classified Graduate Status:

1. Satisfaction of University requirements for classified status (See University catalog section regarding Graduate Programs).
2. Completion of all requirements noted on individual admissions documents.
3. Submit tentative program of study to the CEAM graduate coordinator.
4. Approval by the Department Graduate Coordinator.

For The Degree:

1. Satisfaction of University requirements for the M.S. Degree (see University catalog section regarding Graduate programs).
2. Completion of 30-33 units under the Thesis, Project or the Comprehensive Examination Plan as follows:

A. Thesis Plan (30 Units)

i. 24 units of course work applicable to the M.S. degree; of which, at least 15 units must be taken in engineering courses at the 500-level or above.
ii. an additional 6 units of CE 698 (Thesis), and successful defense of Thesis.

B. Project (30 Units)

i. 27 units of course work applicable to the M.S. degree; of which, at least 18 units must be taken in engineering courses at the 500-level or above.
ii. an additional 3 units of CE 698 (Graduate Project) culminating in a comprehensive report.

C. Comprehensive Exam Plan (33 Units)

i. 30 units of course work applicable to the M.S. degree; of which, at least 21 units must be taken in engineering courses at the 500-level or above.
ii. an additional 3 units of CE 697 Directed Comprehensive Study.

Special Requirements

1. Students entering the program are expected to have completed Soil Mechanics (CE 426) and Structures I (CE 335), Reinforced Concrete Design (CE 438), and Structural Steel Design (CE 439). Admitted students who have not completed such courses as part of an undergraduate program must satisfactorily complete them prior to continuing in the program. These courses cannot be applied toward the formal degree program of study.
2. This program is intended primarily for students holding a B.S. in Civil Engineering or in a closely related field. Prospective students whose undergraduate degree is not in a closely related field should contact the Department in order to discuss additional prerequisite courses with a faculty advisor.
3. The total number of 400-level units in the formal program of study for students pursuing the Thesis, Project, or Comprehensive Examination Plans may not exceed 9.

Required Courses (30-33 Units)

1. Culminating Experience (3-6 units)

CE 697 Comprehensive Exam (3)
or CE 698 Graduate Project (3)
or Graduate Thesis (6)

2. Required Courses (0-7 units)

AM 410 Vibration Analysis (3)
CE 536/L Structures II and Lab (3/1)

NOTE: If AM 410 and CE 536/L or equivalent were completed as part of an undergraduate degree program, additional units must be included in the graduate program, please consult with graduate advisor.

3. Additional courses.

Remaining courses selected from the following list to complete the required units consistent with the culminating experience selected.

CE 537 Timber and Masonry (4)
CE 526 Geotechnical Foundation Design (3)
CE 638 Advanced Reinforced Concrete Design (3)
CE 639 Advanced Structural Steel Design (3)
CE 641 Earthquake Engineering (3)
CE 636 Structural Dynamics (3)
CE 642/L Applied Finite Elements (4)
CE 640 Advanced Analysis Methods (3)
CE 648 Precast And Prestressed Concrete Design (3)

NOTE: If additional units are required to complete the degree as a consequence of taking some of the above courses in a undergraduate program, other courses can be selected with the approval of an advisor or the Graduate Coordinator.

Course List

AM 196A-Z. Experimental Topics Courses in Applied Mechanics (1-4)

AM 296A-Z. Experimental Topics Courses in Applied Mechanics (1-4)

AM 316. Engineering Dynamics (3)

Prerequisites: CE 240; MATH 280. Corequisite: AM 317. Vector calculus and kinematics, force, equations of motion, energy and momentum principles applied to the dynamic behavior of rigid and deformable solids. Design considerations. (Design units: 0.5)

AM 317. Mechanics Lab (1)

Prerequisites: CE 340. Corequisite: AM 316. Experimental analysis of the responses of various configurations of deformable solids to static and dynamic forces. Design of mechanics experiments. One three-hour lab per week. (Design units: 0.5)

AM 396A-Z. Experimental Topics Courses in Applied Mechanics (1-4)

AM 400A. Applied Mechanics Design Clinic I (1-3)

Prerequisite: Senior or graduate standing in Applied Mechanics or related discipline with senior or graduate program on file, acceptable academic record, and written approvals from faculty sponsor and Department Chair. Design units vary.

AM 400B. Applied Mechanics Design Clinic II (1-3)

Prerequisite: AM 400A. Continuation of AM 400A. Design units vary.

AM 410. Vibration Analysis (3)

Prerequisite: AM 316; CE 340. Study of the vibratory motion of linear single degree of freedom systems. Equation of motion, free vibration response and transient and steady state excitation. Introduction to multi-degree-of-freedom systems. (Design units: 0)

AM 496A-Z. Experimental Topics Courses in Applied Mechanics (1-4)

AM 499A-C. Independent Study (1-3)

Prerequisites: Senior or graduate standing in Applied Mechanics with senior or graduate program on file, and written approvals of faculty sponsor

and Department Chair. Admission is based on evidence of ability to pursue Independent Study in depth and approval of a proposal submitted prior to registration in the course. Design units vary.

Graduate Level Courses

Note that 300-level courses in Applied Mechanics do not carry credit for a Master's degree in Engineering.

AM 509. Methods of Applied Mechanics (3)
Prerequisites: AM 316; MATH 280. Survey of methods used in Applied Mechanics. Emphasis on the formulation and solution of problems by the application of appropriate mathematical tools. Application of differential equations, matrix techniques, Fourier series, Laplace Transforms and energy methods to vibration, stability, elasticity and structures problems. (Design units: 0)

AM 610. Advanced Mechanical Vibrations (3)
Prerequisite: AM 410; CE 436. Vibration of multi-degree of freedom lumped parameter systems; formulation of equations of motion using the Newton's 2nd law and analytical mechanics, determination of natural modes, response by the normal mode method. Emphasis on matrix formulation and computer applications. Exact solutions for continuous systems.

AM 618. Theory of Elastic Stability (3)
Prerequisite: Instructor consent. Treatment of stability problems and the stability criteria. Elastic and inelastic buckling of bars, lateral buckling of beams, the stability of frameworks, buckling of rings, curved bars, arches, buckling of thin plates and thin shells, general theory of cylindrical shells, shells having the form of a surface of revolution.

AM 619. Theory of Plates and Shells (3)
Prerequisite: Instructor consent. Cylindrical bending of uniformly loaded plates, symmetrical bending of circular plates, rectangular plates with various edge conditions, plates of various shapes, membrane theory of shells, general theory of cylindrical shells, shells having the form of a surface of revolution.

AM 621. Aerostructure II (3)
Prerequisite: AM 421. Analysis of semimonocoque aircraft structures. Stress, deflection and stability are considered for linear and nonlinear material behavior. Finite element methods are applied to continuous systems. Discussion of structural vibration loads and flutter.

AM 637. Optimum Structural Design (3)
Synthesis of structural components and systems employing parametric computer solutions. Applications to weight, cost, and trade-off criteria, including practical constraints on geometry. Least weight design of cable, column and beam elements and system of elements. Introduction to computer automated design and design space concepts. Examples from aerospace and civil engineering fields.

AM 640. Energy and Approximate Methods in Elastomechanics (3)
Prerequisite: Instructor consent. Theory and application of energy methods in continuous systems using the calculus of variations approach. Derivation of the total potential and complementary energy expressions via virtual work principles. The study of stability configurations of mechanical systems. Development and application of Castigliano's and Engesser's theorems. Approximate methods using Rayleigh-Ritz, Galerkin, and Kantorovich formulations. Hamilton's principle and its applications.

AM 644. Advanced Finite Element Methods (3)
Prerequisites: AM 642, Instructor consent. Includes a brief review of the fundamentals of the finite element method; potential energy basis of finite elements; and isoparametric formulations. Applications of general civil and aerospace structures are considered, especially plates, general shells, vibration and stability analyses, and nonlinear problems in structural mechanics.

AM 645. Nonlinear Mechanics (3)
Prerequisite: AM 610. Introduction to nonlinear problems. Analytic approaches to some closed form solutions of nonlinear differential equations. Vibrations of systems subjected to nonlinear restoring forces. Nonlinear constitutive relations in elasticity. Poincare's method and Phase Plane plots for stable and unstable singular points. Routh Hurwitz Crieria, Conservative systems. Limit cycles, Lyapunov's direct method. Survey of perturbation techniques with time dependent coefficients. Mathieu's Equation, etc.

AM 649. Seminar in Applied Mechanics (3)
Advanced studies of topics of current interest in the field of applied mechanics. Consists, in part, of an intensive study of selected papers from current literature.

AM 695A-Z. Experimental Topics Courses in Applied Mechanics (1-4)

AM 696A-C. Directed Graduate Research (3)
Prerequisite: AM 698; approvals of faculty advisor and either Department Graduate Coordinator or Department Chair.

AM 699A-C. Independent Study (1-3)
Prerequisite: Classified status in the MS program and written approvals from faculty sponsor and Department Graduate Coordinator or Department Chair. Admission is based in part on evidence of the ability to pursue Independent Study or research in depth and approval of a proposal submitted prior to the time of registration.

Civil Engineering Course List

CE 101/L. Introduction to Civil Engineering and Lab (1/1)
Freshman orientation course for the civil engineering program, the profession, and an introduction to the University. Introduction to the tools for civil engineering studies: internet, word processing, spreadsheet. Development of communication skills and ability to work in teams. Development of learning skills in civil engineering studies. One hours lecture-discussion and three hours lab per week.

CE 196A-Z. Experimental Topics Courses in Civil Engineering (1-4)

CE 240. Engineering Statics (3)
Prerequisite: PHYS 220A/L. Corequisite: MATH 150B. Analysis of the distribution of forces on and within bodies in static equilibrium. Free body diagrams, equilibrium equations and the method of sections. Includes a limited introduction to the subject of strength of materials. (Design units: 0)

CE 280/L. Computer Applications in Civil Engineering and Lab (1/1)
Prerequisite: CE 240. Development of computer skills related to the field of Civil Engineering. Introduction of Windows, email and internet usage. Introduction to Office suite, word processing, spreadsheets with VBA applications, presentation and publishing softwares. Development of programming skills. Application of CAD to the development of structural and architectural drawings, dimensioning, grading plans, contour lines, sections. Analysis and design of structural systems using structural engineering packages. Development of algorithms and computer codes for the solution of Civil Engineering problems. One hour of lecture and three hours of lab per week.

CE 296A-Z. Experimental Topics Courses in Civil Engineering (1-4)

CE 308/L. Surveying and Lab (2/1)
Corequisite: 308L. Fundamentals of plane and geodetic surveying. Concepts of linear and angular measurements, precision, errors and corrections. Field problems in chaining, differential and profile level-

ing, triangulation and highway curves. Two hours lecture; one three-hour lab. (Design units: 0)

CE 315/L Construction Engineering and Lab (2/1)
The objective of this course is to introduce undergraduate students to planning, scheduling, estimating, and project control techniques for construction projects.

CE 335/L. Structures I and Computational Lab (3/1)
Prerequisite: CE 340. Corequisite: CE 335L. Determination of the force distribution and deflections in statically determinant and indeterminant structures using the classical, non-matrix methods of structural analysis. Three hours of lecture per week. Lab: Structural analysis problem solving session. Computer applications of structural analysis and design. Three hours of laboratory per week. (Design units: 0)

CE 340. Strength of Materials (3)
Prerequisite: CE 240; MATH 280. Analysis of the stresses and deflections in members and basic structural systems. Axial, torsional, bending and shear stresses and deflections. Introduction to structural stability. Design of structural components. (Design units: 0.5)

CE 396A-Z. Experimental Topics Courses in Civil Engineering (1-4)

CE 400A. Civil Engineering Design Clinic I (1-3)
Prerequisite: Senior or graduate standing in Civil Engineering or related discipline with senior or graduate program on file, acceptable academic record, and written approvals from faculty sponsor and Department Chair. Design units vary.

CE 400B. Civil Engineering Design Clinic II (1- 3)
Prerequisite: CE 400A. Continuation of CE 400A. Design units vary.

CE 408/L. Surveying with GPS Applications and Lab (1/1)
Prerequisites: CE 308/L. Corequisite: 408L. Surveying with Global Positioning Systems (GPS): point positioning, differential positioning, differencing techniques, survey planning, real-time kinematic (RTK) surveys, vertical positioning, random errors and survey specifications, horizontal curves, vertical curves, horizontal control and vertical control. One hour lecture; three hours lab per week. (Design Units: 0)

CE 426/L. Soil Mechanics and Lab (3/1)
Corequisite: 426L. Soil as a foundation for structures and as a material of construction. Lab experiments to be performed to obtain data to determine soil physical properties. Three hours lecture; three hours lab per week. (Design units: 1)

CE 438. Reinforced Concrete Design (3)
Prerequisite: CE 335. Basic concepts in the design of reinforced concrete structures. Applications to beams, columns, slabs, shear walls, footing, and composite construction. (Design units: 3)

CE 439. Structural Steel Design (3)
Prerequisite: CE 335. Basic concepts in the design of steel structures. Design in steel of tension and compression members, beams, columns, welded and bolted connections; eccentrically loaded and moment resistant joints; plate girders. Introduction to computer-aided design. (Design units: 3)

CE 460/L. Engineering Hydrology and Lab (2/1)
Prerequisite: ME 390. Corequisite 460L. Surface Hydrology for the design of drainage, flood control, water storage and distribution systems. Topics include hydrologic cycle, meteorology, surface and ground water movement, interrelation between precipitation and runoff; hydrograph analysis, flood routing, risk assessment. Hydrologic model development and analysis using computers emphasized for design of storm drainage systems, flood protection, water storage and reservoir operations. Two lecture hours; one three-hour lab. (Design units: 1)

CE 488A/L. Civil Engineering Senior Design I and Lab (1/1)
Prerequisites: CE 335/L and senior class standing with senior program on file. Corequisites: CE 488AL and either CE 438 or CE 439. 1st semester of a 2-semester sequence capstone design experience simulating professional practice in civil engineering. (CE 488A and CE 488B must be completed within the same academic year.) Undertakes the preliminary design of a complex engineering project. Addresses ethics of engineering practice, professional lifelong learning requirements, written and oral engineering design project presentations, and methods of technical problem solving. (Offered fall semester.) 1 hour lecture; three hours lab per week. (Design units: 1)

CE 488B. Civil Engineering Senior Design II (2)
Prerequisites: CE 488A/L. Corequisites: Second major civil design course either CE 438, CE 439, or CE 526. Continuation of CE 488A. (CE 488A and CE 488B must be completed within the same academic year.) Final design stage of the project initiated in CE 488A is undertaken, with emphasis on working in project teams. Six hours of lab per week. (Offered spring semester) (Design units: 2)

CE 496A-Z. Experimental Topics Courses in Civil Engineering (1-4)

CE 499A-C. Independent Study (1-3)
Prerequisite: Senior or graduate standing in Civil Engineering with senior or graduate program on file, and written approvals of faculty sponsor and Department Chair. Admission based on evidence of ability to pursue Independent Study in depth and approval of a proposal submitted prior to registration in the course. (Design units vary)

Graduate Courses

Note that 300-level courses in Civil Engineering do not carry credit for a Master's degree in Engineering.

CE 526. Geotechnical Foundation Design (3)
Prerequisite: CE 426. Soil mechanics aspects of foundation design. Shear strength and compressibility of soil. Lateral pressures and retaining structures. Strength and deformation laws for spread footings, piers, piles and caissons. Analysis of mat foundations. Eccentric and inclined foundation loads. (Design units: 1.0)

CE 536/L. Structures II and Lab (3/1)
Prerequisite: CE 335. Corequisite CE 536L. Study of structural analysis and design problems using matrix methods. Complete development of the flexibility and stiffness methods of analysis. Computer applications to structural analysis and design. Three hours lecture; three hours lab per week. (Design units: 1.5)

CE 537. Timber and Masonry Design (4)
Prerequisite: CE 335. Study of vertical and lateral loading on structures. Elements of timber design. Timber beams, tension members, compression members, tension and bending and compression and bending members. Design of horizontal diaphragms and shearwalls. Design of connections. Elements of masonry design. Design of masonry in bending, shear and axial members. Four hours of lecture. (Design units: 4)

CE 636. Structural Dynamics (3)
Prerequisite: AM 610. Vibration of structural systems with emphasis on approximate solutions to continuous systems; assumed modes, Rayleigh-Ritz, Finite Element Applications, nonlinear vibrations. Numerical techniques for computer application. Response spectra for multi-degree-of-freedom systems. Advanced topics.

CE 638. Advanced Reinforced Concrete Design (3)
Prerequisite: CE 438. Advanced topics in concrete design, including frames and slabs.

CE 639. Advanced Structural Steel Design (3)
Prerequisite: CE 439. Advanced topics in structural steel design such as frames, bridges, and buildings.

CE 640 Advanced Analysis Methods (3)
Prerequisite: CE 536. Analytical methods for calculation of stress deflection and stability of structures. Unsymmetrical bending, torsion, plates, treatment of the buckling characteristics of various structural elements. Applications of energy methods. Fundamentals of applied Elasticity. Consideration given to modern structural materials. (Design units: 1)

CE 641. Earthquake Engineering (3)
Prerequisites: AM 410; CE 335. Study of the earthquake problem. Topics covered include plate tectonics, seismology, dynamic response of structures, dynamics of sites, and design for earthquakes.

CE 642/L Finite Element Analysis (3/1)
Prerequisites: AM 410; CE 536. Corequisite: CE 642L. Study of structural mechanics problems by use of finite element method. Formulation of the basic elements, assemblage of elements and application of the method to selected topics in structural mechanics.

CE 643. Foundation Design (3)
Prerequisite: CE 438. Design of foundations for structures. Topics include pile foundations, grade beams, continuous and mat footings and retaining walls.

CE 648. Prestressed Concrete Design (3)
Prerequisite: CE 638. Prestressed concrete design and analysis for gravity and lateral loading. Design of reinforced and prestressed structural elements. Safety and economy. Connection design for earthquake and wind loadings. Design projects using professional practice standards including latest codes. Three hours of lecture. (Design units: 3)

CE 649. Seminar in Civil Engineering (3)
Advanced studies of topics of current interest in the field of civil engineering. The course will consist in part of an intensive study of selected papers from current literature.

CE 695A-Z. Experimental Topics Courses in Civil Engineering (1-4)

CE 696. Directed Graduate Research (3)
Prerequisite: CE 698 and approvals of faculty advisor and either Department Graduate Coordinator or Department Chair.

CE 697. Directed Comprehensive Studies (3)
(Credit/No Credit Only)

CE 698. Thesis (6) or Graduate Project (3)
Prerequisite: Advancement to candidacy for the MS degree and written approvals of faculty advisor and Department Graduate Coordinator or Department Chair.

CE 699A-C. Independent Study (1-3)
Prerequisite: Classified status in the MS program and written approvals from faculty sponsor and Department Graduate Coordinator or Department Chair. Admission is based in part on evidence of the ability to pursue Independent Study or research in depth and approval of a proposal submitted prior to the time of registration.

CMT Course List

CMT 101/L. Introduction to Construction Management and Lab (1/1)
Corequisite: CMT 101L; MATH 102. Freshman orientation course for Construction Management Technology, the profession, professional organizations, and orientation to the university. Construction-related regulatory requirements. Ethics, business, safety, and professional practices. Management techniques and interaction with professional organizations and associations. One hour lecture-discussion; three hours technical activity-lab per week.

CMT 110/L. Construction Drawings and Lab (1/1)
This course is designed to provide students with the foundational knowledge and enough practice at reading blueprints. Both residential and commercial construction drawings will be covered in this course. The set of plans such as the foundation plan, floor plan, elevations, sections, and details that must be assembled into an organized set of drawings to show as much about a project as can be placed on paper in one or two dimensional views are analyzed and studied.

CMT 208/L. Construction Site Surveying and Lab (2/1)
Prerequisite: MATH 104. Corequisite: CMT 208L. Fundamentals of surveying as applied to construction layout. Use of level and transit for location and control of structures, vertical and horizontal control. Introduction to AutoCad as a means of presenting survey information with usage of Autodesk Survey and Autodesk Map. Lab measurements of land surface area, differential and profile leveling, construction layout and plotting profiles using tape, leveling and transit measurements. Two hours lecture; three hours lab per week.

CMT 210/L. Construction Contract Documents and Lab (2/1)
Corequisite: CMT 210L. Recommended Corequisite: BLAW 280. Basic skills and techniques required to produce construction documents conforming to current building codes and standards, including working drawing, specifications, bid documents, addenda and change orders. Two hours lecture per week; three hours technical activity-lab per week.

CMT 240. Engineering Statics for Technology (3)
Prerequisites: MATH 255A; PHYS 100A/L. Not available for credit towards an engineering degree. Analysis of the distribution of forces on and with bodies in static equilibrium. Free body diagrams, equilibrium equations, and the method of sections. Emphasis on application of the principles of static equilibrium to building structures. Three hours lecture-discussion per week.

CMT 240/L Building Construction (2/1)
Corequisite: CMT 210. Introduction to planning, design, and construction of structures, including cost estimating and project scheduling. Computer applications. Two (2) hours of lecture per week.

CMT 309. Computer Applications in Construction Management (2)
Prerequisite: COMP 100 and instructor consent. Application of computer systems to control operations in the building industry. Introduction to commercially available software for planning, scheduling, and estimating that is generally used in the construction industry. Two three-hour technical activity-labs per week.

CMT 310/L. Construction Estimating and Lab (2/1)
Prerequisite: ACCT 220, MATH 255, CMT 240/L and corequisites CMT 312/L and CMT 310L. Procedures for analyzing materials and methods involved in reliable estimates of the cost of a construction task or project, including: direct, indirect, and contingency costs and profits. Two hours lecture; three hours technical activity-lab per week.

CMT 312/L. Project Cost Control, Planning and Scheduling and Lab (2/1)
Prerequisites: ACCT 220, MATH 255A, CMT 240/L, instructor consent, and corequisite CMT 312L. Basic application of construction cost control systems including critical path method techniques, planning, logic, scheduling and updating, and use of computer for scheduling. Use of cost information and associated reports for the planning and scheduling of construction projects. Two hours lecture-discussion; three hours technical activity-lab per week.

CMT 321. Introduction to Mechanical and Electrical Installation (2)
Prerequisite: PHYS 100B/L. Basic understanding of the electrical and mechanical systems, design, and construction procedures used flexibility in each system, space requirements, and at what point in the job the work on a particular system is done.

CMT 326/L. Soil Mechanics for Technology and Lab (2/1)
Prerequisite: MSE 220/L. Corequisite: CMT 326L. Not available for credit towards an engineering degree. Soil Composition, description, and physical properties of soils; earthmoving estimating, soil explorations, ground water effects, plate tectonics, and introduction to seismic effects on soils. Lab: investigations and experiments in soil mechanics including field requirements for foundations and other earthwork structures. Two hours lecture-discussion; three hours technical activity-lab per week.

CMT 334/L. Construction Equipment and Methods (3)
Prerequisites: ACCT 220 and CMT 326/L. Construction procedures, job planning layout and scheduling, selection and application of construction equipment to building and heavy construction projects. One hour lecture, three hours problem-solving.

CMT 336/L. Fundamentals of Green Buildings and Lab (2/1)
Prerequisite: Completion of the lower division writing requirement. The purpose of this course is to give the students an overview of design and construction delivery systems for high performance green buildings. The US Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) will be discussed in detail. Sustainability evaluation systems will be reviewed. This course will focus on LEED-NC (new construction) requirements. (Available for General Education, Lifelong Learning)(IC)(WI)

CMT 340. Statics and Strength of Materials (3)
Prerequisites: CMT 240 and MATH 255B. The analysis of the distribution of forces on and within bodies in static equilibrium. Free body diagrams, equilibrium equations and the method of sections. The analysis of stresses and deflections in members and simple structural systems. Axial, torsional, bending and shear stresses and deflections and column stability. Design of building structural members. Emphasis is given to the application to building structures. Not available for credit towards an engineering degree.

CMT 401/L. Construction Contract Administration and Lab (2/1)
Prerequisite: BLAW 280, CMT 210/L and corequisite CMT 401L. Administration of contract documents including invitation to bid, addenda, proposals, change orders, subcontracts, liens, claims, waivers, arbitration, general and supplemental conditions, and CSI specifications. Two hours lecture-discussion; three hours technical activity-lab per week.

CMT 415/L. Fundamentals of Construction Management and Lab (2/1)
Prerequisite: CMT 312/L and CMT 310/L, instructor consent and corequisite CMT 415L. Introduction to the basic concepts of construction management. Areas of focus to include quantity analysis, productivity, work activity sequencing, network scheduling, and computer applications specific to construction management. The construction manager's relation to internal organization, owner, architect, engineer, public, press, legal aid, unions, trades, equipment, utilities, insurance, finances, and governmental agencies. Two hours lecture-discussion; three hours technical activity-lab per week.

CMT 434/L. Site Planning and Logistics, and Lab (2/1)
Prerequisites: CMT 208/L and CMT 326/L and corequisite CMT 434L. Investigation, market research, finance, cost estimating, and land use with respect to development process. Including an analysis of land development; site investigation; grading; street piping systems and water supply systems including allowable pressure in pipes, head loss calculations, minimum allowable slopes for sewage disposal; and landscaping. Two hours lecture; three hours technical activity-lab per week.

CMT 440A/L. Civil Technology I and Lab (2/1)
Prerequisite: CMT 340. Corequisite: CMT 440AL. Not available for credit towards an engineering degree. Practice oriented treatment of the procedures for structural steel and timber design. Design of tension and compression members, beams and connections. Introduction to computer aided analysis and design. Emphasis on application of building structures. Two hours lecture; three hours technical activity-lab per week.

CMT 440/L. Structural Design (2/1)
Prerequisite: CMT 340. A practice oriented treatment of the procedures for structural concrete, steel, and timber design. Design of columns, beams, slabs, and walls. Lateral load resisting systems. Introduction to computer aided analysis and design. Emphasis is given to the application of building structures. Not available for credit towards an engineering degree. Two (2) hours of lecture per week and three (3) hours of technical activity-laboratory per week.

CMT 440B/L. Civil Technology II and Lab (2/1)
Prerequisite: CMT 440A/L. Corequisite: CMT 440BL. Not available for credit towards an engineering degree. Practice oriented treatment of the procedures for structural concrete and masonry design. Design of columns, beams, slabs, and walls. Lateral load resisting systems. Introduction to computer aided analysis and design. Emphasis on application of building structures. Two hours lecture; three hours technical activity-lab per week.

CMT 441/L. Highway Design (2/1)
Prerequisite: CMT 326/L and CMT 334/L. Corequisite: CMT 441L. The course covers basic highway design and traffic circulation principles. Study of design elements of alignment, profile, cross-section, and controlled-access highways. Investigation of functional highway classification, Traffic volume, signs and measurements, intelligent transportation systems, Caltrans standard drawings and specifications. Two (2) hours of lecture per week and three (3) hours of technical activity-laboratory per week.

CMT 449. Dispute Prevention (1)
Prerequisite: CMT 210/L. In this seminar, students will explore dispute prevention, by emphasizing on partnering and team building, realistic risk allocation, competing engineering & documentation, constructability analysis, dispute resolution clauses. Through readings, discussions, guest speakers, independent research, writing, and oral presentations, students will develop a clearer understanding of the dispute prevention.

CMT 480. Construction Law (3)
Prerequisite: BLAW 280 and CMT 210/L. Orientation to the rules and regulations governing construction industry practices and activities including contractors license law, state lien laws, health and safety regulations, personnel relations and supervision, workers compensation, employment insurance, and taxes. Three hours lecture-discussion per week.

CMT 488A, B. Construction Senior Design I, II (2,2)
Prerequisite: CMT 310/L, CMT 312/L, and senior standing in Construction Management. (CMT 488A and CMT 488B must be completed within the same academic year.) Selection and completion of a project under faculty and/or industry supervision. Projects typical of problems that a graduate of the Construction Management Program must solve in their field of employment. Requires both written formal report and oral presentation of project. Six hours technical activity-lab per week. (A, B Offered Fall, Spring semesters, respectively.)

CMT 494. Cooperative Educational Experience (2)
Prerequisite: CMT 310/L and CMT 312/L. Supervised off-campus professional experience in construction management technology for students with junior or senior standing in the major. Positions are paid and usually run for a full year with summer work available. Course may be repeated for up to six semester units of credit with a maximum of two semester units counting towards the major degree requirements.