CE 246A. Advanced Water Quality (3)
Prerequisite: CE 142 or permission of instructor. Theory and practice of physical/chemical processes for controlling water quality, including chemical equilibrium and kinetics; mass transfer mechanisms; physical separation processes; adsorption, exchange, and membrane-based processes; disinfection.

CE 246B. Advanced Water Quality (3)
Prerequisites: CE 142 or permission of instructor; CE 246A recommended. Theory and practice of biological processes for controlling water quality, including suspended growth systems; attached growth systems; ponds; land treatment. Also sludge treatment processes, including biological stabilization, thickening, and dewatering; sludge disposal.

CE 247. Solid Wastes Engineering (3)
Planning and design of waste collection and disposal systems. Waste segregation and energy impact related to recovery and recycling practices. Environmental impact and institutional issues related to solid and hazardous waste systems.

CE 251. Advanced Boundary Law (3)
Prerequisite: GME 151 or equivalent. Land and water boundary legal issues, both historical and new. Case investigations.

CE 261. Geoprocessing (3)
Prerequisite: GME 173 or equivalent. Integration of computer technologies for gathering, analyzing, and displaying data associated with the earth's spatial features. Engineering design problems dependent on competing factors.

CE 271. Geodetic Systems Optimization (3)
Prerequisite: GME 108 or equivalent. National geodetic networks; planimetric and vertical control systems; geodetic control densification; network optimization criteria and methodology.

CE 280. Geomatics Engineering Seminar (1; max total 3)
Prerequisite: graduate standing. Current California State University, Fresno surveying engineering research presented and discussed by faculty and graduate students. Oral presentation and written report documenting ongoing research activities required.

CE 283. Digital Remote Sensing (3)
Prerequisite: GME 140 or equivalent. Quantitative approach in remote sensing; digital image characteristics, error correction, registration; geometric and radiometric image enhancement; image classification; system design; remote sensing and GIS.

CE 285. Advanced Analytical Photogrammetry (3)
Prerequisite: GME 125 or equivalent. Mathematical models in photogrammetry; bundle block adjustment, self-calibration; close-range photogrammetry; real time photogrammetry and data snooping. System design; hardware and software considerations in photogrammetry.

CE 286. Geographic Information Systems Design (3)
Prerequisite: GME 173 or equivalent. Data structures and algorithms, databases for GIS, error modeling and data uncertainty, visualization, data exchange and standards, the multipurpose cadaster, advanced analysis techniques.

CE 290. Independent Study (1-3; max total 6)
Prerequisite: graduate status in engineering. See *Academic Placement — Independent Study*. Approved for ***RP*** grading.

CE 291T. Topics in Engineering (1-3; max total 6)
Prerequisite: permission of instructor. Investigation of selected engineering topics. May be offered with a lab.

CE 298. Project (3; max total 3)
Prerequisite: graduate status in engineering. See *Criteria For Thesis and Project.* Independent investigation of advanced character such as analysis and/or design of special engineering systems or projects; critical review of state of the art of special topics, as the culminating requirement for the master's degree. Abstract required. Approved for ***RP*** grading.

CE 299. Thesis (2-6; max total 6)
Prerequisite: See *Criteria For Thesis and Project.* Preparation, completion, and submission of an acceptable thesis for master's degree. Approved for ***RP*** grading.

IN-SERVICE COURSES

(See *Catalog Numbering System.*)

Civil Engineering (CE)

CE 311. Professional Examination Review (2; may be repeated in different fields)
Prerequisite: bachelor's degree in engineering or eligibility to take state registration examinations. Review of engineering fundamentals for those qualified to take the state examination for certification as engineer-in-training; or review in a specific field (civil, electrical, mechanical, or other) for those preparing to take the examination for registration as professional engineer.

CE 321. Professional Engineering Seminar (1-3; may be repeated in different fields)
Prerequisite: bachelor's degree in engineering or related field, or experience as a professional engineer. Latest developments in various specialized areas of professional engineering practice; new materials, design and construction methods, equipment, devices, and procedures.

Construction Management

To be announced, *Coordinator*
Engineering East Building, Room 178
559.278.2889

Program Description

The Management Technical Specialty of the Bachelor of Science degree in Construction Management is accredited by the American Council for Construction Education, the professional accreditation organization of the construction industry.

Students in construction management (CM) are exposed to a wide variety of topics, ranging from courses in management and administration of construction companies, projects, people, and equipment to courses focusing on specific techniques for project planning and control work improvement and estimating. The Construction Management program also provides opportunities to develop a strong background in computer applications in construction. Computer skills combined with a solid management and technical background are major assets of the construction management graduate.

Career Opportunities

Opportunities for construction management graduates are excellent. Examples of positions held by construction management graduates are project manager, construction manager, project administrator, estimator, scheduler, architectural representative, project superintendent, and construction administrator. Students should consider this challenging, satisfying, and high-paying profession.

Mission of Construction Management

The mission of the Construction Management Program is to prepare students for employment at the professional level in the discipline of construction and its related fields. The program places emphasis on the acquisition of both fundamental theoretical knowledge and the application of current practices in the industry.

The program strives to provide assistance to the student in the development of personal qualities including human sensitivity, disciplined reasoning, and communications.

Educational Objectives of the Instructional Program

- Provide students with the ability to recognize and independently diagnose construction related problems accurately, develop creative alternatives, and implement practical and effective solutions.
- Provide students with the ability to plan, schedule and control work activities, motivate and provide accurate and timely constructive alternatives, and implement practical and effective solutions.
- Provide students with the ability to apply construction related techniques, skills, and tools to construction materials as necessary for a managed construction project.
- Provide students with the ability to understand technical issues related to the fields of architecture, engineering, business and construction accounting, and finance. Work effectively and efficiently with personnel from these disciplines to properly apply related fundamentals, techniques, and procedures.
- Provide students with the ability to apply basic construction related design theory within the areas of structural, mechanical, electrical, thermodynamics, civil, and soil mechanics.

Bachelor of Science Degree Requirements

Construction Management Major

Units

Major requirements 72
Construction Core ..... (45)
CONST 1, 5, 10, 15, 42, 43, 50, 105, 107, 116, 120, 122, 124, 162, 164
CE 127; GME 15, 15L; ACCT 3; MGT 104 ..... (12)
Technical Specialty ..... (15)
Select one:
Architecture
CONST 31, 32, 131, 132, 134
Management
CONST 144, 150, 151, 166; FIN 180

Additional requirements 4-15*
MATH 75; PHYS 2A; ECON 40 or 50
Select one from CHEM 3A, GEOL 1, MATH 76, PHYS 2B

General Education requirements 51
CONST 114 satisfies the G.E. IB requirement

Total 127*

*This total indicates that 9 units from MATH 75, PHYS 2A, and ECON 40 or ECON 50 in Additional Requirements are being used to satisfy the General Education requirement of 51 units.

Advising Notes

1. Courses in mathematics, the physical sciences, or construction (except CONST 193) taken ***CR/NC*** are not counted toward fulfillment of degree requirements in construction.
2. The Upper-Division Writing Skills requirement can be met by passing the university examination or by completing a "W" course with a letter grade of ***C*** or better no sooner than the term in which 60 units of coursework are completed.
3. Other construction specialties may be developed under department advisement.

See the catalog Web Site for recommended program at *www.csufresno.edu/catoffice/current/engconrec.html.*

Construction Management Minor

Students from interrelated disciplines will acquire professional and specialized construction knowledge and skills. Preparation for participation in the building-related professions leads to careers in solving the infrastructure needs of society and the environment.

Units

Required Core courses 15
CONST 5, 10, 43, 50, 120

Additional elective courses 6
The student will select two additional construction courses in consultation with a faculty adviser. Emphasis may be placed upon a variety of specialization areas.

Total 21

Note: The Construction Management Minor also requires a 2.0 GPA and 6 upper-division units in residence.

COURSES

Construction Management (CONST)

CONST 1. Construction Management Orientation (3)
Orientation to essential elements of professional practice in construction management: construction-related regulatory requirements; ethics, business, safety, and personnel practices. Management techniques and interaction with professional organizations and associations.

CONST 5. Construction Materials (3)
Introduction to basic construction materials: concrete, masonry, metals, woods, thermal materials, finishes, equipment, and specialties. (2 lecture, 2 lab hours; field trips)

CONST 10. Estimating and Bidding (3)
Prerequisites: CONST 5, 43. Basic methods used to evaluate, fix cost, calculate worth, make accurate quantity take-offs and labor time estimates; preparing bids for prospective buyers. (6 lab hours)

CONST 15. Construction Management Software (3)
Introduction to construction industry software and project documentation. Basic instruction in estimating, scheduling, design, and project control software. Designed to provide an overview of those particular software packages used in subsequent construction management coursework. (2 lecture, 2 lab hours)

CONST 31. Architectural Graphics (3)
Introduction to basic techniques and media used in architectural graphic communication including: perspective techniques, sciagraphy, models, and photography; emphasis on various ways of making drawn representations of architectural design proposals. (6 lab hours)

CONST 32. Architectural Design (3)
Introduction to architectural design theory; analysis of architectural design problems, assessment of human needs, establishment of architectural design criteria and development of architectural design concept. (6 lab hours)

CONST 42. Architectural Drawing (3)
Architectural drafting techniques and standards progressing from fundamentals to details in the area of light construction design through the use of sketching, drafting methods, and computer aided design. Study includes the application of building codes and regulations. (6 lab hours)

CONST 43. Computer-Aided Construction Detailing (3)
Application of computers to planning and details for wood, concrete, masonry, and steel structures. (6 lab hours)

CONST 50. Basic Building Systems (3)
Prerequisite: CONST 5. Exploration of theoretic principles relating to the various building systems. (2 lecture, 2 lab hours; field trips)

CONST 105. Construction Structures (3)
Prerequisites: CONST 5, 50; PHYS 2A; MATH 71 and 72 or 75. Properties, strength, and functional applications of basic construction materials: woods, metals, and concrete. Recent developments in new materials and applications. (2 lecture, 2 lab hours; field trips)

CONST 107. Advanced Construction Structures (3)
Prerequisite: CONST 105. Analysis of construction materials in its application to different structural systems. (2 lecture, 2 lab hours)

CONST 114. Construction Management (3)
Prerequisite: senior standing in construction. The construction manager's relation to internal organization, owner, architect, engineer, public, press, legal aid, unions, trades, equipment, utilities, insurance, finances, government, and others.

CONST 116. Scheduling and Control (3)
Prerequisites: CONST 10, 15, and 50. Critical path method; planning, scheduling, and control of construction projects including logic, time assignment and computation, analysis, replanning, diagramming practices, monitoring and updating, computer utilization; role of management. (2 lecture, 2 lab hours)

CONST 120. Construction Contracts and Specifications (3)
Principles and methods for developing and applying construction contracts and specifications, including bidding requirements, bonds and insurance, certificates, agenda, change orders, general and supplemental conditions, and CSI specifications. (2 lecture, 2 lab hours)

CONST 122. Construction Laws (3)
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.

CONST 124. Construction Labor Law (3)
Prerequisite: CONST 122. Study of federal and state labor-oriented regulations as applied to construction industry practices. Interaction between technical and legal aspects of collective bargaining, pre-hire agreements, hiring hall referrals, open shop construction, work force management, labor standards, employment discrimination, strikes, and picketing.

CONST 131. Advanced Architectural Graphics (3)
Prerequisite: CONST 31. Architectural graphic techniques as tools of three dimensional analysis and representation in the design process. (6 lab hours)

CONST 132. Advanced Architectural Design (3)
Prerequisite: CONST 32. Development of understanding of the forces affecting the man-made environment through function identification, systems analysis, and development of architectural design solutions to problems at an intermediate level of complexity. (6 lab hours)

CONST 134. Architectural Design Problems (3)
Prerequisites: senior standing or permission of instructor; CONST 131 and 132. Conceptual planning and design of a large scale architectural project responding to the social and cultural context of the environment. Employing team research and analysis leading to the design and presentation on individual solutions with graphic and three-dimensional techniques. Satisfies the senior major requirement for the architecture specialty of the B.S. in Construction Management. (6 lab hours)

CONST 144. Construction Site Planning and Development (3)
Prerequisite: CONST 10, 43, and 116; senior standing. Analysis of land development; site investigation, grading, street piping systems, and landscaping. (2 lecture, 2 lab hours; field trips)

CONST 150. Heavy Construction (3)
Prerequisites: senior standing or permission of instructor; CONST 10, 105, 116, 120. Problems and methods of solutions in the construction of heavy buildings; site, excavations, foundations, framework, heavy timber, reinforced concrete, structural steel, masonry construction and related elements. Satisfies the senior major requirement for the B.S. in Construction Management. (2 lecture, 2 lab hours; field trips)

CONST 151. Heavy Building Construction (3)
Prerequisites: senior standing or permission of instructor; CONST 10, 50, and 116. Problems and methods of solution in heavy construction from earth moving, paving, compacting to tunneling; administrative procedures, quantity surveying, estimating, scheduling, and bidding. Satisfies the senior major requirement for the B.S. in Construction Management. (2 lecture, 2 lab hours; field trips)

CONST 162. Mechanical Systems (3)
Prerequisites: CONST 1, 5, and 50. Mechanical systems for heating, ventilating, air conditioning, plumbing, storm drainage, and sewage disposal systems in commercial, industrial, residential construction; heat loss and gain, solar systems, mechanical system sizing, and life cycle cost analysis. Lectures, field trips, and guest speakers.

CONST 164. Building Electrical Systems (3)
Prerequisites: CONST 5 and 50. Electrical systems for power, light, heat, signals, and communications in commercial, industrial, and residential buildings. (2 lecture, 2 lab hours; field trips)

CONST 166. Advanced Mechanical Systems (3)
Prerequisite: CONST 5 and 50. Construction application of water systems, plumbing and storm drainage, and sewage disposal systems.

CONST 190. Independent Study (1-3; max total 6)
See *Academic Placement — Independent Study*. Approved for ***RP*** grading.

CONST 191T. Technical Topics in Construction (1-3; max total 6)
Prerequisite: permission of instructor. Investigation and analysis of selected subjects in construction. (2-6 lab hours)

CONST 193. Internship/Work Experience (3-6; max total 6)
Open only to construction majors. Prerequisites: junior standing and permission of instructor. Supervised work experience in construction related industries. Periodic consultations with instructor. ***CR/NC*** grading only.

Department of Electrical and Computer Engineering
Ramakrishna Nunna, *Coordinator*
Engineering East Building, Room 274
559.278.2726

Program Description

Electrical Engineering. The Electrical Engineering Program is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

Electrical engineers design and develop electronic circuits, equipment and systems in the areas of electromagnetics (antennas; radar, radio, and television systems), communications and control (telephone systems, satellite communications; laser and optical fiber communications; aircraft and missile guidance systems), computers and digital systems (computers, microprocessors, and microcomputers; artificial intelligence), physical electronics and optics (transistors; integrated circuits; optical display devices; lasers; optical fibers), power systems and energy conversion (hydro, thermal, nuclear, solar electric power generation; analysis and synthesis of power transmission and distribution systems; on-line power control and dispatch centers), and control systems (computer control, robotics, automated manufacturing, intelligent sensors).

Computer Engineering. The Computer Engineering Program is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). Computer engineering is a discipline which allows the student to obtain expertise in the design, programming, and applications of computers. It prepares the graduate for professional practice or graduate studies. The program combines the following:

a. A strong emphasis on electrical engineering (primarily electronic circuits and systems)
b. A broad basis in mathematics, physical science, and general engineering
c. Fundamentals of computer science including programming methodology, software engineering, and operating systems
d. Introductory and advanced concepts in the design of computers and computer systems

A rich set of technical area courses is available to allow students to broaden their knowledge within any of several computer engineering areas.

Career Opportunities

According to a report by the American Electronics Association, a shortage of electrical and computer engineers is projected for the next several years; it is anticipated that computer engineering positions will increase more than any other major profession. New developments are evolving in optical communications, microelectronics, intelligent controls, computers, radar, microwave communications, and innovative alternative energy sources at an explosive pace which should assure a solid growth pattern for electrical and computer engineers into the foreseeable future.

Mission and Educational Objectives

The mission of the Department of Electrical and Computer Engineering is to fulfill the needs of the region and state by providing an undergraduate technical education in electrical engineering and computer engineering to a diverse group of students. Additionally, the department strives to continually update its rigorous program of study in order to qualify its graduates for positions in industry located in the region and beyond while providing sufficient programmatic breadth and depth to assure its graduates a successful practice in the profession. Furthermore, students are grounded in the rigorous scientific and theoretical foundations of the discipline, in order not only to enable graduates to enter and be successful in any advanced level educational program of their choosing, but also to be able to build upon this strong foundation and extend it to new depths.

The mission of the department complements and is enhanced by a graduate program leading to the M.S. in Engineering. For more information, see the Master of Science in Engineering Program, pages 316-317.

The faculty members possess depth and breadth in their specialty areas and are active in bringing these experiences and skills to the classroom. The identifiable strengths of the academic program are the laboratory and hands-on experience for students, the proper attention given to the scientific and mathematical foundation of electrical engineering and computer engineering, and the rigor of upper-division courses coupled with design and culminating senior projects. The technical and liberal arts components of the curriculum provide the students with the opportunity for gaining self-development, technical competence, and awareness of economic and ethical responsibilities. The technical curriculum includes (l) basic engineering science, (2) core electrical and computer engineering subjects, and (3) a junior-/senior-level choice for more depth in communications and analog systems, power systems and controls, or digital systems and computers.

The department has a mandatory advising program to help students make sound academic decisions.

Organizations

Student chapters of the Institute of Electrical and Electronic Engineers and Eta Kappa Nu (the national honor society for electrical engineers) are active in the department. The College of Engineering, in addition, has chapters of Tau Beta Pi, the Society of Women Engineers, the Society of Hispanic Engineers, and the National Society of Black Engineers.