

# CONSTRUCTION MANAGEMENT

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<https://construction.calpoly.edu>

## Academic Programs

Program name	Program type
Construction Management	BS, Minor

The professional constructor plays the central role in building and maintaining the infrastructure of this country and in markets around the world, making significant contributions throughout the planning, design, construction, and facilities management phases of major projects. The curriculum of the Construction Management program is specifically designed to prepare young men and women to fill this essential role. Building on a solid foundation in architecture, engineering, and business, the curriculum introduces students to construction methods and materials; to the techniques used to manage budgets, schedules, quality, and safety; to the varied contracting approaches used to deliver today's complex construction projects; and to the leadership and teamwork skills demanded by this profession. This curricular content is delivered in a unique, project-based environment that explores how these management principles are applied in each of the construction sectors, such as, commercial building, residential, heavy/civil, industrial, and specialty.

The mission of the department is to "provide innovative educational challenges focused on preparing construction professionals committed to excellence." To attain this mission and to support the interdisciplinary goals of the College of Architecture and Environmental Design, the department has established the following program goals:

### The Cal Poly CM department will produce graduates who:

1. Demonstrate a readiness and ability to perform in the construction industry.
2. Demonstrate an ability to apply problem solving skills and integrate technical knowledge.
3. Demonstrate an ability to participate successfully within an interdisciplinary team environment.
4. Demonstrate an understanding of professional behavior, standards, and leadership attributes.
5. Demonstrate an ability to communicate effectively, both orally and written, and professionally present ideas.
6. Demonstrate a propensity for life long learning and service to the industry and community at large.

### The Cal Poly CM faculty will:

1. Work closely with the architecture, engineering, and construction (AEC) industry and maintain currency and participation with industry practice.
2. Bring the AEC professions into the classroom and engage students in innovative learning experiences.
3. Engage in the scholarship of teaching, discovery, application, and integration.
4. Engage in life-long learning endeavors.

### The Cal Poly CM administration will:

1. Secure, develop, and maintain professional relationships with the construction industry.
2. Create opportunities for faculty professional development.
3. Create a rich and challenging learning environment by providing the staff, faculty, space, equipment and supplies required.
4. Encourage and support innovative endeavors and approaches to teaching, learning, and the engagement of students.

Due to the department's close association with practitioners in the industry, many professional development opportunities are provided for our students. Over 200 companies per year recruit for internships, co-ops, and permanent job placements directly through the department. Through our Professional Advancement for Construction Students (PACS) program, students are systematically introduced to and encouraged to participate with the major associations and societies representing this industry. These opportunities include participation in the Associated Students of Construction Management (ASCM) club as well as student chapters of AGC, ABC, CMAA, DBIA, MCAA, NECA, Emerging Green Professionals, and Sigma Lambda Chi, the national honorary society for construction students. Extensive interaction with industry brings practicing professionals into the classroom and students out to the jobsites of projects throughout the region. Finally, student participation in regional and national project management competitions gives our students the opportunity to test their knowledge and management skills against teams of students from other universities.

For both first time Freshmen and transfer students from community colleges, the Construction Management faculty and staff are committed to providing the best education possible for the future generation of leaders in the construction profession. These future constructors are educated in modern, state-of-the-art facilities utilizing the technology typical of the companies for whom they will work. They benefit from a unique, interdisciplinary program that has been accredited by the American Council for Construction Education (ACCE) since 1978. The program at Cal Poly remains one of the largest and most respected Construction Management programs in the United States.

## Transfer Students

Transfer students are welcome in the Construction Management program and should contact the department for advising help with efficiently scheduling their graduation requirements. Most lower division courses may be completed at most California Community Colleges. Full time students who have successfully completed these lower division courses prior to transferring into the department can usually anticipate graduating in six or seven quarters. Transfer students should work closely with their assigned advisors before registering for classes every quarter to ensure efficient progress to degree.

## Laptop Requirement

The department has a requirement that all students have a laptop computer. Most Construction Management classes emphasize cooperative projects/assignments, and a laptop computer provides the required mobility to facilitate collaboration. In today's construction environment, computing is an integral component with the computer being the standard tool. A laptop computer is the key to having computing capability available at all times and all locations. Financial aid may be available to help cover the cost of the computer laptop (contact the Financial Aid Office (<http://financialaid.calpoly.edu>) for more information).

## Undergraduate Programs

### BS Construction Management

The Construction Management Department is the only one of its kind housed in a college that includes all of the other planning and design professions that define the built environment: Architecture, Architectural Engineering, Landscape Architecture, and City and Regional Planning.

### Construction Management Minor

The Construction Management Minor provides students with an introduction to the body of knowledge expected of persons pursuing careers in the construction industry. This minor focuses on the materials, means and methods, which encompass the construction process. The Construction Management Minor will give students a competitive edge when applying for certain jobs in the built environment and is recommended for majors in architecture, architectural engineering, business, civil engineering, mechanical engineering, and electrical engineering. Contact the department for more information.

### Minors

The department offers a Construction Management Minor for students in other programs and also participates in offering interdisciplinary minors in Real Property Development. Please see the College of Architecture and Environmental Design (<http://catalog.calpoly.edu/collegesandprograms/collegeofarchitectureandenvironmentaldesign>) for more information.

### CM Courses

#### CM 102. Introduction to Construction Management. 2 units

Term Typically Offered: F, W, SP

Introduction to the fundamental concepts and overview of the essential elements associated with the construction profession, to include: construction trends, ethics, safety and health issues, and professional practice methods. 2 lectures.

#### CM 113. Construction Materials and Assemblies. 2 units

Term Typically Offered: F, W, SP

Recommended: CM 102.

Exploration of the various materials, assemblies, and processes used and applied in the building construction process. Includes presentation, discussion, analysis, study and research of construction materials and assemblies. 2 lectures.

#### CM 114. Construction Materials and Assemblies Lab. 2 units

Term Typically Offered: F, W, SP

Corequisite: CM 113. Recommended: CM 102.

Exploration of the various materials, assemblies, and processes used and applied in the building construction process. Includes presentation, discussion, analysis, study and research of construction materials and assemblies. 2 laboratories.

#### CM 115. Fundamentals of Construction Management. 6 units

Term Typically Offered: F, W, SP

Prerequisite: ARCE 106 or CM 113; MATH 141; and PHYS 141.

Production of drawings and specifications for residential and light commercial construction. Integration of scheduling, estimating, codes, and contracts with a project based approach. Manual drawing techniques and computer aided drafting with building information modeling develop visualization skills for architectural systems. 4 laboratories, 2 activities.

#### CM 212. Construction Management Principles. 3 units

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Introduction to the fundamental concepts of construction management. Primary areas of focus are quantity surveying and basic scheduling techniques. Additional topics of study to include work activity durations and sequencing, and computer applications in scheduling. Course does not satisfy approved technical elective requirement for CM majors. 3 laboratories.

#### CM 214. Residential Construction Management. 5 units

Term Typically Offered: F, W, SP

Prerequisite: CM 115, PHYS 132 or CHEM 124. Corequisite: CM 232.

Materials, methods, and techniques associated with residential and light commercial construction operations. Topics include shallow foundations, timber and masonry framing, roofing, and exterior and interior finishes. Scheduling, estimating, and construction contracts are integrated into a project based approach. 3 laboratories, 2 activities.

#### CM 221. Concrete and Formwork Technology. 3 units

Term Typically Offered: TBD

Prerequisite: ARCH 106.

Modern concepts of concrete and formwork construction. Significant developments in concrete chemistry and strength theory. Formwork systems, concrete mix design, admixtures, batching, finishing, curing and testing. Includes physically building basic forms, finishing and curing concrete, and testing of designed mixes. 2 lectures, 1 laboratory.

#### CM 232. Evaluation of Cost Alternatives. 3 units

Term Typically Offered: F, W, SP

Prerequisite: MATH 142 or MATH 182.

Basic principles of economic evaluations using fundamental concepts of time value of money to compare cost alternatives related to construction, design, and real property development. 3 lectures.

#### CM 239. Construction Surveying. 4 units

Term Typically Offered: SU

Prerequisite: MATH 119 or equivalent.

Theory and practice of plane surveying with an emphasis on construction applications. Topics include property use and care of survey equipment and instruments, distance measurement, leveling, angular measurement, construction layout, basic roadwork, and as-built surveys. 3 lectures, 1 laboratory.

#### CM 270. Selected Topics. 1-4 units

Term Typically Offered: TBD

Prerequisite: Open to undergraduate students and consent of instructor.

Directed group study of selected topics. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 lectures.

**CM 280. Building Information Modeling. 2 units**

Term Typically Offered: F, W, SP  
Prerequisite: CE 113 or CM 115.

Use of building information modeling software to emphasize residential, commercial, and heavy civil assembly methods and techniques. BIM drafting applications integrated with construction materials, details, and assemblies supporting the understanding of the construction building process. 2 activities.

**CM 310. Construction Means and Methods. 4 units**

Term Typically Offered: F, W, SP  
Prerequisite: CM 113.

Construction means, methods, and techniques related to the built environment including residential, commercial, heavy civil and HVACR construction. Focus on the major construction material assemblies and systems with an emphasis on constructability, best practices, and application. Field trips required. 4 lectures.

**CM 313. Commercial Construction Management. 5 units**

Term Typically Offered: F, W, SP  
Prerequisite: CM 214 and ARCE 212.

Materials, methods, and techniques associated with large commercial and institutional construction operations. Topics include building systems analysis of foundations, waterproofing, structural framing, exterior cladding, and finishes. Scheduling, estimating, and construction contracts are integrated into a project based approach. 3 laboratories, 2 activities.

**CM 314. Heavy Civil Construction Management. 5 units**

Term Typically Offered: F, W, SP  
Prerequisite: CM 313. Corequisite: CM 334.

Materials, methods, and techniques associated with civil engineering projects and heavy construction operations. Topics include tunnel, bridge, dam, and road construction; equipment selection; and temporary structures. Scheduling, estimating, and construction contracts are integrated into a project based approach. 3 laboratories, 2 activities.

**CM 317. Sustainability and the Built Environment. 4 units**

GE Area F  
Term Typically Offered: F,W,SP,SU  
Prerequisite: Junior standing and completion of GE Area B.

Interdisciplinary analysis of sustainable strategies and technologies to enhance the built environment. A systems approach to green building science that includes sustainable site development, water use efficiency, renewable energy, improving material use, indoor environmental quality, and design innovation. Course may be offered in classroom-based or online format. 4 lectures. Fulfills GE Area F.

**CM 334. Construction Law. 2 units**

Term Typically Offered: F, W, SP  
Prerequisite: CM 115 and BUS 207.

The intersection of law and the construction industry. Topics of study include a survey of most major legal issues potentially encountered during construction activity. 2 activities.

**CM 335. Construction Accounting. 2 units**

Term Typically Offered: F, W, SP  
Prerequisite: BUS 215 and CM 232.

Fundamentals of construction accounting principles to include income recognition, job cost control, cash flow analysis and associated cost reports. 2 activities.

**CM 371. Construction Management and Project Planning. 4 units**

Term Typically Offered: F, W, SP  
Prerequisite: ARCE 106, CE 259 or CM 113.

Theory and practice of planning, scheduling, estimating, and reporting for construction projects. Fundamentals of scheduling logic including critical path, deterministic, and probabilistic scheduling; including the impact of constraints. Identifying resources and estimating time requirements for design activities and project operations. Not open to Architectural Engineering or Construction Management majors. 3 lectures, 1 activity. Crosslisted as CE/CM 371.

**CM 400. Special Problems for Advanced Undergraduates. 1-2 units**

Term Typically Offered: TBD  
Prerequisite: Consent of instructor.

Individual investigation, research, studies or surveys of selected problems. Total credit limited to 6 units, with a maximum of 4 units per quarter.

**CM 411. Specialty Contracting Construction Management. 5 units**

Term Typically Offered: F, W, SP  
Prerequisite: CM 313.

Materials, methods, and techniques associated with mechanical, electrical, and plumbing systems. Topics include heating, ventilating, air conditioning, power distribution, grounding, lighting, communication, fire detection/protection, and plumbing. Integration of scheduling, estimating, and construction subcontracts with a project based approach. 3 laboratories, 2 activities.

**CM 413. Jobsite Construction Management. 5 units**

Term Typically Offered: F,W,SP,SU  
Prerequisite: CM 313.

Management activities applicable to the construction process involving techniques, applications, and theory needed in a jobsite environment. Addresses the relationships, roles, and perspectives of all stakeholders. Integrated utilization of temporary structures associated with field construction. 3 laboratories, 2 activities.

**CM 415. Integrated Project Delivery. 4 units**

Term Typically Offered: F,W,SP,SU  
Prerequisite: CM 413 and CM 480.

Team based collaborative effort to analyze and evaluate the unique interdisciplinary challenges associated with coordinating and integrating the design and construction processes to deliver a project with respect to the design, budget, schedule, quality, and performance expectations of a client. Not open to students with credit in CM 450. 4 laboratories.

**CM 420. Service / Experiential Learning. 1-6 units**

Term Typically Offered: SP

Prerequisite: Third-year standing.

Service and project-based learning and teaching techniques as applied to a variety of construction management concepts. Goals and objectives achieved through service-learning, project-based, and/or experiential pedagogical approaches. The Schedule of Classes will list topic selected. Total credit limited to 8 units. 1-6 activities.

**CM 421. Emerging Trends. 1-6 units**

Term Typically Offered: F, SP

Prerequisite: Third-year standing.

Emerging trends related to construction management concepts and practices. Goals and objectives achieved through analysis, study, and research of a particular construction emerging trend. The Schedule of Classes will list topic selected. Total credit limited to 8 units. 1-6 activities.

**CM 422. Professional Preparation. 1-6 units**

Term Typically Offered: F, W, SP

Prerequisite: Third-year standing.

Professional practice related to the construction management industry. Goals and objectives achieved through analysis, study, and preparation for a particular professional practice. The Class Schedule will list topic selected. Total credit limited to 8 units. 1 to 6 activities.

**CM 423. Construction Materials / Assemblies. 1-6 units**

Term Typically Offered: W

Prerequisite: Third-year standing.

Various materials and assemblies related to construction process. Goals and objectives achieved through analysis, study, and research of a particular construction material and/or assembly. The Schedule of Classes will list topic selected. Total credit limited to 8 units. 1-6 activities.

**CM 424. Construction Technology. 1-6 units**

Term Typically Offered: SP

Prerequisite: Third-year standing.

Technology related to construction management education and the construction industry. Goals and objectives achieved through analysis, study, and research of a particular construction technology. The Schedule of Classes will list topic selected. Total credit limited to 8 units. 1-6 activities.

**CM 425. Sustainability and Environment. 1-6 units**

Term Typically Offered: W

Prerequisite: Third-year standing.

Sustainable and environmental issues related to the construction industry. Goals and objectives achieved through analysis of a particular construction related sustainable and/or environmental issue. The Schedule of Classes will list topic selected. Total credit limited to 8 units. 1-6 activities.

**CM 426. International Construction Studies. 1-6 units**

Term Typically Offered: SU

Prerequisite: Third-year standing.

Exploration of international construction studies through several potential teaching techniques, including field trips to countries overseas, research and case studies of companies and projects, and management skills and leadership as they relate to international construction. The Schedule of Classes will list topic selected. Total credit limited to 8 units. 1-6 activities.

**CM 432. Design-Build Project Management. 3 units**

Term Typically Offered: TBD

Prerequisite: Minimum junior standing.

Management issues applicable to the design and construction integration method of project delivery. Project sponsor/project advocate techniques, monitoring the evolving design, detecting and controlling change, early warning systems, cost trending, schedule impacts, cost impacts, systems integration, contract/scope modifications, procurement, contingencies, quality, and overall process control. 3 activities.

**CM 433. Integrated Project Delivery. 2 units**

Term Typically Offered: TBD

Prerequisite: CM 214.

Investigation and analysis of special advanced topics in Integrated Project Delivery including Design-Build, CM-at-Risk, Alliance Contracting and other alternative delivery models and application across a wide range of project types. Topics include source selection, acquisitions, contracting, performance criteria, design management, and others. 2 activities.

**CM 443. Management of the Construction Firm. 3 units**

Term Typically Offered: F,W,SP,SU

Prerequisite: CM 334; CM 335; and CM 413.

Applications of strategic management techniques and business strategy for managing and long-range planning of the construction firm. 3 activities.

**CM 450. Integrated Project, Design and Program Management. 5 units**

Term Typically Offered: F,W,SP,SU

Prerequisite: CM 313 and CM 334.

Evaluation of roles and relationships of owner, designer, and construction professionals over project life cycles. Modeling, conceptual estimating, lean scheduling, contract selection, integrated delivery, design management, program management, and influential leadership strategies and techniques. Not open to students with credit in CM 415. 3 laboratories, 2 activities.

**CM 460. Senior Project Methodology. 2 units**

Term Typically Offered: F, W, SP

Prerequisite: CM 313; junior standing; Construction Management majors only.

Introduction to senior project processes, timelines, requirements, and best practices including topic selection, literature review, methodology, and paper formatting. 2 lectures.

**CM 461. Senior Project I. 1 unit**

Term Typically Offered: F, W, SP

Prerequisite: CM 460 and consent of project advisor. See department for additional guidelines and requirements.

Selection and completion of a comprehensive project under faculty supervision. Problems to involve the student's technical and creative skills. Student proposal must be submitted and approved by project advisor prior to registration for course. Construction and team projects encouraged.

**CM 462. Senior Project II. 1 unit**

Term Typically Offered: F, W, SP

Prerequisite: CM 460 and consent of project advisor. See department for additional guidelines and requirements.

Selection and completion of a comprehensive project under faculty supervision. Problems to involve the student's technical and creative skills. Student proposal must be submitted and approved by project advisor prior to registration for course. Construction and team projects encouraged.

**CM 463. Senior Project: Professional Practice for Constructors. 3 units**

Term Typically Offered: TBD

Prerequisite: CM 413. Corequisite: CM 443.

Practical application of construction management theory and practice solving problems related to the built environment. 3 laboratories.

**CM 470. Selected Advanced Topics. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 8 units. 1 to 4 lectures.

**CM 471. Selected Advanced Laboratory. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 8 units. 1-4 laboratories.

**CM 475. Real Property Development Principles. 4 units**

Term Typically Offered: SP

Prerequisite: Minimum junior standing.

Development process and its major actors: investors, developers, government agencies, environmental and local stakeholders; their development roles, objectives, approaches. Basics of urban markets and economics, financing, regulation, public planning; value added, contractual, environmental and community context factors. 4 lectures.

**CM 480. Preconstruction Integration and Planning. 2 units**

Term Typically Offered: F, W, SP

Prerequisite: CM 313.

Examination of the role of preconstruction services, team integration, and joint design planning in several Integrated Project Delivery (IPD) approaches. Various tools and techniques associated with preconstruction services and design planning from the proposal stage through the design stages of a project. 2 activities.

**CM 485. Cooperative Education Experience. 1-6 units**

CR/NC

Term Typically Offered: F, W, SP

Prerequisite: Consent of instructor.

Full-time work experience in an area directly related to the construction industry for 3 months. Positions are paid and usually require relocation and registration in course for one quarter. Registration in course is required at start of work experience. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. May be repeated for credit. Major credit limited to 6 units; total credit limited to 12 units. See department for additional requirements.

**CM 495. Cooperative Education Experience. 12 units**

CR/NC

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Full-time work experience in an area directly related to the construction industry for 6 months. Positions are paid and usually require relocation for two consecutive quarters. Registration in course is required at start of work experience. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. May be repeated for credit. Major credit limited to 6 units; total credit limited to 24 units. See department for additional requirements.

**CM 510. Principles of Integrated Facility Management. 4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Examination of the facility management profession and all functions associated with it, including strategic planning, financial planning, budgeting, project management, operations and maintenance, sustainability, and emergency preparedness, and how those functions interface with the overall goals of the business enterprise. Course offered online only. 4 lectures.

**CM 511. Facility Risk Analysis and Project Management. 4 units**

Term Typically Offered: TBD

Prerequisite: CM 510 or IFMA's CFM certification.

Examination of the full range of financial risks and management strategies associated with facilities including asset management, real estate options, budget development, analysis and cost control, project management, contracting methods for design and construction, and procurement approaches. 4 lectures.

**CM 512. Facility Maintenance and Operation Strategies. 4 units**

Term Typically Offered: TBD

Prerequisite: CM 510 or IFMA's CFM certification.

Examination of the various strategies associated with the oversight and management of operations and maintenance of the internal and external systems, equipment, and building functions associated with the physical plant of real estate assets. 4 lectures.

**CM 513. Facility Systems Assessment and Integration. 4 units**

Term Typically Offered: TBD

Prerequisite: CM 510 or IFMA's CFM certification.

Examination of how facility conditions assessments and the integration of systems through computerized, intelligent networks of electronic devices designed to monitor and control the mechanical electronics, lighting systems, access, and security systems enhance building performance and ease of operation over its life-cycle. 4 lectures.

**CM 514. Sustainable Facility Management. 4 units**

Term Typically Offered: TBD

Prerequisite: CM 510 or IFMA's CFM certification.

Examination of the basics of environmental sustainability as applied to new or existing facilities and the identification of skills, tools, and techniques necessary to make effective and sustainable facility management and operations decisions that align with the organization's sustainability goals and objectives. 4 lectures.

**CM 515. Environmental Health and Safety Management for Facilities. 4 units**

Term Typically Offered: TBD

Prerequisite: CM 510 or IFMA's CFM certification.

Examination of major safety and environmental regulations, regulatory implications, and how best to minimize associated risk. Examination of emergency preparedness at both a macro and micro level, from planning for an emergency through recovering from disasters. 4 lectures.

**CM 521. Construction Cost Estimating and Work Procurement. 4 units**

Term Typically Offered: TBD

Prerequisite: Consent of program coordinator.

Examination of the construction discipline of cost estimating and pre-construction activities, emphasizing both the core and higher functions associated with types of estimates, measuring and pricing, bidding procedures and strategies, procurement, pre-construction services, budget, and cost control analysis. 4 lectures.

**CM 522. Construction Planning, Scheduling, and Impact Analysis. 4 units**

Term Typically Offered: TBD

Prerequisite: Consent of program coordinator.

Examination of the construction discipline of planning, scheduling, management, and control relating to both core and higher functions associated with network diagram analysis, CPM scheduling, project diagnostics, short interval, resource loaded, pull scheduling, forecasting, and earned value management techniques. 4 lectures.

**CM 523. Construction Contracts and Law. 4 units**

Term Typically Offered: TBD

Prerequisite: Consent of program coordinator.

Examination of the discipline of law and contracts as they relate to the construction industry, including both the core and higher functions associated with the construction process, business organization, employment responsibilities, liability, damages, claims, dispute resolution, and risk management. 4 lectures.

**CM 524. Construction Project Management and Control. 4 units**

Term Typically Offered: TBD

Prerequisite: Consent of program coordinator.

Examination of the discipline of construction project management and control relating to both the core and higher functions associated with the construction process, pre-construction services, and management in the areas of safety, quality, resource, risk, schedule, budget, changes, and value. 4 lectures.

**CM 525. Construction Workforce, Productivity, and Safety. 4 units**

Term Typically Offered: TBD

Prerequisite: Consent of program coordinator.

Examination of the disciplines of workforce productivity and safety as they relate to the construction industry, including both the core and higher functions associated with field personnel management, construction operations, lean construction techniques, equipment utilization, productivity, and OSHA regulations. 4 lectures.

**CM 570. Selected Advanced Topics in Construction Management. 4 units**

Term Typically Offered: TBD

Prerequisite: Graduate standing or consent of instructor.

Directed study of selected topics in Construction Management. Class Schedule will list topic selected. Total credit limited to 12 units. 4 seminars.

**CM 571. Selected Advanced Laboratory. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Graduate standing or consent of instructor.

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1-4 laboratories.