BRAE 464  Professional Practice (3)
Contracts, specifications, and legal aspects of agricultural engineering. Safety and human factors. Engineering ethics and professional registration. 3 lectures. Prerequisite: Senior standing.

BRAE 470  Selected Advanced Topics (1–4)
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. 1–4 lectures. Prerequisite: Consent of instructor.

BRAE 471  Selected Advanced Laboratory (1–4)
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. Prerequisite: Consent of instructor.

BRAE 481  Advanced Agricultural Mechanics (2)
Advanced shop skills. Carpentry, electricity, plumbing, surveying, power mechanics, tractor equipment operation and maintenance. 2 lectures, 2 laboratories weekly for five weeks per session–two sessions per quarter. Prerequisite: Agricultural teacher candidates starting/returning from student teaching, senior or graduate standing or consent of instructor.

BRAE 485  Cooperative Education Experience in BioResource and Agricultural Engineering (6) (CR/NC)
Part-time work experience with an approved BioResource and Agricultural Engineering firm engaged in production or related business, industry or governmental agency. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Degree credit limited to 6 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

BRAE 492  Pumps and Pump Drivers (3)
Pump characteristics and system head. Net positive suction head. Series and parallel operation. Pump contracts and protection. Selection of pumping systems for different water sources. Design of pump intakes for surface water supplies. Driver selection. Servicing motors and engines. Hand pumps and wind mills. 2 lectures, 1 laboratory. Prerequisite: Senior standing.

BRAE 495  Cooperative Education Experience in BioResource and Agricultural Engineering (12) (CR/NC)
Full time work experience with an approved BioResource and Agricultural Engineering firm engaged in production or related business, industry or governmental agency. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Degree credit limited to 6 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

BRAE 500  Individual Study (1–3)
Advanced study planned and completed under the direction of a member of the department faculty. Open only to graduate students who have demonstrated ability to do independent work. Enrollment by petition. Prerequisite: Consent of instructor.

BRAE 521  Systems Analysis of Agricultural Systems (4)
Principles and methods of creative problem solving and systems analysis as applied to the design of agricultural systems. Problem solving using the engineering design process to analyze the need, establish boundaries, and generate creative alternative solutions. Examples worked through in feasibility analysis, transportation and network problems, linear programming, project planning, human factors and ergonomics, and system analysis with an emphasis on optimum system operation. 3 lectures, 1 laboratory. Prerequisite: Consent of instructor.

BRAE 522  Instrumentation Control/Microprocessors (4)
Engineering input/output instrumentation for sensing and controlling functions through data acquisition, analysis and response to agricultural processing. Miscellaneous course fee required–see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: BASIC language programming or consent of instructor.

BRAE 529  Small Farm Mechanization (3)
Principles of farm machinery used for tillage, seeding, weeding, harvesting and transport of agricultural crops. Small-scale equipment, suitable for subsistence farming in developing countries. Small tractors, hand tools, animal power, and fuel from renewable sources. Miscellaneous course fee required–see Class Schedule. 2 lectures, 1 laboratory. Prerequisite: BRAE 143 or equivalent, graduate standing, or consent of instructor.

BRAE 531  Water Wells (3)
Groundwater resources drilling methods and development of wells. Water well design for pollution prevention. Well rehabilitation. Destruction of abandoned wells. Design of domestic water systems. Water quality standards and water conditioning for different applications. 2 lectures, 1 laboratory. Prerequisite: Graduate standing.

BRAE 533  Irrigation Project Design (4)
Engineering solutions and social aspects of improved water delivery to farms and canal automation. Flow measurement. Water user associations. Unsteady canal and pipeline controls. PID controls and modeling. Miscellaneous course fee required–see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: BRAE 340, hydraulics/fluid mechanics.

BRAE 570  Selected Topics in BioResource and Agricultural Engineering (1–4)
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 12 units. 1 to 4 seminars. Prerequisite: Graduate standing or consent of instructor.

BRAE 581  Cooperative Education Experience in BioResource and Agricultural Engineering (1–4)
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. 1–4 laboratories. Prerequisite: Consent of instructor.

BRAE 587  Graduate Seminar in BioResource and Agricultural Engineering (3)
Group study of current problems of the bioresource and agricultural engineering industry; current experimental and research findings as applied to field of bioresource and agricultural engineering. Class Schedule will list topic selected. Total credit limited to 9 units. 3 seminars. Prerequisite: Graduate standing or consent of instructor.

BRAE 599  Thesis in BioResource and Agricultural Engineering (1–9)
Systematic research of a significant problem in bioresource and agricultural engineering. Thesis will include problem identification, significance, methods, data analysis, and conclusion. Students must enroll every quarter in which facilities are used or advisement is received. Degree credit limited to 6 units. Prerequisite: Graduate standing and consent of instructor.

BUS–BUSINESS

BUS 100  Study Skills Adjunct (2) (CR/NC)
Offered concurrently with BUS 101 to assist students in developing and improving their study skills, textbook comprehension, critical analysis, application and retention of the subject matter presented in the specific content course. Credit/No Credit grading only. 1 lecture, 1 activity.
BUS 101 The Business Enterprise (4)
Orientation to the business administration program. Examination of the business enterprise, stressing its historical, environmental, and economic setting. Business organization and functions. 4 lectures.

BUS 178 Introduction to Human Relations in Business (3)
Small group dynamics, leadership, communication, motivation, and perception. The individual in the business organization. For non-Business majors. 3 lectures.

BUS 200 Special Problems for Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of area coordinator.

BUS 201 Business Law Survey (3)
Overview of business law for other than business majors. Similar in scope to BUS 207, but in less detail. Not acceptable for credit toward Business Administration degree. 3 lectures.

BUS 207 Business Law (4)
American legal system, contracts, agency, business organizations, and real property. Case studies. 4 lectures. Prerequisite: Sophomore standing.

BUS 212 Financial Accounting for Nonbusiness Majors (4)
Introduction to financial accounting theory and practice with an emphasis on financial statement preparation and analysis. Not open to Business majors. 4 lectures.

BUS 214 Financial Accounting (5)
Principles of financial accounting for Business majors. The course prepares students to read and interpret financial statement information. Financial reporting standards are explored to give students an understanding of how financial transactions and events are reflected in financial statements. 5 lectures. Prerequisite: Sophomore standing.

BUS 215 Managerial Accounting (4)
Applications of accounting for management decision-making, planning and control including cost behavior, budget preparation, performance reporting, motivational and behavioral considerations, and ethics. 4 lectures. Prerequisite: Demonstrated competency in electronic spreadsheet, word processing, and presentation applications. BUS 212 or BUS 214 or equivalent.

BUS 245 Elements of Marketing (4)
Overview of the marketing institutions and function of marketing in the economic, socio-cultural and political-legal environments. Not acceptable for credit toward Business Administration degree. 4 lectures. Prerequisite: ECON 201 or ECON 221 or equivalent, or consent of instructor.

BUS 271 Principles of Management (3)
Management process involving organization, decision-making, and managerial activities fundamental to all management levels and functional areas. Application to business firms, governmental agencies, hospitals, benevolent groups, and colleges. For non-Business majors. 3 lectures.

BUS 276 Principles of Purchasing (3)
Purchasing function applied to manufacturing, retailing, and food-service institutions. Its interdependence with other functional areas of the organization. For non-Business majors. 3 lectures.

BUS 302 International and Cross Cultural Management (4)
Dimensions of culture and its variations within and across nations. Impact of culture on managing in a global context. Development of managerial competencies requisite to working in and supervising multicultural groups in international corporations. Frameworks for analyzing cultural and contextual influences on organizational behavior, culture shock and readjustment, expatriation and reparation, cultural change and innovation, intercultural conflict, and ethical dilemmas. Case studies, behavioral simulations, self-assessments and fieldwork. 4 lectures. Prerequisite: Junior standing and BUS 387 or consent of instructor.

BUS 303 Introduction to International Business (4)
Special terms, concepts, and institutions associated with the environment in which international companies operate. Students will be enabled to understand, analyze and offer solutions to global business problems. 4 lectures. Prerequisite: Junior standing.

BUS 308 Business Law II (4)
Legal aspects of management decisions, including problems arising in sales, commercial paper, personal property and bailments, secured transactions, bankruptcy, and securities regulation, with emphasis on the uniform commercial code. Case studies. 4 lectures. Prerequisite: BUS 207 or equivalent and junior standing.

BUS 311 Managing Technology in the International Legal Environment (4)
Analysis of U.S. and international laws concerning technological innovations from economic, social and political perspectives. Copyrights, patents, trademarks, trade secrets, contracts, products liability and privacy. The Internet, computer programs and biotechnology. 4 lectures. Prerequisite: Completion of GE Areas A, D1 and D2.

BUS 320 Taxation of Business Entities (4)
Federal income taxation of the various forms of business entities. Introduction to broad range of tax concepts and types of taxpayers. Role of taxation in the business decision-making process. 4 lectures. Prerequisite: BUS 212 or BUS 214 or consent of instructor.

BUS 321, 322, 323 Intermediate Accounting I, II, III (4) (4) (4)
Comprehensive coverage of financial reporting. 321 covers financial statements, assets, and current liabilities. 322 covers long-term debt, equities, accounting changes, cash flows and consolidations. 323 covers accounting for inflation, leases, interim and segment reporting, measurement problems, and financial disclosures. 4 lectures. Prerequisite: 321: BUS 214 and junior standing; 322: BUS 321 with minimum grade of C-; 323: BUS 322 with minimum grade of C.

BUS 342 Fundamentals of Corporate Finance (4)
Theory and applications of financing business operations. Financial management of current and fixed assets from internal and external sources. Analysis, planning, control, and problem solving. 4 lectures. Prerequisite: A grade of C- or better in all of the following: ECON 222, MATH 221, STAT 252, BUS 215. Junior standing required.

BUS 343 Quantitative Methods in Finance (4)
Basic mathematical foundations for 400-level courses in finance: mathematical finance -- dealing with elementary materials (time value of money, single multiple period portfolio choice, and application of arbitrage), and risk management -- dealing with value-at-risk, stressing current industry practices. 4 lectures. Prerequisite: STAT 252.

BUS 344 Advanced Corporate Finance (4)
Corporate finance with an emphasis on managing the corporation to create shareholder value. Detailed treatment of topics such as capital budgeting, corporate finance, economic value-added, corporate distribution policy, financial distress, and mergers and acquisitions. 4 lectures. Prerequisite: BUS 321, BUS 342, BUS 343.

BUS 346 Principles of Marketing (4)
Basic course in marketing that examines marketing's role in society and management of the product, promotion, pricing and channel strategies of the firm. Includes discussion of ethical issues in marketing. 4 lectures. Prerequisite: A grade of C- or better in all of the following: ECON 222, STAT 252, BUS 207, junior standing, or equivalent.

BUS 347 Marketing Information and Analysis (4)
Market planning and information systems. Survey and experimental design, secondary and primary data collection, measurement and
scaling. Questionnaire design, attitude theory and measurement, statistical
sampling theory and sampling design. Elementary data analysis, report
writing. Miscellaneous course fee required—see Class Schedule. 3
lectures, 1 activity. Prerequisite: STAT 252 or equivalent and BUS 346.

BUS 348 Buyer Behavior (4)
Applied study of individual and group psychological and behavioral
group processes that affect marketing decisions in both consumer and
business markets. 4 lectures. Prerequisite: BUS 346.

BUS 349 Selling: Building Partnerships (4)
Basic skills and tools for successfully planning and conducting sales calls,
building long-term buyer/seller relationships and territory, time and career
management. Emphasis on sales role plays. 4 lectures. Prerequisite: Junior
standing.

BUS 360, 361 Undergraduate Integrated Core Curriculum I, II (12)
(12)
The foundation knowledge and skills required of all business
cent rations. Integration of accounting, finance, marketing, operations
management, government and social influences. Organizational behavior
and international topics in one two-quarter curriculum, based on the
approved business core. 10 lectures, 2 activities per course. Prerequisite:
BUS 207, BUS 214, BUS 215, BUS 391, ECON 221, ECON 222, MATH
221, STAT 251, STAT 252.

BUS 371 Production and Operations Management (4)
Introduction to operations management and production systems;
production models. Planning and control in manufacturing. Quantitative
methods and statistical techniques used in production systems
management. Miscellaneous course fee may be required—see Class
Schedule. 3 lectures, 1 activity. Prerequisite: A grade of C- or better in all
of the following: MATH 141 or MATH 221, and STAT 211 or STAT
252, and junior standing.

BUS 381 Industrial Management (4)
Organization and functioning of management in industry. Planning,
direction, and control of the business enterprise in terms of policy
formation, organizational structure, finance, sales, procurement, plant
location, facilities and production processes. 4 lectures. Prerequisite:
Junior standing.

BUS 382 Organization and Management Theory (4)
Examination of macro dimensions of organizations including
environment, mission, goals, structure, technology, and internal
management systems and processes. Case analysis, simulation.
Application to business firms, government, voluntary organizations. 4
lectures. Prerequisite: Junior standing.

BUS 383 Industrial Relations (3)
Functions of personnel and labor relations as they relate to the
management of the human resources in the organization. Industrial
relations theory and practice. For non-Business majors only. 3 lectures.
Prerequisite: Junior standing.

BUS 384 Human Resources Management (4)
Personnel function as it relates to the management of the human resources
of the organization. Survey of employee/employer relations, the work
environment, employee development and labor relations. 4 lectures.
Prerequisite: Junior standing.

BUS 387 Organizational Behavior (4)
Application of behavioral science concepts to management. Motivation,
perception, communications, leadership style, group dynamics.
Effectiveness: individual, interpersonal, team, intergroup and
organizational. 3 lectures, 1 activity. Prerequisite: Junior standing.
Recommended: A grade of C- or better in STAT 252.

BUS 390 Data Structures for Business Systems (4)
Algorithmic processes related to business practices. Analysis techniques
for managing data structures such as lists, stacks, queues and trees.
Algorithms to perform common programming tasks such as sorting,
searching and hashing. 3 lectures, 1 activity. Prerequisite: CSC 102.

BUS 391 Management Information Systems (4)
Applications of computers in business and industry. Management
information systems and integrated systems concepts. Data organizations,
file processing, spreadsheets, database management, functional
information systems, data communications and networks, database
organization, presentation systems, and web development. System
development process and information resource management. Decision
support systems and the relationship of the computer to the management
decision process. Miscellaneous course fee may be required—see Class
Schedule. 3 lectures, 1 activity. Prerequisite: CSC 110 and junior
standing.

BUS 392 Functional Information Systems (4)
Organizational support systems, including decision support systems, data
warehouses, online analytical processing, data mining and project
management. Overview of functional information systems. Various
arrangements of course are designed for functional areas (e.g. accounting,
marketing, and finance). 3 lectures, 1 activity. Prerequisite: A grade of C-
or better in BUS 391 and junior standing.

BUS 393 Advanced Management Information Systems I (5)
Combines data base systems, data analysis and modeling of business
applications. Relational, post-relational and object-oriented
Diagramming techniques – entity-relationship and data flow diagrams and
case tools. Information systems architecture, data, process, network and
object modeling. Web-based database systems. 4 lectures, 1 activity.
Prerequisite: BUS 391, CSC 101, CSC 102, CSC 103 or BUS 390, and
junior standing.

BUS 394 Advanced Management Information Systems II (5)
Interfaces system analysis to the system design construction,
implementation and evaluation. User interface design including
input, output and web-based platforms. Prototyping and Rapid
Application Development (RAD). Software design, quality and testing.
Transitions from process design to process simulation and improvement.
Cost estimation techniques. 4 lectures, 1 activity. Prerequisite: BUS 393
and junior standing.

BUS 400 Special Problems for Advanced Undergraduates (1–4)
Individual investigation, research, studies, or surveys of selected
problems. Total credit limited to 4 units. Prerequisite: Senior standing or
censor of instructor.

BUS 401 Seminar in General Management and Strategy (4)
Application of interdisciplinary skills to business and corporate strategy
formulation and implementation. Analysis of interdependence between
external environments and internal systems. Focus on responsibilities,
tasks, and skills of general managers. Case studies, group problem
solving. Integrating course of Business core curriculum. 4 seminars.
Prerequisite: A grade of C- or better in all 300-level Business core
courses, BUS 391, and senior standing.

BUS 402 International Business Management (4)
Managerial concepts and techniques for analysis and decision making
within international businesses. Environmental and organizational factors
influencing multinational operations. Assessing international market
opportunities and entry modes. Complexities of multinational
management strategy, structure and systems, especially during initial
stages of internationalization. Case studies and simulations. 4 lectures.
Prerequisite: BUS 342, BUS 346, BUS 387 or consent of instructor.

BUS 403 Advanced Seminar in International Management (4)
Integration of management concepts within complex multinational
organizations. Interdisciplinary approach to identifying and assessing
multinational and global competitive environments and strategies;
structuring and managing interdependent multinational operations;
addressing conflicts between domestic and international policies and
practices in multinational enterprises. Case studies, simulations, group
analysis and problem solving. 4 seminars. Prerequisite: BUS 302 and BUS 402 or consent of instructor.

BUS 404 Governmental and Social Influences on Business (4)
Analysis from legal, economic, political, and ethical perspectives, of the changing domestic and international environments of the business enterprise. Topics include administrative law and regulatory policy, antitrust law, public policy analysis, and the interaction of business and government. Case studies. 4 lectures. Prerequisite: Senior standing.

BUS 405 Joint Ventures and Alliances (4)
Examination of joint ventures and alliances between organizations, using cross-cultural, interdisciplinary perspective. Alliance motives, types and traits. Processes for partner selection, negotiation, structure, operation, and performance assessment of international and cross-cultural alliances. Lectures, case studies, and simulation. 4 lectures. Prerequisite: Senior standing and completion of all 300-level business core courses, or consent of instructor.

BUS 406 Managing Mergers, Acquisitions and Divestitures (4)
Issues associated with analyzing, negotiating, and managing mergers, acquisitions and divestitures (MADS) using cross-cultural, interdisciplinary perspective. Rationale for decision to pursue MADS and processes for identifying targets; valuing and negotiating MADS; staffing and human resource management issues; strategic control and integration; and cross-cultural conflict and divided loyalties in domestic and international MADS. Lectures, case studies and simulation. 4 lectures. Prerequisite: Senior standing and completion of all 300-level Business core courses, or equivalent.

BUS 407 Managing People in Global Markets (4)
Impact of cultural and strategic differences on management of people in multinational organizations. Critical human resource issues in domestic and international operations. 4 lectures. Prerequisite: Senior standing and completion of all 300-level Business core courses, and BUS 384; or equivalent.

BUS 409 Law of Real Property (4)
Legal problems of acquisition, ownership and transfer of real property. Contracts, agency, estates, and co-ownership, mortgages and deeds, covenants, conditions, and restrictions, easements, landlord-tenant, and zoning. 4 lectures. Prerequisite: Senior standing.

BUS 410 The Legal Environment of International Business (4)
U.S., foreign, and international law affecting international business transactions. U.S. and foreign cultural, ethical, and political norms and legal institutions, and their effect on law and business. 4 lectures. Prerequisite: Senior standing, a course in American business law, one Political Science course, or consent of instructor.

BUS 412 Advanced Managerial Accounting (4)
Product costing systems including hybrid costing systems, management control systems, cost allocation, activity based costing, cost information for decision making, new manufacturing environment, backflush costing and strategic control systems. International dimension integrated in the course content. 4 lectures. Prerequisite: BUS 215.

BUS 414 Taxation of Partnerships, Estates and Trusts and Complex Capital Transactions (4)
Federal income taxation of sales and exchanges, Subchapter S corporations, partnerships, estates and trusts. Federal gift and estate taxes. 4 lectures. Prerequisite: BUS 320 or equivalent.

BUS 415 Corporate Tax Accounting and Tax Administration (4)
Federal income taxation of regular corporations, tax research, tax administration, and IRS practice. 4 lectures. Prerequisite: BUS 320 or equivalent.

BUS 416 Volunteer Income Tax Assistance (4)
Coverage of the deductions and credits applicable to individuals. Training and practice in the preparation of state and federal income tax returns. Under supervision of qualified professionals, tax preparation sites are operated to provide free tax assistance to community residents. 2 lectures, 2 activities. Prerequisite: BUS 320 or equivalent.

BUS 422 Government and Not-For-Profit Entities (4)
Accounting and reporting by state and local governments and not-for-profit entities. State and local governmental topics include: fund structures, budgetary accounting, the modified accrual basis of accounting, reporting entity issues. Not-for-profit topics include: financial and reporting concepts and practices, contributions, restricted resources, endowments. 4 lectures. Prerequisite: BUS 321.

BUS 423 Financial Reporting by Public Companies (2)
A study of the Securities and Exchange Commission and its reporting requirements. Emphasis is placed on the Commission's regulation of accounting, reporting, internal controls, and auditing. Impact on accountants' legal liability is also examined. 2 lectures. Prerequisite: Consent of instructor.

BUS 424 Professional Accounting (4)
Development of the accounting profession. Past, present and future. Emphasis on contemporary issues confronting the professional accountant and his/her social and ethical responsibilities and opportunities. 4 lectures. Prerequisite: Consent of instructor.

BUS 425 Auditing (4)
Survey of the auditing environment including institutional, ethical, and legal liability dimensions. Introduction to audit planning, assessing materiality and audit risk, collecting and evaluating audit evidence, considering the internal control structure, substantive testing, and reporting. 4 lectures. Prerequisite: Consent of instructor. Recommended: BUS 391.

BUS 426 Advanced Auditing (4)
Advanced coverage of selected topics including assessing materiality and audit risk, applying nonstatistical and statistical sampling, auditing computerized accounting systems, performing other attestation and accounting services, and researching auditing problems. 3 lectures, 1 activity. Prerequisite: BUS 425. Recommended: BUS 391.

BUS 427 International Accounting (4)
Consideration of conceptual, managerial, professional and institutional issues of international accounting. 4 lectures. Prerequisite: BUS 321 or equivalent.

BUS 428 Accounting Policy (4)
Role of management in establishing and directing accounting policy. Coverage includes impact of management decisions on external reporting and taxes and the impact of financial reporting requirements on management decisions. 4 seminars. Prerequisite: BUS 322.

BUS 429 Enterprise Wide Business Processes (4)
Role of information systems underlying business processes, identification of relevant information, understanding the flow of information in a business entity, analysis of transactions, preparation of accounting records and reports. 3 lectures, 1 activity. Prerequisite: BUS 392 with a minimum grade of C– and BUS 321 with a minimum grade of C–.

BUS 430 Cooperative Education/Internship (2–12) (CR/NC)
Work experience in business, industry, government and other areas of student career interest. Periodic written progress reports, final report, and evaluation by work supervisor required. Credit/No Credit grading. Total credit limited to 16 units. Prerequisite: Approval of area chair, sophomore standing, and a CPSLO cumulative GPA of at least 2.5 without being on academic probation.

BUS 431 Security Analysis and Portfolio Management (4)
Analysis of securities, markets, and valuation. Security price movements related to money and capital market factors and corporate events. Portfolio planning, risk, media, and objectives of individual and institutional investors. 4 lectures. Prerequisite: BUS 342 and BUS 343.
BUS 433 International Business Finance (4)
Financial management of international business. International capital and money markets, international financial institutions, special problems in evaluating direct foreign investment, and financial techniques used in international business operations. 4 lectures. Prerequisite: BUS 342.

BUS 434 Real Estate Finance (4)
Analysis of the relationship between national and local money markets. Real estate financing techniques, sources of funds, government participation, legal instruments of finance. 4 lectures. Prerequisite: BUS 342.

BUS 435 Real Estate Investment (4)
effects of federal, state and local taxes on investment transactions. Intensive investigation and computer analysis of urban investment opportunities. Problems in exchanging real estate and property management. 4 lectures. Prerequisite: BUS 342. Recommended: BUS 434.

BUS 440 Commercial Bank Management (4)
Analysis of the management of a commercial bank as a profit-making entity. Emphasis put on cases in bank management, especially those which deal with the management of a bank's asset and liability structure. 4 lectures. Prerequisite: Senior standing, BUS 342, and ECON 337.

BUS 441 Computer Applications in Finance (4)
A combination lecture/computer lab course focusing on computer acquisition of financial data and the subsequent application of financial theory and analysis to this data so as to facilitate financial decision making. 3 lectures, 1 activity. Prerequisite: BUS 342 and BUS 391.

BUS 442 Advanced Seminar in Investment (4)
Current topics in investments. An in-depth analysis of derivatives, the efficient markets hypothesis and capital market theory. 4 seminars. Prerequisite: BUS 343 and BUS 431.

BUS 443 Case Studies in Finance (4)
Development of analytical and decision-making techniques in applying financial theory to business management problems. Emphasizes working capital management, financial analysis and forecasting, mergers and acquisitions, and other current topics in finance, including financial ethics. Cases are used to emphasize practical problems. 4 lectures. Prerequisite: BUS 321, BUS 342, BUS 343, and BUS 431.

BUS 444 Financial Engineering and Risk Management (4)
Advanced course synthesizing concepts from corporate finance, derivative securities, statistics, and computer science. Emphasis on both computer programming in a matrix programming language (Matlab) to solve practical risk management and valuation problems, and analytical training in the area of stochastic calculus, and its application to derivative security pricing. Practical applications of derivatives for controlling risk in an international corporate environment. 4 lectures. Prerequisite: BUS 343, BUS 422 or BUS 433, CSC 234 or equivalent.

BUS 446 International Marketing (4)
Basic skills and tools needed to evaluate the cultural factors that impact the acceptance of products and services in markets around the world. Understanding consumers and marketing in various countries. 4 lectures. Prerequisite: BUS 346 and senior standing.

BUS 447 Advanced Techniques in Marketing Research (4)
Emphasizes customer data analysis and data mining. Includes current marketing research techniques. Regression, conjoint, and multidimensional scaling analysis. Miscellaneous course fee required—see Class Schedule. 3 lectures, 1 activity. Prerequisite: BUS 347 and senior standing.

BUS 448 Services Marketing (4)
Examines service organizations such as banks, hotels, hospitals and professional service organizations, and the distinctive approach required for marketing strategy which is unique to service companies. 4 lectures. Prerequisite: BUS 346 and senior standing.

BUS 449 Sales Management (4)
Management of the field sales force, including staffing, training, directing, evaluating and control of sales personnel. 4 lectures. Prerequisite: BUS 346, BUS 349, and senior standing.

BUS 450 Promotion Strategies (4)
Designing the promotion strategies of the firm, including advertising, personal selling, sales promotion, publicity and public relations. Communications media available; their uses and limitations. 4 lectures. Prerequisite: BUS 346, BUS 348 or equivalent.

BUS 452 Product Management (4)
New product development process, building and maintaining brands, and managing life cycles for goods and services. 4 lectures. Prerequisite: BUS 346 and senior standing.

BUS 454 Developing and Presenting Marketing Plans (4)
Developing and presenting professional marketing plans. Focus on activities most relevant to junior-level managers: analysis of information pertaining to a product/service’s environment, customers and competitors. 4 lectures. Prerequisite: BUS 346, BUS 347, BUS 348 and senior standing.

BUS 455 Marketing Management (4)
Integration of key marketing concepts using tools such as computer simulations, readings, and/or case studies. Participants develop and implement strategic and tactical decisions for companies and brands. Miscellaneous course fee required—see Class Schedule. 4 lectures. Prerequisite: BUS 347, BUS 348, and senior standing.

BUS 456 Industrial Customer Interfacing (4)
Focus on managing aspects of the customer interface for strategic advantage. Emphasis on building and maintaining customer data bases. Establishing and maintaining customer service centers. Providing technical support services. Conference and trade show planning and development. 4 lectures. Prerequisite: BUS 346 or consent of instructor.

BUS 457 Business Marketing (4)
Industrial markets and product classifications as they relate to industrial markets. Chain of derived demand. Industrial buying, buyer/seller relationships, and purchasing. Market information sources. Segmentation, competition/cooperation, and technology. Distribution and logistics management. Industry communication and strategic planning as related to industrial markets. 4 lectures. Prerequisite: BUS 346 or consent of instructor.

BUS 458 Internet Marketing (4)
The companies and people leading innovation and establishing best practice on the Internet. Marketing tactics and capabilities enabled by the Internet. How to create a presence on the Net and build a profitable e-business strategy. 4 lectures. Prerequisite: BUS 346 or equivalent.

BUS 461, 462 Senior Project (2) (2)
Selection and analysis of a problem under faculty supervision. Problems typical of those which graduates must solve in their fields of employment. Formal report is required. Minimum 120 hours total time.

BUS 463 Applied Accounting and Auditing Research (4)
Practice with multiple authoritative accounting and auditing databases, actual published financial reports, and business writing. Real world accounting and auditing issues, including revenue recognition and ethics issues. Federal and state regulation of securities transactions. Prerequisite: BUS 322 and Graduation Writing Requirement.

BUS 470 Selected Advanced Topics (1–4)
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. 1–4 lectures. Prerequisite: Consent of instructor.
BUS 471 Compensation (4)
Design and management of compensation systems. Job analysis, job evaluation, wage and salary surveys, incentive systems, gainsharing, benefit administration, pay equity and legal regulation. Simulation and case study development of a wage structure, pay level and individual raise policies, administrative controls, salary and program budgets. 4 lectures. Prerequisite: BUS 384 and STAT 252, or equivalent.

BUS 472 Labor Relations (4)
Union organizing. Negotiation and administration of collective agreements. Simulation of bargaining, grievance, and arbitration processes. 4 lectures. Prerequisite: BUS 384 or equivalent.

BUS 473 Employment Law (4)
Federal and state labor policy as expressed in common law, relevant statutes, and executive orders. Effects upon employees, management, protected groups, and the public. Current rules analyzed in a contemporary and historical context. Understanding important workplace and employment problems. 4 lectures. Prerequisite: BUS 207, BUS 384 or equivalent.

BUS 474 Staffing (4)
Processes by which individuals and organizations become matched to form the employment relationship. Specific issues related to human resources planning, internal and external recruitment and selection. 4 lectures. Prerequisite: BUS 384 and STAT 252, or equivalent.

BUS 475 Staffing and Development (4)
Design, delivery and evaluation of employee training and human resource development in an organizational setting. 4 lectures. Prerequisite: BUS 384.

BUS 477 Organization Development (4)
Analysis of development and trends in the field of organization development. Application of behavioral science knowledge and social technology to growth and change of organizations for the purpose of improving effectiveness. Problem diagnosis and facilitation skills. 4 seminars. Prerequisite: BUS 387 or consent of instructor.

BUS 478 Organization Design (4)
Impact of changing business environment on design of organizations. Alternative design models, redesign processes, and guiding principles. Application to case studies, current redesign projects and field studies. 4 lectures. Prerequisite: BUS 382 or consent of instructor.

BUS 479 Purchasing and Materials Management (4)
Role and scope of the procurement function and concept of an integrated materials management process. Relations with functional departments. Purchasing structure and processes in business and service organizations. Global concept of international purchasing. Measuring purchasing performance. 4 lectures. Prerequisite: Junior standing.

BUS 480 Operations Planning and Control (4)
Framework for operations planning and control. Management problems associated with controlling flows of material and inventory levels in manufacturing and distribution systems. 4 lectures. Prerequisite: BUS 371.

BUS 481 Service Operations Management (4)
Principles and techniques of operations management applied to the management of service operations. Producing organizational success through offering reliable, dependable, readily available, and flexible customer service. 4 lectures. Prerequisite: BUS 371.

BUS 482 Advanced Operations Management (4)
Advanced principles in operations management as applied to both manufacturing and service organizations. Product-service conversion systems, capacity planning and utilization, aggregate planning, scheduling and control, inventory management, and operations subsystem coordination with the organization's strategy. 4 lectures. Prerequisite: BUS 371, and senior standing.

BUS 483 Seminar in Managerial Consultation (4)
Management consulting in the private and public sectors. Analysis of substantive and process skills required to provide independent and objective advice to clients. Application of consulting knowledge and skills to real client problems and facilitation of change. 4 seminars. Prerequisite: Senior standing or consent of instructor.

BUS 484 Corporate Training (4)
Developing and managing curriculum for an industrial setting. Developing a philosophy, assessing resources, developing and sequencing objectives, developing and properly using materials in training, evaluating and reporting effectiveness. Managing people and resources within this process in an industrial setting. 4 lectures. Prerequisite: Senior standing.

BUS 486 Human Resource Information Systems (4)
Application of computers to the management of human resources. Human resource decision support systems and routine transaction processing. Basic system design decisions. Use of information systems to support traditional human resource functional areas. Exposure to enterprise-wide, integrated software. 2 lectures, 2 activities. Prerequisite: BUS 384 and BUS 392.

BUS 487 Seminar in Quality Management (4)
Principles and techniques of quality and performance management as applied to organizations in the private and public sector. Emphasis on competitive implications. Integrations of fundamental management techniques, existing improvement efforts, technical tools, and new management technologies focused on continuous organizational improvement. 4 seminars. Prerequisite: Senior standing, BUS 371.

BUS 488 Small Business Management (4)
Application of management knowledge and skills to the specific managerial problems involved in planning and operating the smaller company; growth strategies; the art of securing performance; changing the organization structure to match growth; recruiting and compensating new personnel. 4 seminars. Prerequisite: Senior standing.

BUS 491 Advanced Quantitative Methods in Business (4)
Application of quantitative methods to support managerial decision. For the senior student who needs operational knowledge for applications in business analysis, decision support systems, data warehousing, OLAP (On-line Analytical Processing), and Data Mining. 3 lectures, 1 activity. Prerequisite: BUS 391.

BUS 492 Expert Systems Applications in Business (4)

BUS 494 Small Business Information Systems (4)
Information systems in a simulated small business environment. Collaborative learning with teams analyzing, designing and implementing accounting and management reporting software. Determine and implement organizational policies and procedures. Organizational productivity as contrasted to individual productivity. 3 lectures, 1 activity. Prerequisite: BUS 391, BUS 392 or consent of instructor.

BUS 497 Multimedia Presentation Systems in Business (4)
Use of front-end software animation development tools, such as Director, to explore computer multimedia environments with an emphasis on visual programming for business applications. Methods for integrating text, graphics, animation, sound and video to construct desktop presentations. 3 lectures, 1 activity. Prerequisite: BUS 391.

BUS 498 Directed Topics in MIS (4)
Specialized MIS topic will be selected from the MIS areas of current interest. Intended for proficient and advanced MIS concentration.
opportunities and the program at Cal Poly. Information on intellectual and
Introduction to child development, including methods and theories, career
CD 102  Orientation to the Child Development Major (4)
BUS 499 Data Communications and Networking (4)
Combines the fundamental concepts of data communications and networking with practical applications in business. Provides a basic understanding of the technical and managerial aspects of business telecommunication. Introduction to data communications and applications and technical fundamentals, and to network products, technologies, applications, and services. 3 lectures, 1 activity. Prerequisite: BUS 391, BUS 392, BUS 215 or consent of instructor.
BUS 501 Managerial Accounting and Managerial Economics I (5)
Accounting portion of course covers applications of accounting to management decision-making, planning, and control. Cost behavior analysis, budgets, performance reporting, plus motivational and behavioral considerations. Economics portion of course covers demand and supply analysis, static and dynamic market equilibrium analysis, and elasticities. 5 lectures. Prerequisite: Graduate standing.
BUS 502 Managerial Finance and Managerial Economics II (4)
Finance portion of course covers short-term financial management, investment decisions, and cost of capital determination. Economics portion of course covers consumer choice analysis, theory of the firm, production theory, and market structures. 4 lectures. Prerequisite: BUS 501.

CD–CHILD DEVELOPMENT

CD 102 Orientation to the Child Development Major (4)
Introduction to child development, including methods and theories, career opportunities and the program at Cal Poly. Information on intellectual and attitudinal development during the college years, and a series of assessments to aid in setting goals. 4 lectures. Prerequisite: CD majors only.

CD 108 Child, Family, and Community (3)
Introduction to individual development and socialization processes from life span and human ecology perspectives with emphasis on interactions among the child, the family and community. Not open to CD majors. 3 lectures.

CD 109 Parenting (2)
Philosophies and techniques explored out of which an individual can devise an effective parenting style. Basic skills for parent effectiveness. 2 lectures.

CD 128 Program Planning for Infants and Toddlers (3)
Creating an environment to meet the needs of the infant and toddler. Establishing communication in an atmosphere of trust and providing activities which enhance the emerging capabilities of the infant and toddler. 3 activities.

CD 130 Supervised Study of Children: Infants and Toddlers (4)
Faculty supervised experience with young children, emphasizing infants and toddlers. Participant observation, data collection skills, planning and conducting activities for individuals and groups in educational or childcare facilities. Prerequisite: CD 128 or concurrent enrollment.

CD 200 Special Problems for Undergraduates (1–4)
Supervised investigation, including a written report, of a topic chosen with prior approval of instructor. Total credit limited to 6 units, with a maximum of 4 units per quarter.

CD 203 Family Development (4)
Examination of how families live out alterations experienced over the life cycle. Emphasis on using family development concepts to clarify central questions facing families over time. A model will be presented that will apply to the diversity found in society. 4 lectures.

CD 209 Early Development: Conception through Childhood (4)
Human development from conception through childhood. Discussion and analysis of research and theory regarding physiological, cognitive and psychosocial domains of development, especially as they apply to working with children and families in educational settings. 4 lectures. Prerequisite: CD 102, PSY 201 or PSY 202.

CD 230 Supervised Study of Children: Early Childhood (4)
Teaching experience with children in a preschool laboratory setting. Participant planning, execution and evaluation of age-appropriate activities. Observation is used as the basis for planning for the development of the whole child. 4 laboratories. Prerequisite: CD 209.

CD 301 Introduction to the Learner's Development, Culture, Language, and Identity (5) (Also listed as EDUC 301)
Theoretical background of child development for teaching-learning in all aspects of development that influence the teaching-learning process. Special emphasis on multicultural, language, and other diversity issues. Fieldwork activities in public school classrooms. 4 lectures, 1 activity. Prerequisite: PSY 201 or PSY 202.

CD 306 Adolescence (4) (Also listed as PSY 306)
Psychological analysis of the years from prepubescence to young adulthood. Current research on behavior and development during adolescence with emphasis on physical, affective, cognitive, sociocultural, historical, family, peer and school aspects of life during the post-child, pre-adult years. 4 lectures. Prerequisite: PSY 201 or PSY 202; junior standing.

CD 309 Learning, Development, and Technology I (4)
Introduction to relationship between development and learning, and to application of developmental principles to the creation of age appropriate curriculum. Principles illustrated through examination of sensory-motor development and appropriate activities for promoting gross motor, fine motor, perceptual, and volitional development. 4 activities. Prerequisite: CD 128, CD 209, computer literacy (Recommended: CSC 111, CSC 113 or CSC 118).

CD 310 Learning, Development, and Technology II (4)
Examination of developmental learning and the activities, organizational practices, and methods which promote or hinder it, with a special examination of the influence of development in the process of children learning to read. 4 activities. Prerequisite: CD 309.

CD 311 Learning, Development, and Technology III (4)
Examination of the concept of learning competence and its relation to creativity. 4 activities. Prerequisite: CD 310.

CD 324 Guiding Children (4)
Group process and guidance techniques for adults working with children in family, community, and educational settings. Examination of cases which require the application of theory to practical situations typically encountered by adults working with children. 4 lectures. Prerequisite: CD 209, or consent of instructor.

CD 329 Research Methods in Child Development (3)
Introduction to research methods in child development. Critically evaluating research literature, generating research questions, and developing expertise in methods of naturalistic and structured observation, testing, structured situations, and interviews with children and adolescents. 2 lectures, 1 activity. Prerequisite: PSY 201 or PSY 202, STAT 217.

CD 330 Supervised Internship (4) (CR/NC)
Faculty-supervised internship. Role of professional apprentice is experienced and analyzed by each student. Credit/No Credit grading only. Prerequisite: CD or Liberal Studies major, CD 230, CD 311, CD 324, PSY 323, KINE 280 or equivalent first aid certification, junior standing and consent of instructor.

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CD 350 Developmental Issues in Education (3)
Interaction of nature and nurture as related to fundamental issues about how human beings develop and learn. Questions concerning intelligence, temperament, talent, creativity, learning competence, volition, moral development, group process, and the implications these topics have for education. 3 lectures. Prerequisite: CD 209.

CD 390 Career Planning (2) (CR/NC) (Also listed as PSY 390)
Individual career and graduate school planning. Current employment issues for college graduates such as career profiles, trends and work environments. Credit/No Credit grading only. 2 seminars. Prerequisite: Junior or senior standing or consent of instructor.

CD 400 Special Problems for Advanced Undergraduates (1–4)
Supervised investigation, including a written report, of a topic chosen with prior approval of instructor. Total credit limited to 6 units, with a maximum of 4 units per quarter. Prerequisite: Junior standing.

CD 401 Perspectives on Childhood Education (4)
Past, present and future perspectives in theory and practice of childhood education. Analysis of current research issues and applications. 4 seminars. Prerequisite: CD 310, CD 329, CD 330 or consent of instructor.

CD 404 Administration of Children's Programs (3)
Organization and administration of programs for young children, preschool and child care centers. Staffing, finance, equipment, records, program evaluations, regulations, public policy and community relations. 3 lectures. Prerequisite: CD 102.

CD 405 Advanced Administration of Child Development Centers (3)

CD 430 Advanced Internship (4) (CR/NC)
Faculty-supervised preprofessional experience in a career-related setting which complements the CD 330 internship. Such roles as master teacher, caseworker, therapeutic intern, administrative aide or program specialist are experienced and analyzed by each student. Credit/No credit grading only. Prerequisite: CD or Liberal Studies major, CD 330, and consent of instructor.

CD 461 Senior Project Seminar (2)
Senior project expectations and skills. Students work alone or in groups to identify appropriate topics, methods and content for the senior project; to be presented in a series of progress reports. 2 seminars. Prerequisite: CD major, completion of GWR, CD 309, CD 329, and consent of instructor.

CD 462 Senior Project (2)
Completion of a project under faculty supervision. Prerequisite: CD 461.

CD 470 Selected Advanced Topics (1–4)
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. 1–4 lectures. Prerequisite: Consent of instructor.

CE–CIVIL ENGINEERING

CE 111 Introduction to Civil Engineering (1) (CR/NC)
Broad overview of the field of civil engineering, including professional societies and their student chapters, professional licensing and registration, professional codes of ethics, the elements of engineering design, and the scope of analysis and design activities undertaken by private- and public-sector civil design professionals. Credit/No Credit grading only. 1 lecture.

CE 114 Introduction to CAD in Civil and Environmental Engineering (4)
The Civil and Environmental Engineering design process. Use of AutoCAD to illustrate and quantify design alternatives. Practice in creating and evaluating typical designs drawn from different specialty areas of the field. Related topics in information technology. Miscellaneous course fee may be required—see Class Schedule. 2 lectures, 2 laboratories. Prerequisite: MATH 141; CSC 110 or equivalent or passing score on qualifying test of basic computer skills.

CE 200 Special Problems for Undergraduates (1–2) (CR/NC)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Credit/No Credit grading only. Prerequisite: Consent of department chair.

CE 201 Strength of Materials (5)
Stresses, strains, and deformations associated with axial, torsional, and flexural loading of bars, shafts, and beams. Mohr’s Circle representations of the state of stress and strain at a point. Buckling of rigid and deformable columns. Analysis of elementary determinate and indeterminate mechanical and structural systems. Equivalent in content to CE 204 and CE 205. 5 lectures. Prerequisite: ME 211.

CE 204 Strength of Materials I (3)
Stresses, strains, and deformations associated with axial, torsional, and flexural loading of bars, shafts, and beams. Analysis of elementary determinate and indeterminate mechanical and structural systems. 3 lectures. Prerequisite: ME 211.

CE 205 Strength of Materials II (2)
Mohr’s Circle representations of the state of stress and strain at a point. Analysis of beam deflections and rotations. Shear force and bending moment diagrams for indeterminate beams. Buckling of rigid and deformable columns. 2 lectures. Prerequisite: CE 204.

CE 206 Strength of Materials Laboratory (1)
Introduction to experimental stress analysis. Verification of analytical equations through strain gage measurements of axially, torsionally, and flexurally loaded specimens. 1 laboratory. Prerequisite or concurrent: CE 201 or CE 205.

CE 221 Fundamentals of Transportation Engineering (3)
The characteristics and functions of highway, air, rail, transit and other modes of urban and intercity transportation. History of transportation design, operations, and planning. Evaluation of costs, benefits, and environmental considerations. 3 lectures. Prerequisite: MATH 141.

CE 222 Fundamentals of Transportation Engineering Laboratory (2)
Application of principles of transportation planning, operations, and design. Emphasis on urban transportation planning and operations, and the design of urban and intercity highway and rail facilities. 2 laboratories. Prerequisite: CE 221.
CE 259 Civil Engineering Materials (2)
Experimental determination of mechanical properties of concrete, asphalt, and soils as required for engineering applications. Experimental verification of assumptions made in mechanics of materials procedures. Use of strain measuring devices. Preparation of technical reports. 2 laboratories. Prerequisite: CE 204.

CE 336 Water Resources Engineering (4)
Hydraulics of open channel flow, flow through hydraulic structures, stream flow and stream flow hydrographs, hydrologic routing. 4 lectures. Prerequisite: ME 341.

CE 337 Hydraulics Laboratory (1)
Application of basic fluid dynamic principles to various mechanical systems. Exposure to experimental problems and techniques with guided laboratory projects related to civil engineering discipline. 1 laboratory. Prerequisite: ME 341.

CE 351 Structural Analysis (5)
Analysis for member forces and deflections of determinate and indeterminate structures, including trusses, beams, and frames. General theorems, influence diagrams, and energy methods. 5 lectures. Prerequisite: CE 201 or CE 205.

CE 355 Reinforced Concrete Design (3)
Analytical and design principles of reinforced concrete in designing civil engineering systems. Origin of code requirements. Fundamentals of proportioning. Details of elements and structural systems. 3 lectures. Prerequisite: CE 259, CE 351.

CE 381 Geotechnical Engineering (4)
Engineering geology, elementary mass-volume relations, clay-water interaction, soil classification, soil compaction, geostatic stress distributions, 1-D and 2-D steady-state flow, shear strength under drained and undrained conditions. 4 lectures. Prerequisite: CE 205, ME 341.

CE 382 Geotechnical Engineering Laboratory (1)
Use of standard laboratory test methods to determine physical, mechanical, and hydraulic properties of soil. 1 laboratory. Co-requisite: CE 381.

CE 400 Special Problems for Advanced Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of department chair.

CE 401 Advanced Strength of Materials I (4)

CE 402 Advanced Strength of Materials II (4)
Development of reduced order theories such as torsion, beams and columns from the general three-dimensional continuum. Application and limitation of these theories are discussed. Similarities are drawn between analytical formulas and code base rules and/or formulas. 4 lectures. Prerequisite: CE 401.

CE 407 Structural Dynamics (4)
Effect of vibration and transient loads on structural elements. Dynamics load factors, support motion, damping and natural frequencies of multidimensional structural systems. Modal analysis. 3 lectures, 1 laboratory. Prerequisite: CE 351, ME 212.

CE 421 Traffic Engineering (4)
Improvement of urban circulation on freeways, city streets, and parking facilities. Traffic monitoring and control. Traffic data systems. Centralized versus decentralized control. Use of traffic simulation. New technologies. 3 lectures, 1 laboratory. Prerequisite: CE 221 or consent of instructor.

CE 422 Highway Geometrics and Design (4)
Location and safe geometric design of highway and other transportation facilities. Earthwork and drainage related to highway, railway, dock, and airport design. Theory and practice in design of alignments, highway cross-sections, intersections, interchanges, and freeways in urban and rural areas. 3 lectures, 1 laboratory. Prerequisite: CE 221 or consent of instructor.

CE 424 Public Transportation (4)
Interdisciplinary aspects of public transportation problems, systems-team design approach to solutions. History and present state of public transportation; role of public transportation in urban environment; legislative, political, social, and economic aspects of public transportation systems. Methodology and procedures for transit planning. Review of transit studies. 3 lectures, 1 laboratory. Prerequisite: CE 221 or consent of instructor.

CE 431 Coastal Hydraulics (3)
Waves and their characteristics, types of waves, water wave theories, orbital velocities, refraction of waves, wave diffraction, wave reflection, application of linear theory to wave forces on cylindrical structures, submerged pipelines and vertical flat barriers (sea walls), wave uprush, rubble mound breakwaters. 3 lectures. Prerequisite: ME 341.

CE 432 Coastal Engineering (3)
Application of linear wave theory to the analysis of beaches and coastal revetments for wave runup, overtopping, and structure setback. Design of rip-rap revetments for wave runup, over-topping, and structure setback. Analysis of wave forces on breakwaters and vertical walls. Application of Catenary theory to ocean and offshore ship moorings. 3 lectures. Prerequisite: CE 431.

CE 434 Groundwater Hydraulics and Hydrology (3)

CE 440 Hydraulic Systems Engineering (3)

CE 453 Structural Steel Design (3)
Design and behavior of the elements of steel structures. Proportioning of members and connections. Introduction to plastic design. 3 lectures. Prerequisite: CE 351.

CE 454 Structural Design (4)
Design of reinforced concrete, steel and timber structures. Loading standards, code design methods, connection design. Comprehensive design projects. 2 lectures, 2 laboratories. Prerequisite: CE 351, CE 355, CE 453.

CE 457 Bridge Engineering (4)

CE 461, 462 Senior Project (2) (2)
Completion of a 120-hour integrated civil research, analysis, and/or design project that is representative of those encountered in professional practice. Prerequisite: Senior standing and consent of the supervising faculty member.
CE 464 Professional Practice (3)
Examination of the non-technical issues that are dealt with on a regular basis by the design professional, including professional ethics, marketing and business development, professional engagement, personnel and project management, risk management, professional liability insurance, and dispute resolution. 3 seminars. Prerequisite: Senior standing.

CE 466 Senior Project Design Laboratory I (2)
Selection and initial work on a project by individuals or team which is typical of problems graduates must solve in their fields of employment. Project involves, but is not limited to, physical modeling, testing and design. The project may include student/elements from other disciplines. Formulation of outline, literature review, project schedule, initial analyses and interim report. 2 laboratories. Prerequisite: Senior standing and consent of instructor.

CE 467 Senior Project Design Laboratory II (2)
Continuation of CE 466. Continuation of research methodology: problem statement, method, results, analysis, synthesis, project design, construction (when feasible), and evaluation/conclusions. Project results are presented in formal written reports for reference library and formal oral reports. 2 laboratories. Prerequisite: CE 466.

CE 470 Selected Advanced Topics (1–4)
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. Prerequisite: Consent of instructor.

CE 471 Selected Advanced Laboratory (1–4)
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 to 4 laboratories. Prerequisite: Consent of instructor.

CE 481 Analysis and Design of Shallow Foundations (4)
Immediate settlement, consolidation settlement, rate of consolidation, and creep. Stress distributions beneath loaded areas. Methods for accelerating and/or reducing settlement. Analysis of bearing capacity for generalized conditions. Design of reinforced concrete spread footings. Standard field and laboratory testing. 3 lectures, 1 laboratory. Prerequisite: CE 381, CE 382.

CE 482 Conventional Subsurface Exploration (4)
Subsurface exploration and sampling techniques. Laboratory analysis of material variability. Preparation of subsurface exploration reports. 2 lectures, 2 laboratories. Prerequisite: CE 481.

CE 483 Environmental Geotechnology (4)

CE 485 Cooperative Education Experience (6) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. Total credit limited to 16 units. Prerequisite: Sophomore standing and consent of instructor.

CE 495 Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. Total credit limited to 16 units. Prerequisite: Sophomore standing and consent of instructor.

CE 500 Individual Study (1–3)
Advanced study planned and completed under the direction of a member of the department faculty. Open only to graduate students who have demonstrated ability to do independent work. Enrollment by petition. Prerequisite: Consent of department chair, graduate adviser and supervising faculty member.

CE 501 Advanced Matrix Analysis of Structures I (4)
Matrix terminology and operations. Matrix procedures for analysis of two-dimensional frameworks. Development of stiffness, flexibility and mixed methods. Development of algorithms and programs for use in the analysis of structural frameworks. Discussion of modeling issues and limitations. 3 lectures, 1 laboratory. Prerequisite: CE 351 or consent of instructor.

CE 502 Advanced Matrix Analysis of Structures II (4)
Matrix procedures for analysis of three-dimensional frameworks. Development of algorithms and programs for use in the analysis of structural frameworks. Additional topics to include: member releases, nonprismatic members, elastic supports, offset connections and oblique supports. 3 lectures, 1 laboratory. Prerequisite: CE 501 or consent of instructor.

CE 504 Advanced Finite Element Analysis I (4)

CE 505 Advanced Finite Element Analysis II (4)
Finite element theory and analysis for multi-dimensional equations. Variational formulations and their significance. Isoparametric formulation and numerical integration. Development of two and three-dimensional finite element algorithms using industry based software. Discussion modeling issues and limitations. 3 lectures, 1 laboratory. Prerequisite: CE 504.

CE 521 Airfield and Highway Pavement Designs (4)
Theories, principles, and procedures in the structural design of highway and airfield pavements. Design of rigid and flexible pavements. Construction and maintenance procedures for pavements and stabilized bases. 3 lectures, 1 laboratory. Prerequisite: CE 221, CE 259, graduate standing or consent of instructor.

CE 522 Advanced Transportation Design (4)
Application of computers to advanced highway and transportation systems and geometries. Use of computers for the solution of transportation facility design problems. 2 lectures, 2 laboratories. Prerequisite: CE 221, graduate standing, or consent of instructor.

CE 523 Transportation Systems Planning (4)
Planning of urban and regional multimodel transportation systems. Selection of routes and types of systems based on economic, social, technological, and other characteristics. 2 lectures, 2 laboratories. Prerequisite: CE 221, graduate standing, or consent of instructor.

CE 525 Airport Planning and Design (4)
Historical background of aviation and airport development; financing; estimating demand; aircraft characteristics; airport capacity; airspace and air traffic control; site selection; airport configuration; geometric design of landing area; planning and development of terminal areas; lighting; pavement design and drainage. 3 lectures, 1 laboratory. Prerequisite: CE 221, graduate standing, or consent of instructor.

CE 528 Transportation Analysis (4)
Principles and applications of engineering systems analysis to transportation using examples from different modes. Identification of transportation benefits, costs, user and non-user impacts, vehicle operating characteristics, programming and scheduling. 3 lectures, 1
laboratory. Prerequisite: CE 221, graduate standing, or consent of instructor.

CE 529 Modeling and Simulation in Transportation (4)
Theory and operation of transportation systems, the systems approach, simulation techniques. Use of available software packages. Simulation model development, calibration and use. 2 lectures, 2 laboratories. Prerequisite: CE 221, graduate standing, or consent of instructor.

CE 533 Advanced Water Resources Engineering (3)
Matrix and simulation methods in hydrology, statistical studies in hydrology and their applications to civil engineering problems. Generalized hydrologic characteristics. Hydrologic simulation, computer applications, urban and small watershed hydrology, macroscopic and microscopic approach. Storm water management models. Hydrologic design. 3 lectures. Prerequisite: CE 336 or graduate standing.

CE 535 Water Resources Systems Planning and Analysis (3)
Water resources planning, development, system analysis and optimization. Dynamic programming, multi-objective water resource systems. 3 lectures. Prerequisite: CE 336.

CE 537 Groundwater Contamination (3)
Sources and types of groundwater contamination, contamination transport mechanisms. Sorption and other chemical reactions. Numerical modeling of contaminant transport. Nonaqueous phase liquids. Groundwater remediation and design. 3 lectures. Prerequisite: CE 114; co-requisite: CE 434 or equivalent.

CE 555 Advanced Civil Engineering Materials Laboratory (2)
Fundamental properties of new and advanced materials. Experimental techniques. Fracture characteristics and composite response of cement matrix composites. New materials and products to advanced applications such as automation. 2 laboratories. Prerequisite: CE 259 or graduate standing.

CE 557 Seismic Analysis and Design for Civil Engineers (4)
Extension of the basic principles of structural dynamics to analysis of civil structures (buildings, bridges, tanks, etc.) to earthquake loading. Code based (Uniform Building Code and AASHTO) earthquake resistant design of civil structures. 3 lectures, 1 laboratory. Prerequisite: CE 407.

CE 559 Advanced Structural Design (4)
Advanced analysis, design and behavior of structural concrete. Reinforced, prestressed, and precast concrete elements. Linear and nonlinear structural systems. Origin of code requirements. Detailed design of prestressed concrete components of civil engineering systems for buildings and highway construction. Beams, slabs, columns, continuous systems, walls, connections, and composite systems. 4 lectures. Prerequisite: CE 355 or graduate standing.

CE 570 Selected Advanced Topics (1–4)
Directed group study of selected topics for advanced students. Open to graduate students. Class Schedule will list topic selected. Total credit limited to 8 units. 1–4 seminars. Prerequisite: Graduate standing or consent of instructor.

CE 571 Selected Advanced Laboratory (1–4)
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. Prerequisite: Graduate standing or consent of instructor.

CE 573 Public Works Administration (3)
Management and engineering of transportation and related systems in public jurisdictions. Traffic systems, streets and highways, illumination, distribution systems, etc. Personnel management, financing, public relations, and contract management. 3 seminars. Prerequisite: Graduate standing or consent of instructor.

CE 574 Computer Applications in Civil Engineering (3)
Overview of computer application, hardware and software alternatives, use of selected application programs, CAD, microcomputers, management and application of resources. 1 lecture, 2 laboratories. Prerequisite: Graduate standing or consent of instructor.

CE 581 Advanced Geotechnical Engineering (4)
Advanced topics in saturated flow, unsaturated flow, and consolidation. Stress-strain-deformation response of soils under both drained and undrained loading. Soil stabilization, and ground modification. Conventional and advanced field and laboratory strength testing. 2 lectures, 2 laboratories. Prerequisite: CE 481 or graduate standing.

CE 582 Advanced Geotechnical Testing (4)
Standard penetration, cone penetration, and flat-plate dilatometer testing. Equipment operation and maintenance. Interpretation of SPT/CPT/DMT sounding data. Stratigraphic analysis. CPT/DMT-based analysis and design of shallow and deep foundations. 2 lectures, 2 laboratories. Prerequisite: CE 481 or graduate standing.

CE 583 Geotechnical Earthquake Engineering (4)
Introduction to engineering seismology, dynamic behavior of soils, seismic site response analysis, seismic earth pressures, seismic stability of slopes, soil liquefaction and lateral spreading, and mitigation techniques. Computer-aided analysis. 4 lectures. Prerequisite: CE 481 or graduate standing.

CE 584 Lateral Support Systems (4)
Classical and modern earth pressure theories. Lateral earth pressure calculations for general subsurface conditions. Analysis and design of reinforced concrete cantilever walls, sheetpile walls, soldier-pile walls, tie-back walls, and mechanically-stabilized earth. Computer-aided analysis and design. 4 lectures. Prerequisite: CE 481 or graduate standing.

CE 585 Slope Stability Analysis (4)

CE 586 Analysis and Design of Deep Foundations (4)
Bearing capacity and settlement analysis of drilled shafts and driven piles. Analysis and design of single piles and pile groups for vertical, lateral, and combined loading. Construction procedures, field inspection, and load-testing. Computer-aided analysis and design. 4 lectures. Prerequisite: CE 481 or graduate standing.

CE 591 Graduate Seminar (1)
Examination of current research activities and analysis/design philosophies in civil and environmental engineering practice. 1 seminar. Prerequisite: Graduate standing.

CE 599 Design Project (Thesis) (2) (2) (5)
Each individual or group will be assigned a project for solution under faculty supervision as a requirement for the master's degree, culminating in a written report/thesis. Prerequisite: Graduate standing.

CHEM—CHEMISTRY

CHEM 106 Introductory Chemistry (3)
Introductory course in chemistry. Measurement, metric system, properties of matter, chemical symbols, atomic structure, chemical formulas, nomenclature, chemical equations, the mole concept, stoichiometry. Not open to students who have credit in a college chemistry course. 3 lectures.
CHEM 110  World of Chemistry (4)  GE B3 & B4  
The fundamentals of chemical cause and effect—structure/function relationships. The basic principles of chemistry and their applications to solving human problems in organic materials science, biochemistry, toxicology, environmental science, agriculture, nutrition, and medicine. Not open to students majoring in Chemistry or Biochemistry. 3 lectures, 1 laboratory. Prerequisite: Appropriate score on the ELM examination for MATH 116 eligibility, or an ELM exemption, or MATH 104.

CHEM 111  Survey of Chemistry (5)  GE B3 & B4  
Introduction to atomic theory, chemical reactions, bonding, stoichiometry, nomenclature, and solutions. Intended for students who are preparing for CHEM 212/312. Not open to students with credit for CHEM 128. 4 lectures, 1 laboratory. Prerequisite: High school chemistry or CHEM 106 or equivalent, and appropriate score on the ELM examination for MATH 116 eligibility, or an ELM exemption, or MATH 104.

CHEM 124  General Chemistry for the Engineering Disciplines (4)  GE B3 & B4  
General chemistry concepts presented using a materials science approach with engineering applications. Thermochemistry, bonding, solid-state structures, fundamentals of organic chemistry including polymers. Classwork is presented in an integrated lecture-laboratory format, with an emphasis on computer-based data acquisition, collaborative methods and multimedia-based presentation. Not open to students with credit for CHEM 111 or CHEM 127. 3 lectures, 1 laboratory. Prerequisite: High school chemistry or CHEM 106 or equivalent, and appropriate score on the ELM examination for MATH 116 eligibility or an ELM exemption or MATH 104.

CHEM 125  General Chemistry for the Engineering Disciplines (4)  GE B3 & B4  
A continuation of general chemistry designed for engineering students. Topics include solution chemistry, thermodynamics, kinetics, equilibrium, acids and bases, electrochemistry, and nuclear chemistry. Integration of laboratory with theoretical concepts. Use of computers for data acquisition and multimedia resources. Guided inquiry and collaborative methods emphasized. Not open to students with credit for CHEM 128. 3 lectures, 1 laboratory. Prerequisite: CHEM 124 or equivalent.

CHEM 127  General Chemistry (4)  GE B3 & B4  
Introduction to atomic theory, chemical reactions, bonding, stoichiometry, nomenclature, gas laws, colligative properties, colloids and solutions. Intended primarily for students whose majors are in the College of Science and Mathematics. Not open to students with credit in CHEM 111 or CHEM 124. 3 lectures, 1 laboratory. Prerequisite: High school chemistry or CHEM 106 or equivalent, and appropriate score on the ELM examination for MATH 116 eligibility or an ELM exemption or MATH 104.

CHEM 128  General Chemistry (4)  
Continuation of CHEM 127. Oxidation-reduction reactions, electrochemistry, kinetics, equilibria, thermodynamics, acids and bases. Intended primarily for students whose majors are in the College of Science and Mathematics. Not open to students with credit in CHEM 125. 3 lectures, 1 laboratory. Prerequisite: CHEM 127.

CHEM 129  General Chemistry (4)  
Acid and base equilibria, buffers, transition elements, solubility, complex ions, hybridization, nuclear chemistry. Laboratory study of the chemical properties and semi-micro qualitative analysis of the representative group elements of the periodic table. Intended primarily for students whose majors are in the College of Science and Mathematics. 3 lectures, 1 laboratory. Prerequisite: CHEM 125 or CHEM 128.

CHEM 156  General Chemistry Laboratory (1)  
Additional laboratory to be taken with CHEM 129. Includes chemical properties and semi-micro qualitative analysis of the transition and post-transition metal ions of the periodic table, methods of inorganic synthesis. 1 laboratory. Prerequisite: CHEM 111, CHEM 125, or CHEM 128.

CHEM 200  Special Problems for Undergraduates (1–2)  
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: CHEM 111, CHEM 124, or CHEM 127 and consent of department head.

CHEM 212  Introduction to Organic Chemistry (5)  
Introduction to the fundamentals of organic chemistry nomenclature and selected reactions for the major functional groups. Promotes an understanding of how the structure and reactions of selected organic molecules relate to living systems and our environment. Transfer equivalent to CHEM 312. Not open to students with credit in CHEM 312, CHEM 216/316. 4 lectures, 1 laboratory. Prerequisite: CHEM 111 or CHEM 128 or equivalent.

CHEM 216  Introduction to Organic Chemistry I (5)  
Basic principles of the bonding, isomerism and stereochemistry in compounds of carbon. Essentials of organic nomenclature. Representative reactions and mechanisms for selected aliphatic and aromatic compounds. Introduction to the physical analysis and synthesis of organic compounds. Transfer equivalent to CHEM 316. Not open to students with credit in CHEM 316. 4 lectures, 1 laboratory. Prerequisite: CHEM 111 or CHEM 125 or CHEM 128.

CHEM 217  Introduction to Organic Chemistry II (5)  
Properties and reactions of carbonyl compounds, alcohols, and organic halides with an overview of the mechanisms of the reactions. Introductory concepts and applications of infrared and NMR spectroscopy. Transfer equivalent to CHEM 317. Not open to students with credit in CHEM 317. 3 lectures, 2 laboratories. Prerequisite: CHEM 216/316.

CHEM 218  Introduction to Organic Chemistry III (3)  
Properties and reactions of amines, heterocyclic and aromatic compounds with an overview of the mechanisms of the reactions. Introductory concepts and applications of ultraviolet spectroscopy and mass spectrometry. Transfer equivalent to CHEM 218. Not open to students with credit in CHEM 318. 3 lectures. Prerequisite: CHEM 217/317.

CHEM 231  Introduction to Quantitative Analysis (5)  
Fundamental theory for common titrimetric and spectrophotometric methods in analytical chemistry. Essentials of chemical equilibria as it applies to titration curves. The laboratory focuses on precision and accuracy for common, practical methods in analytical chemistry. Transfer equivalent to CHEM 331. Not open to student with credit in CHEM 331. 3 lectures, 2 laboratories. Prerequisite: CHEM 129.

CHEM 252  Laboratory Glassblowing (1)  
Techniques of glassblowing applied to the making of simple laboratory apparatus. 1 laboratory. Prerequisite: CHEM 111, CHEM 124 or CHEM 127.

CHEM 305  Physical Chemistry (3)  
Fundamentals and applications of chemical thermodynamics of particular interest to engineers. Chemical and phase equilibria. 3 lectures. Prerequisite: PHYS 125 or PHYS 133, CHEM 125 or CHEM 129, MATH 143.

CHEM 306  Physical Chemistry (3)  
Applications of chemical thermodynamics. Electrochemistry. Kinetic theory of gases. Chemical kinetics. 3 lectures. Prerequisite: CHEM 305, or CHEM 351 or ME 302.

CHEM 312  Survey of Organic Chemistry (5)  
Structure, isomerism, nomenclature, fundamental reactions of major functional groups and applications of organic chemicals in agriculture, medicine, industry, and the home. Not open to students with credit in
CHEM 212 or CHEM 216/316. 4 lectures, 1 laboratory. Prerequisite: CHEM 111 or CHEM 128 or equivalent.

CHEM 313 Survey of Biochemistry and Biotechnology (5)
Chemistry of biomolecules including carbohydrates, proteins, fats, vitamins, enzymes and hormones. Basic molecular biology with applications to biotechnology and genetic engineering. Practical intermediary metabolism of prokaryotic and eukaryotic systems. 4 lectures, 1 laboratory. Prerequisite: CHEM 212/312 or equivalent.

CHEM 316 Organic Chemistry I (5)
Structure, bonding, nomenclature, isomerism, stereochemistry and physical properties of organic compounds. Introduction to spectroscopy. Reactions and mechanisms of alkanes, alkenes, alkynes, cycloalkanes and aromatic compounds. Laboratory techniques in organic preparations. 4 lectures, 1 laboratory. Prerequisite: CHEM 111 or CHEM 125 or CHEM 128.

CHEM 317 Organic Chemistry II (5)
Reactions and reaction mechanisms of organic halides, alcohols, phenols, epoxides, ethers, carboxylic acids and their derivatives, aldehydes, ketones; acidity and basicity; infrared and NMR spectroscopy. 3 lectures, 2 laboratories. Prerequisite: CHEM 216/316.

CHEM 318 Organic Chemistry III (3)
Chemistry of amines, aromatic compounds, heterocycles, macromolecules, some biomolecules, carbanions, rearrangement and ultraviolet and mass spectrometry. 3 lectures. Prerequisite: CHEM 217/317.

CHEM 319 Advanced Organic Chemistry Laboratory (2)
Practice in multiple step organic synthesis, column chromatography, vacuum distillation, enzymes as chemical reagents, inert atmosphere techniques, introduction to FT NMR spectroscopy and mass spectrometry, survey of organic chemical literature. 2 laboratories. Prerequisite: Concurrent or prior enrollment in CHEM 218/318.

CHEM 331 Quantitative Analysis (5)
Theory and application of chemical equilibrium to analytical problems. Survey of important analytical methods with stress placed on the theory and application associated with titrimetric and spectrophotometric analysis. 3 lectures, 2 laboratories. Prerequisite: CHEM 129.

CHEM 337 Clinical Chemistry I (2)
Basic principles of physiological chemistry including clinical significance of medical laboratory data. Introduction to the clinical aspects of carbohydrate, lipid and protein metabolism. 2 lectures. Prerequisite: CHEM 313 or CHEM 371. Recommended: CHEM 231/331.

CHEM 338 Clinical Chemistry I Laboratory (1) (CR/NC)
Medical laboratory techniques in analysis of serum, blood and urine for glucose, protein and lipids. Basic principles of physiological chemistry including clinical significance of medical laboratory data. Credit/No Credit grading only. 1 laboratory. Corequisite: CHEM 337. Prerequisite: CHEM 313 or CHEM 371. CHEM 231/331 strongly recommended.

CHEM 341 Environmental Chemistry: Water Pollution (3)
Chemical aspects of water and water pollution: alkalinity; acid deposition, particularly relating to lake and stream acidification and forest decline; drinking water treatment and THMs; wastewater treatment; detergents, builders, and eutrophication; pesticides; other toxic organic compounds such as PCBs and dioxin; hazardous wastes; toxic elements such as Pb, Hg, Sn, Cd, and Se. 3 lectures. Prerequisite: CHEM 129 and CHEM 212/312 or CHEM 216/316.

CHEM 342 Environmental Chemistry: Air Pollution (3)
Chemical aspects of the atmosphere and air pollution: greenhouse effect and global climate change; CFCs, the ozone layer, and the ozone hole; carbon monoxide, nitrogen oxides, and photochemical smog, particulate matter; radon, asbestos, indoor air pollution; sulfur oxides and acid deposition, particularly relating to atmospheric reactions and control options. 3 lectures. Prerequisite: CHEM 129 and CHEM 212/312 or CHEM 216/316.

CHEM 344 Environmental Chemistry Laboratory (1)
Applicability of modern chemical instrumentation to the solution of present-day environmental problems. Includes instruction in operation of instrumentation, calculations, and interpretation of results from environmental analyses of a variety of air, water, and solid samples. 1 laboratory. Prerequisite: CHEM 341 or CHEM 342.

CHEM 348 Bioinformatics (4)  GE Area F  (Also listed as BIO/CPE/CSC 348)
Introduction to problems in molecular biology and the use of computers to address them. The computational perspectives on problems involving nucleic acid and protein analysis, and the algorithmic and database approaches to their solution. The ethical and societal challenges of genetic manipulation. 3 lectures, 1 laboratory. Prerequisite: Consent of instructor, or the following: CSC 103, completion of GE Area B, and junior standing.

CHEM 350 Chemical Safety (1)
Laboratory regulations, equipment hazard analysis, hazardous chemicals, classification of chemicals, toxic materials handling, reaction hazards, radiation, emergency procedures, safety management programs and legal concerns. Includes project. 1 lecture. Prerequisite: CHEM 212/312 or equivalent.

CHEM 351 Physical Chemistry I (3)
Basic physical chemistry for the study of chemical and biochemical systems. Kinetic-molecular theory, gas laws, principles of thermodynamics. Not open to students with credit in CHEM 305. 3 lectures. Prerequisite: CHEM 129; PHYS 123 or PHYS 133; MATH 143.

CHEM 352 Physical Chemistry II (3)
Application of physical chemistry to chemical and biochemical systems. Electrochemistry, kinetics, viscosity, surface and transport properties. Not open to students with credit in CHEM 306. 3 lectures. Prerequisite: CHEM 305 or CHEM 351.

CHEM 353 Physical Chemistry III (3)
Principles and applications of quantum chemistry. Chemical bonding and molecular structure. Spectroscopy and diffraction. 3 lectures. Prerequisite: CHEM 352, or CHEM 306, or consent of instructor.

CHEM 354 Physical Chemistry Laboratory (2)
Experimental studies of gases, solutions, thermochemistry, chemical and phase equilibria, electrochemistry, chemical and enzyme kinetics, computational methods and applications to chemistry and biochemistry. Use of applicable literature and databases. 2 laboratories. Prerequisite: CHEM 231/331 and CHEM 306 or CHEM 352.

CHEM 357 Physical Chemistry III Laboratory (1)
Experimental and computational investigations of quantum chemistry, spectroscopy, symmetry and statistical chemistry. 1 laboratory. Corequisite: CHEM 353.

CHEM 371 Biochemical Principles (5)
Chemical and physical factors in biological processes. Chemistry and function of major cellular constituents: proteins, lipids, carbohydrates. 4 lectures, 1 laboratory. Prerequisite: CHEM 212/312 or CHEM 217/317. Recommended: CHEM 231/331.

CHEM 372 Metabolism (3)
Intermediate metabolism, regulation and integration of metabolic pathways, bioenergetics, photosynthesis, electron transport, nitrogen fixation, biochemical function of vitamins and minerals. 3 lectures. Prerequisite: CHEM 371.
CHEM 373 Molecular Biology (3)

CHEM 374 Biochemistry Laboratory (2)
Experiments in microbial metabolism, purification, analysis and manipulation of proteins and nucleic acids. 2 laboratories. Prerequisite: CHEM 371.

CHEM 375 Molecular Biology Laboratory (2)
(Also listed as BIO 375)
Introduction to techniques used in molecular biology and biotechnology; plasmid DNA extraction, characterization and use in transformation. Gene cloning, Southern blotting, reverse transcription, and polymerase chain reaction. 2 laboratories. Prerequisite: MCRO 221 or MCRO 224, and BIO 351 or CHEM 373.

CHEM 377 Chemistry of Drugs and Poisons (3)
Introduction to pharmacology: history, sources, development and testing, physical and chemical properties, biochemical and physiological effects, mechanisms of action, and the therapeutic uses and toxicology of common drugs and poisons acting on the nervous, cardiovascular, immune and hormone systems, and on cancer, infectious disease, etc. Especially applicable to students in nonbiochemical disciplines. 3 lectures. Prerequisite: CHEM 313 or CHEM 371 or consent of instructor.

CHEM 385 Geochemistry (3)
Application of chemical principles to terrestrial and extraterrestrial systems. Formation of the elements; chemical influences on the earth's formation; chemical evolution studies; age-dating techniques; reactions in sea water; petroleum and ore formation; distribution and movement of the systems. Formation of the elements; chemical influences on the earth's atmosphere, oceans and crust; thermal history of the earth and the moon; applications to problems of origin of life, geophysical exploration, and mineral formation. 3 lectures. Prerequisite: CHEM 316/317, CHEM 218/318.

CHEM 400 Special Problems for Advanced Undergraduates (1–3)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 3 units per quarter. 1-3 laboratories. Prerequisite: Junior standing and consent of department head.

CHEM 405 Advanced Physical Chemistry (3)
Selected advanced topics in physical chemistry, which may include statistical mechanics, computational chemistry, nonequilibrium thermodynamics, lasers in chemistry, solid-state and/or advanced spectroscopy. Total credit limited to 6 units. 3 lectures. Prerequisite: CHEM 353 or consent of instructor.

CHEM 419 Bioorganic Chemistry (3)
Methods of investigating reaction mechanisms, mechanisms of chemical catalysis, organic models of enzymes, chemistry of vitamins that serve as enzyme cofactors, chemistry of the phosphate group, synthesis of biomolecules. 3 lectures. Prerequisite: CHEM 218/318.

CHEM 420 Advanced Organic Chemistry–Synthesis (3)

CHEM 437 Clinical Chemistry II (3)
Advanced principles of physiologic chemistry including clinical significance of medical laboratory data. Theoretical and practical aspects of biochemical profiling. Theory of biochemical techniques in clinical chemistry and pathology, metabolic and organ-specific investigations and interpretation of results, clinical instrumentation, serum enzyme and hormone assay techniques. 3 lectures. Prerequisite: CHEM 337 or CHEM 372.

CHEM 438 Clinical Chemistry Laboratory II (1) (CR/NC)
Theory and practice of biochemical techniques in clinical chemistry and pathology. Overview of clinical instrumentation. Credit/No Credit grading only. 1 laboratory. Prerequisite: CHEM 338 or CHEM 372; corequisite: CHEM 437.

CHEM 439 Instrumental Analysis (5)
Theory, practice and method selection of modern instrumental analytical techniques, including spectroscopic, electrochemical, chromatographic and thermal methods. Current industrial applications. Laboratory work emphasizes optimization of experimental parameters. 3 lectures, 2 laboratories. Prerequisite: CHEM 231/331, CHEM 354. Recommended: CHEM 353.

CHEM 444 Polymers and Coatings I (3)
Physical properties of polymers and coatings and their measurement. Molecular weight averages, glass transition, thermodynamics of polymers. Viscoelastic properties, rheology, molecular weight determination. Thermal analysis, spectroscopic analysis, mechanical testing. 3 lectures. Prerequisite: CHEM 217/317.

CHEM 445 Polymers and Coatings II (3)
Introduction to polymerization methods and mechanisms. Chemistry of initiators, catalysts and inhibitors. Uses of representative polymer types. Synthesis, film formation, structure and properties of polymers commonly used in coatings and adhesives. 3 lectures. Prerequisite: CHEM 217/317.

CHEM 446 Surface Chemistry of Materials (3)
(Also listed as MATE 446)
Surface energy. Capillarity, solid and liquid interface, adsorption. Surface areas of solids. Contact angles and wetting. Friction, lubrication and adhesion. Relationship of surface to bulk properties of materials. Applications. 3 lectures. Prerequisite: CHEM 305 or CHEM 351 or course in engineering thermodynamics.

CHEM 447 Polymers and Coatings Laboratory I (2)

CHEM 448 Polymers and Coatings Laboratory II (2)

CHEM 449 Internship in Polymers and Coatings (2)
Selected students will spend up to 12 weeks with an approved polymers and coatings firm engaged in production or related business. Time will be spent applying and developing production and technical skills and abilities in the polymers and coatings industry. Prerequisite: CHEM 217/317 or consent of instructor.

CHEM 450 Chemical Warfare (2)
History, development, and use of chemical weapons. Chemical disarmament. Production and destruction of modern agents. Use of chemical agents in Southeast Asia and Middle East. Ethics of chemical warfare. 2 seminars. Prerequisite: CHEM 212/312 or CHEM 216/316.

CHEM 455 FT-NMR Laboratory (1) (CR/NC)
Basic theory and operation of the high-field Fourier transform nuclear magnetic resonance spectrometer. Credit/No Credit grading only. Not open to students with credit for CHEM 458. 1 laboratory. Prerequisite: CHEM 319.

CHEM 458 Instrumental Organic Qualitative Analysis (3)
Separation, purification, and identification of organic molecules using chemical and instrumental methods, including nuclear magnetic resonance, infrared and ultraviolet spectroscopy and mass spectrosocopy,
and techniques in high resolution FT-NMR. 1 lecture, 2 laboratories. Prerequisite: CHEM 319.

**CHEM 459 Undergraduate Seminar (2)**
Oral presentation of current developments in chemistry based on current literature. Searching, organizing and presenting chemical information. Preparation for employment and for independent work, including senior project, in chemistry. 2 seminars. Prerequisite or corequisite: CHEM 359 and junior standing.

**CHEM 460 Senior Project – Extended Report (1)**
Extended report on a topic from either an elective laboratory course or an off-campus laboratory experience. Consent of a supervising faculty member must be obtained prior to enrollment in the laboratory course or the off-campus experience. Minimum 30 hours time commitment. Prerequisite: CHEM 359, CHEM 459, and consent of instructor.

**CHEM 461 Senior Project – Literature Review (2)**
Completion of a written literature review project under faculty supervision. Written report includes analysis of experimental results presented in the chemical or biochemical literature. Minimum 60 hours time commitment. Prerequisite: CHEM 359, CHEM 459, and consent of instructor.

**CHEM 462 Senior Project – Laboratory Research (2)**
Completion of a laboratory research project and written report under faculty supervision. Minimum 60 hours time commitment. Total credit limited to 4 units. Prerequisite: CHEM 359, CHEM 459, and consent of instructor.

**CHEM 463 Senior Project – Honors Report (2)**
Advanced laboratory research. Results are presented in a poster session or other public forum. Minimum 60 hours time commitment. Prerequisite: 4 units of CHEM 462 and consent of instructor.

**CHEM 465 College Teaching Practicum (1–2) CR/NC**
Teaching assignment in an undergraduate college classroom. Includes teaching and related activities under the direction of a permanent faculty member in the Department of Chemistry and Biochemistry. Total credit limited to 4 units. Prerequisite: Junior standing, CHEM 231/331 (or permission of instructor), evidence of satisfactory preparation in chemistry. Department chair approval required.

**CHEM 470 Selected Advanced Topics (1–4)**
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. Prerequisite: CHEM 305, or CHEM 351, or CHEM 217/317 or consent of instructor.

**CHEM 471 Selected Advanced Laboratory (1–4)**
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 to 4 laboratories. Prerequisite: Consent of instructor.

**CHEM 472 Plant Biochemistry (3)**
Application of plant biochemistry, molecular biology and physiology to topics, including plant secondary metabolism, defense mechanisms, drought tolerance, functional genomics, advanced photosynthesis, circadian rhythms, manipulation of plants for improved nutrition, other current research topics. 3 lectures. Prerequisite: CHEM 313 or CHEM 371 or BIO 435.

**CHEM 473 Immunoochemistry (3)**
Theory and practice of immunochemistry including the structure, genetics, chemical modification and production of antibodies, immunological techniques and the biochemistry of the immune defense process. 3 lectures. Prerequisite: CHEM 371 or consent of instructor.

**CHEM 474 Protein Techniques Laboratory (2)**
Experiments in protein affinity chromatography, electrophoresis and blotting, immunoprecipitation techniques, antibody–enzyme conjugation, and immunoassay. 2 laboratories. Prerequisite: CHEM 313 or CHEM 371.

**CHEM 475 Tissue Culture Techniques (4) Also listed as BIO 475**
Introduction to the principles and methods of tissue culture with emphasis on the manipulation and study of animal cells. 2 lectures, 2 laboratories. Prerequisite: MCRO 224, BIO 303 or BIO 351 and CHEM 313 or CHEM 371.

**CHEM 477 Biochemical Pharmacology (3)**
Consideration of current selected topics in pharmacology including drug design, biochemical mechanisms of drug activity and issues pertaining to the disposition of drugs to the public. Lecture, professional consultation, library research, and student presentations. 3 lectures. Prerequisite: CHEM 377 or equivalent as determined by instructor.

**CHEM 481 Inorganic Chemistry (3)**
A systematic study of chemical and physical properties of inorganic compounds based on periodic groupings with emphasis on chemical bonding and structure. Topics will include coordination chemistry and kinetics, organometallic chemistry, advanced acid-base relationships and bonding theories plus other selected topics. 3 lectures. Prerequisite: CHEM 306, or CHEM 352, and CHEM 231/331 or consent of instructor.

**CHEM 483 Inorganic Synthesis (1)**
Synthetic methods involving the preparation and characterization of a variety of inorganic, organometallic and coordination compounds employing high temperature, inert atmosphere, photolytic, electrolytic and other synthetic techniques. Use of specialized inorganic chemical literature. 1 laboratory. Prerequisite or concurrent: CHEM 481.

**CHEM 485 Cooperative Education Experience (6) (CR/NC)**
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. 2 units only applicable to approved chemistry electives. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

**CHEM 495 Cooperative Education Experience (12) (CR/NC)**
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. 2 units only applicable to approved chemistry electives. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

**CHEM 528 Nutritional Biochemistry (3)**
Nutritional aspects of biochemistry. Lecture, library research and student presentations. Topics include vitamins and minerals, essential and energy providing nutrients, deficiency, degenerative and genetic diseases of metabolism. Emphasis on current research and controversy. 3 lectures. Prerequisite: CHEM 313 or CHEM 372 or consent of instructor.

**CM–CONSTRUCTION MANAGEMENT**

**CM 211 Construction Contract Documents (4)**
Basic skills and techniques required to produce construction contract documents conforming to current building codes and standards, including working drawings, specifications, bid documents, addenda and change orders. 4 laboratories. Prerequisite: ARCH 106, ARCH 111.

**CM 212 Fundamentals of Construction Management (3)**
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. 3 laboratories. Prerequisite: CM 211 and AE 237.
CM 315 Fiscal and Project Feasibility (4) (Also listed as CRP 315)
Analysis of the revenue streams and costs involved in project development. Impact analysis of costs and revenues on private and public sectors included. Impact analysis of costs and revenues on private and public sectors included. Construction of pro-formas for various project types. 3 lectures, 1 laboratory. Prerequisite: ECON 201 or ECON 221.

CM 321 Concrete Technology (3)
Modern concepts which form the basis for solutions to problems of concrete construction. Includes significant developments in concrete chemistry and strength theory. Concrete mix design, physical properties of concrete, use of admixtures, concrete batching, curing and testing. Includes physical testing of designed mixes. 2 lectures, 1 laboratory. Prerequisite: Third-year standing.

CM 325 Construction Management Practices (3)
Overview of construction methods, building systems, construction and contract documents, cost estimating and scheduling and other practices used in the contracting process. For non-majors. 2 lectures, 1 activity. Prerequisite: Second-year standing or consent of instructor.

CM 331 Construction Cost Control (3)
Basic application of construction cost control systems and the use of cost information and associated reports. 3 lectures. Prerequisite: BUS 212 and third-year standing or consent of instructor.

CM 332 Cost Alternatives Evaluation (4)
Basic principles of economic evaluations between cost alternatives. 4 lectures. Prerequisite: ECON 222 or consent of instructor.

CM 333 Construction Contracts Administration (3)
Administration of construction documents including invitation to bid, addenda, proposals, change orders, subcontracts, liens, claims, waivers, and arbitration. 3 lectures. Prerequisite: BUS 201 and third-year standing or consent of instructor.

CM 341 Residential and Light Commercial Construction Practices (3)
Building systems, equipment, materials, and techniques. Construction practices related to residential and light commercial structures. One designated field trip required. 3 laboratories. Prerequisite: Third-year standing.

CM 342 Commercial, Institutional and Industrial Construction Practices (3)
Building systems, equipment, materials, and techniques. Construction practices related to large commercial, institutional and industrial structures. One designated field trip required. 3 laboratories. Prerequisite: Third-year standing.

CM 343 Earthwork and Civil Works Construction Practices (3)
Earthwork and civil works construction methods, stressing field operations management, engineering estimating. 3 laboratories. Prerequisite: Third-year standing.

CM 350 Computer Applications in Construction Management (2)
Application of computer systems to control construction operations in the building industry. Development of construction management games. 2 lectures. Prerequisite: CSC 110 or ARCH 250.

CM 352 Building Support System Construction Practices (4)
Equipment, materials and techniques of installation and construction of underground utilities and electrical power systems. Includes water supply and collection, electrical and gas distribution, Communications, CATV and conveyance systems. Emphasis on the role of specialty contractors in the construction process. 4 activities. Prerequisite: Third-year standing.

CM 353 Building Support System Construction Practices (4)
Equipment, materials and techniques of installation and construction of environmental systems. Includes commercial and industrial piping, environmental systems controls, and conveyances. Emphasis on the role of specialty contractors in the construction process. 4 activities. Prerequisite: Third-year standing.

CM 364 Project Administration (3)
Management activities applicable to the construction project involving techniques, applications, and theory needed in a changing environment. An interdisciplinary approach addressing the relationship and roles of the project team of the constructor, architect, engineers and owner. 3 laboratories. Prerequisite: Third-year standing.

CM 400 Special Problems for Advanced Undergraduates (1–2)
Individual investigation, research, studies or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of department head.

CM 431 Management of Interdisciplinary Functions in Construction (3)
Management activities applicable to the building process including conceptual, planning, design, bid, negotiation, construction, and occupancy phases of public and private projects. Emphasis on the integration of planning, design and construction efforts to achieve maximum project quality and value. 3 activities. Prerequisite: Upper division standing.

CM 433 Economic Analysis for Engineers (2)
Engineering economics, and engineering studies including feasibility and alternate problem analysis. 2 lectures.

CM 443 Principles of Construction Management (3)
Applications of a broad range of construction management techniques to case studies involving a variety of operations in construction firms. 3 activities. Prerequisite: Fourth-year standing or consent of instructor.

CM 444 Concrete Formwork and Temporary Structures (3)
Methods and techniques used in the design and construction of concrete formwork, temporary earth retaining systems, and other temporary construction structures. 3 activities. Prerequisite: Fourth-year standing or consent of instructor.

CM 452 Project Controls (3)
Planning, organization, scheduling, and control of construction projects. 3 laboratories. Prerequisite: Fourth-year standing or consent of instructor.

CM 453 Project Development (4)
Methods and procedures used in the development of a residential, commercial, or industrial project. 4 laboratories. Prerequisite: Fourth-year standing, CRP 212 or consent of instructor.

CM 454 Building Estimating (3)
Procedures for analyzing materials and methods involved in estimating costs for construction projects. 3 laboratories. Prerequisite: Fourth-year standing or consent of instructor.

CM 461, 462 Senior Project (2) (CR/NC)
Selection and completion of a comprehensive project under faculty supervision. Problems to involve the student's technical and creative skills. Construction and team projects encouraged. To be completed in two consecutive quarters. 90 hours minimum total time. Credit/No Credit grading only. Prerequisite: CM 341, CM 342, CM 343.

CM 463 Professional Practice for Senior Construction Project Managers (4)
Practical application of construction management theory and practice solving problems in a simulated professional environment. Computer applications used in the decision making process. 4 laboratories: Prerequisite: CM 443, CM 452, CM 454.

CM 470 Selected Advanced Topics (1–4)
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. Miscellaneous course fee required–see Class Schedule. 1 to 4 lectures. Prerequisite: Consent of instructor.

CM 471 Selected Advanced Laboratory (1–4)
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. Prerequisite: Consent of instructor.

CM 475 Real Property Development Principles (4)
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. Prerequisite: Upper-division standing.

CM 485 Cooperative Education Experience (6) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

CM 495 Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Total credit limited to 16 units. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

CM 531 Construction Cost and Material Control (3)
Advanced theory and practice of cost and material control for construction projects. Emphasis on computer applications. 2 lectures, 1 activity. Prerequisite: CM 331 or consent of instructor.

CM 533 Case Histories in Contract Administration (3)
Common points of disputes between design professional, owner, and contractor. Methods of avoidance and dispute resolution. 3 activities. Prerequisite: CM 333, 4th year architectural practice or consent of instructor.

CM 542 Construction Estimating and Bidding Strategy (3)
Advanced theory and practice of cost estimating techniques. Includes standard, conceptual and parameter estimating; risk analysis. Emphasis on computer applications. 2 lectures, 1 activity. Prerequisite: CM 420 or consent of instructor.

CM 552 Construction Project Scheduling (3)
Basic and advanced network scheduling techniques as applied to architectural building projects. Emphasis on computer applications. 2 lectures, 1 activity. Prerequisite: CM 542 or consent of instructor.

CM 570 Selected Advanced Topics in Construction Management (4)
Directed study of selected topics in Construction Management. Class Schedule will list topic selected. Total credit limited to 12 units. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

CPE–COMPUTER ENGINEERING

CPE 100 Computer Engineering Orientation (1) (CR/NC)
Introduction to the computer engineering discipline. Success skills and curricular information. Career paths and opportunities. Professional aspects of engineering and computer science. Interaction with upper division students, alumni, faculty and staff. Introduction to computer software and hardware. Credit/No Credit grading only. 1 lecture.

CPE 101 Fundamentals of Computer Science I (4)
(Also listed as CSC 101)
Basic principles of algorithmic problem solving and programming using methods of top-down design, stepwise refinement and procedural abstraction. Basic control structures, data types, and input/output. Introduction to the software development process: design, implementation, testing and documentation. The syntax and semantics of a modern programming language. 3 lectures, 1 laboratory. Prerequisite: CSC 100 or CSC 111 or consent of instructor.

CPE 102 Fundamentals of Computer Science II (4)
(Also listed as CSC 102)
Continuation of the software development process: requirements analysis, specification, design, implementation and testing of abstract data types. Application development using abstract data types. Introduction to the analysis of algorithms. Software design case studies and practice. 3 lectures, 1 laboratory. Prerequisite: CPE 101 with a C- grade or better and either MATH 141 or MATH 221 with a C- grade or better, or consent of instructor.

CPE 103 Fundamentals of Computer Science III (4)
(Also listed as CSC 103)
Continuation of material from CPE 102: abstract data types specification and implementation, the analysis of algorithms and the software development process. Introduction to a specific high level design notation. Recursive algorithms. Software design case studies and practice. Software testing and program verification. 3 lectures, 1 laboratory. Prerequisite: CPE 102 with a C- grade or better and CSC 141 with a C- grade or better, or consent of instructor.

CPE 109 Accelerated Introduction to Computer Science (5) (Also listed as CSC 109)
Accelerated coverage of the material in CPE 101, CPE 102, and CPE 103. 4 lectures, 1 activity. Corequisite: CSC 141, significant background in computer science, and consent of instructor.

CPE 200 Special Problems for Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of CPE Director.

CPE 205 Software Engineering I (4) (Also listed as CSC 205)
Introduction to the software lifecycle. Methods and tools for the analysis, design, and specification of large, complex software systems. Project documentation, organization and control, communication, and time and cost estimates. Group laboratory project. Graphical User Interface Design. Technical presentation methods and practice. Software design case studies and practices. Ethical and societal issues in software engineering. Miscellaneous course fee may be required–see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CPE 103.

CPE 206 Software Engineering II (4) (Also listed as CSC 206)
Continuation of the software lifecycle. Methods and tools for the implementation, integration, testing and maintenance of large, complex software systems. Program development and test environments. Group laboratory project. Technical presentation methods and practice. Ethical and societal issues in software engineering. 3 lectures, 1 laboratory. Prerequisite: CPE 205.

CPE 215 Computer Architecture I (4) (Also listed as CSC 215)
Assembly level computer organization. Basic machine representation of numeric and non-numeric data. Assembly level instruction sets, address modes and the underlying computer architecture. Intended for CPE and CSC majors. Miscellaneous course fee required–see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CPE 219 and CPE 102.

CPE 219 Logic and Switching Circuits (3) (Also listed as EE 219)
Modulo-N arithmetic and digital coding techniques. Fundamentals of Boolean algebra and minimization techniques. Two-level logic realizations of SOP and POS functions, and an introduction to multi-level logic. Multiple function synthesis using PLDs and gate arrays.
Combination circuit design as it applies to computers. Sequential circuit elements, flip-flops, counters and shift-registers. 3 lectures. Prerequisite: CPE 101 or CSC 234. Concurrent: CPE 259.

**CPE 259 Logic and Switching Circuits Laboratory (1)**
(Also listed as EE 259)

Laboratory synthesis of combinational logic circuits and counters. Introduction to laboratory equipment such as logic state analyzers. Use of software (both off-the-shelf and customized) for logic simulation and design. Introduction to use of PLDs and hardware description languages in combinational design and testing. 1 laboratory. Concurrent: CPE 219.

**CPE 270 Computer Graphics Applications (4)**
(Also listed as CSC 270)

Use of common graphics applications packages. Business graphics, figure editing, animation and image editing, photorealistic image generation, scientific visualization and multimedia. 2 lectures, 2 activities.

**CPE 305 Individual Software Design and Development (4)**
(Also listed as CSC 305)

Practical software development skills needed for construction of mid-sized production-quality software modules, using the CSC upper division programming language. Topics include inheritance, exceptions, and memory and disk-based dynamic data structures. Students must complete an individual programming project of mid-level complexity. 3 lectures, 1 laboratory. Prerequisite: CPE 103.

**CPE 315 Computer Architecture II (4)**
(Also listed as CSC 315)

Intermediate architecture topics. Levels of virtual machines and their languages. Special emphasis on data paths and microprogramming. Design of conventional machines; study of trade-offs in various designs. Miscellaneous course fee required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CPE 103, CPE 215, CPE 219.

**CPE 316 Computer Architecture III (4)**
(Also listed as CSC 316)

Microprocessor architecture and interfacing. Emphasis on study of one microprocessor and how it interfaces with other logical components of a computer system. Serial and parallel I/O, static and dynamic RAM, ROM, DMA and Disk Controllers. 3 lectures, 1 laboratory. Prerequisite: CPE 315.

**CPE 319 Digital System Design (3)**
(Also listed as EE 319)

Introduction to the design of digital systems utilizing state-machines; analysis and synthesis of state-machines. Design of synchronous, asynchronous, and pulse mode sequential logic circuits. Practical considerations of digital system design and implementation. Emphasis on the use of PLDs and hardware description language for implementation technology. Considerations of testing of digital systems as a part of design. 3 lectures. Prerequisite: CPE 219, EE 307. Concurrent: CPE 359.

**CPE 336 Microprocessor System Design (4)**
(Also listed as EE 336)

Introduction to microcontrollers and integrated microprocessor systems. Emphasis on the Intel 8051 and Motorola 68HC11 families and derivatives. Hardware/software trade-offs, system economics, and functional configurations. Interface design, real-time clocks, interrupts, A/D conversion, serial and parallel communications, watchdog timers, low power operation, and assembly language programming techniques. Architecture and design of sampled data and digital control systems. Case studies of representative applications. 3 lectures, 1 laboratory. Prerequisite: CPE/EE 219/259.

**CPE 348 Bioinformatics (4)**
(Also listed as BIO/CHEM/CSC 348)

GE Area F

Introduction to problems in molecular biology and the use of computers to address them. The computational perspectives on problems involving nucleic acid and protein analysis, and the algorithmic and database approaches to their solution. The ethical and societal challenges of genetic manipulation. 3 lectures, 1 laboratory. Prerequisite: Consent of instructor, or the following: CPE 103, completion of GE Area B, and junior standing.

**CPE 353 Computer Systems Programming (3)**

Design of assemblers, macroprocessors, linkers and loaders. Advanced macrowriting, I/O programming, and interrupt handlers. 3 lectures. Prerequisite: CPE 215, CPE 103.

**CPE 359 Digital System Design Laboratory (1)**
(Also listed as EE 359)

Laboratory synthesis of combination and sequential logic circuits. Implementation with PLDs and hardware description language. Sequential analysis with the logic state analyzer. Fault testing and automated checkout procedures. Familiarization with the characteristics of SSI and MSI logic components. 1 laboratory. Prerequisite: CPE 259, EE 347. Concurrent: CPE 319.

**CPE 365 Introduction to Database Systems (4)**
(Also listed as CSC 365)

Basic principles of database management systems (DBMS) and of DBMS application development. DBMS objectives, systems architecture, database models with emphasis on Entity-Relationship and Relational models, data definition and manipulation languages, the Structured Query Language (SQL), database design, application development tools. 3 lectures, 1 laboratory. Prerequisite: CPE 103.

**CPE 366 Database Modeling, Design and Implementation (4)**
(Also listed as CSC 366)


**CPE 369 Introduction to Distributed Computing (4)**
(Also listed as CSC 369)

Introduction to distributed systems as a computing paradigm, the client-server model, distributed algorithms, interprocess communication, distributed computing environment, data replication and fault tolerance. Emphasis on distributed software above the operating system layer. 3 lectures, 1 laboratory. Prerequisite: CPE 103.

**CPE 400 Special Problems for Advanced Undergraduates (1–2)**

Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of CPE coordinator.

**CPE 402 Software Requirements Engineering (4)**
(Also listed as CSC 402)

Software requirements elicitation, analysis and documentation. Team process infrastructure and resource estimation to support appropriate levels of quality. Software architectural design. 3 lectures, 1 laboratory. Prerequisite: CPE/CSC 206, CPE/CSC 305, CPE/CSC 494 or CPE/CSC 495.

**CPE 405 Software Construction (4)**
(Also listed as CSC 405)

Design and construction of sizeable software products. Technical management of software development teams. Software development process models, software design, documentation, quality assurance during development, software unit and integration testing; CASE tools, development environments, test tools, configuration management. 3 lectures, 1 laboratory. Prerequisite: CPE/CSC 402.

**CPE 406 Software Deployment (4)**
(Also listed as CSC 406)

Deployment of a sizeable software product by a student team. Software maintenance and deployment economic issues. Management of deployed software: version control, defect tracking and technical support. CPE/CSC 406 is the capstone software engineering course. 3 lectures, 1 laboratory. Prerequisite: CPE/CSC 405.
CPE 415 Microcomputer Systems (4)
Recent advances in microcomputer architectures. RISC, parallel processing advances, and component communication. 3 lectures, 1 laboratory. Prerequisite: CPE 316.

CPE 430 Programming Languages II (4) (Also listed as CSC 430)
Regular languages and finite automata. Table-driven lexical analysis. Recognition of reserved words. Symbol table construction. Parsing: top-down (LL) and bottom-up (LR). Table-driven versus recursive descent parsing. Context-free languages and pushdown automata. 3 lectures, 1 laboratory. Prerequisite: CSC 330 and CSC 445.

CPE 431 Programming Languages III (4) (Also listed as CSC 431)

CPE 434 Compilers – Hardware/Software Interface (4)
(Also listed as CSC 434)
Block structured programming languages, their design and implementation via retargetable compilers, with emphasis on code generation for a variety of contemporary computer architectures. 3 lectures, 1 laboratory. Prerequisite: CPE 205 and CPE 315.

CPE 435 Introduction to Object Oriented Design Using Graphical User Interfaces (4) (Also listed as CSC 435)
Principles of object-oriented design, with emphasis on use of these principles in the design of graphical interfaces. Comparison and contrasting of two major object-oriented languages and their corresponding GUI class libraries. Language-independent object-oriented design methods, and application of these methods in the construction of a GUI-based project. 3 lectures, 1 laboratory. Prerequisite: CPE 103 or equivalent and CPE 305.

CPE 437 Digital Computer Subsystems (3) (Also listed as EE 437)
Design of components and subsystems in digital computers. Use of modern techniques and devices (CPLDs and FPGAs) in implementation. Consideration given to cost/speed tradeoffs. Implementation of a basic digital computer using pre-designed subsystems. 3 lectures. Prerequisite: CPE/EE 319. Concurrent: CPE/EE 478.

CPE 438 Digital Computer Systems (3) (Also listed as EE 438)
Design of computer ALU’s, microprogram controllers, memory systems, and I/O controllers. Use of LSI components in CPU design. Microprogram and nanoprogram development. 3 lectures. Prerequisite: CPE 437 or consent of instructor.

CPE 439 Computer Peripheral Interfacing (3)
(Also listed as EE 439)
Design of the more common computer peripherals with the emphasis on the controller and interfacing aspects. Use of microprocessors and/or LSI controller chips in the design of intelligent peripherals. 3 lectures. Prerequisite: CPE 336, or consent of instructor.

CPE 453 Introduction to Operating Systems (4)
(Also listed as CSC 453)
Introduction to sequential and multiprogramming operating systems; kernel calls, interrupt service mechanisms, scheduling, files and protection mechanisms, conventional machine attributes that apply to operating system implementation, virtual memory management, and I/O control systems. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CPE 315.

CPE 454 Implementation of Operating Systems (4)
(Also listed as CSC 454)
Design and implementation of multiprogramming kernels, systems programming methodology, interprocess communications, synchronization, device drivers and network access methods. 3 lectures, 1 laboratory. Prerequisite: CPE 453.

CPE 459 Real-Time Systems (4) (Also listed as CSC 459)
Analysis and synthesis of robust real-time systems including embedded systems, real-time architectures, and programming, parallel processing, specification techniques, algorithms for guaranteeing stringent timing constraints. Understanding of the trade-offs between robustness and response times of time-critical systems. 3 lectures, 1 laboratory. Prerequisite: CPE 315.

CPE 461, 462 Senior Project (3) (2)
Selection and completion of a project under faculty supervision. Project results are presented in a formal report. Miscellaneous course fee required—see Class Schedule. Minimum 150 hours total time. Prerequisite: CPE 315, CPE 319, CPE 359.

CPE 464 Computer Networks I (4) (Also listed as CSC 464)
Communications architectures and distributed systems; multicomputer complexes and interprocessor communications; communications media, message switching, and communications protocol standards. 3 lectures, 1 laboratory. Prerequisite: CSC 141 and CPE 315.

CPE 465 Computer Networks II (4) (Also listed as CSC 465)
Network architectures and protocols; network performance analysis; the theory of error detection and correction; other advanced topics such as routing, network management, integrated services, satellite networks, fiber optics. 3 lectures, 1 laboratory. Prerequisite: CPE 464.

CPE 468 Database Management Systems Implementation (4)
(Also listed as CSC 468)
Data structures and algorithms used in the implementation of database systems. Implementation of data and transaction managers: access methods interfaces, concurrency control and recovery, query processors and optimizers. Introduction to implementation of distributed database systems. 3 lectures, 1 laboratory. Prerequisite: CPE 365.

CPE 470 Selected Advanced Topics (1–4)
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. Prerequisite: Consent of instructor.

CPE 471 Introduction to Computer Graphics (4)
(Also listed as CSC 471)
Graphics hardware and primitives. Modeling and rendering, geometric transforms, hidden-surface removal, the graphics pipeline, scan-conversion and graphics applications. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CPE 103 and CSC 141.

CPE 473 Advanced Rendering Techniques (4)
(Also listed as CSC 473)
Illumination models, reflectance, absorption, emittance, Gouraud shading, Phong shading, raytracing polyhedra and other modeling primitives, coherence, acceleration methods, radiosity, form factors, advanced algorithms. 3 lectures, 1 laboratory. Prerequisite: CPE 471.

CPE 474 Computer Animation (4) (Also listed as CSC 474)
Basic and advanced algorithms for generating sequences of synthetic images. Interpolation in time and space, procedural and keyframe animation, particle systems, dynamics and inverse kinematics, morphing and video. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CPE 471.

CPE 475 Multimedia Tool Development (4)
(Also listed as CSC 475)
Algorithms and techniques for creating multimedia applications. Topics include audio and video compression techniques, multimedia network architectures, synchronization of audio and video, multimedia toolkits, user interfaces and file systems. 3 lectures, 1 laboratory. Prerequisite: CPE 471.
CPE 477 Computer Vision (4) (Also listed as CSC 477)
Fundamental issues in computer vision. Convolution, edge detection and image segmentation. Pattern classification methods and neural networks. Stereoscopic vision and optical flow. 3 lectures, 1 laboratory. Prerequisite: CPE 103 and MATH 206.

CPE 478 Digital Computer Subsystems Laboratory (1) (Also listed as EE 478)
Introduction to industrial grade CAD tools. Design and implementation of digital computer subsystems using SPLDs, CPLDs, and FPGAs. 1 laboratory. Prerequisite: CPE/EE 359. Concurrent: CPE/EE 437.

CPE 480 Artificial Intelligence (4) (Also listed as CSC 480)
Programs and techniques that characterize artificial intelligence. Programming in a high level language. 3 lectures, 1 laboratory. Prerequisite: CPE 103 and CSC 141.

CPE 481 Knowledge Based Systems (4) (Also listed as CSC 481)
In-depth treatment of knowledge representation, utilization and acquisition in a programming environment. Emphasis on the use of domain-specific knowledge to obtain expert performance in programs. 3 lectures, 1 laboratory. Prerequisite: CPE 480.

CPE 484 User-Centered Interface Design and Development (4) (Also listed as CSC 484)
Introduction to the importance of user-centered principles in the design of good interfaces and effective human-computer interaction. Topics include: study of human characteristics affected by interface design, effective requirements data collection and analysis, user-centered approaches to software engineering, and evaluation of interface and interaction quality. 3 lectures, 1 laboratory. Prerequisite: CPE 205.

CPE 485 Cooperative Education Experience (6) (CR/NC)
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. Total credit limited to 16 units. Prerequisite: Sophomore standing and consent of instructor.

CPE 487 Graphical User Interface Systems (4) (Also listed as CSC 487)
Further study of graphical user interface (GUI) programming systems. Structure of tools and underlying systems to build such interfaces. Human factors including considerations of good and bad interfaces. 3 lectures, 1 laboratory. Prerequisite: CPE 435.

CPE 488 Performance Analysis (4) (Also listed as CSC 488)
Statistical and mathematical techniques for modeling and analyzing the performance of computer and communication systems. Tools and techniques for measuring performance of operational systems. Theory and methodologies for the design, procurement and evaluation of systems. Introduction to elementary concepts of discrete event simulation. 3 lectures, 1 laboratory. Prerequisite: STAT 321 or consent of instructor.

CPE 495 Cooperative Education Experience (12) (CR/NC)
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. Total credit limited to 16 units. Prerequisite: Sophomore standing and consent of instructor.

CPE 520 Computer Architecture (4) (Also listed as CSC 520)
Comparative study and design of multiprocessor dataflow, RISC, high level language and other new computer architectures. VLSI processor design techniques. 3 seminars, 1 laboratory. Prerequisite: CPE 315 and graduate standing, or consent of instructor.

CPE 580 Artificial Intelligence (4) (Also listed as CSC 580)
Current research in the field of artificial intelligence with emphasis on cooperative agents, distributed agents, and decision making in complex, concurrent environments. AI programming in a distributed environment. 3 lectures, 1 laboratory. Prerequisite: CPE 481.

CRP–CITY AND REGIONAL PLANNING

CRP 101 Introduction to the Profession of City and Regional Planning (1) (CR/NC)
Introduction to what professional planners do in the public and private sectors and how they help manage growth and change. Credit/No Credit grading only. 1 lecture. Required of freshmen; optional course for transfer students and non-majors.

CRP 201 Basic Graphic Skills (4)
Basic techniques used in graphic communication for representation of the real world on two-dimensional planes. Use of scale, drawing conventions, orthographic and isometric projections, perspective drawings. Sketching, delineation and rendering including the use of black and white and color techniques. 4 laboratories.

CRP 202 Introduction to Environmental Design (4)
Exploring elements and principles of environmental design. Understanding the form and character of the designed urban environment. Introduction to problem analysis and problem solving in environmental design. Implications of design decisions and solutions on urban context. Assignments of object, project and system scale in an urban context. 4 laboratories. Prerequisite: CRP 201.

CRP 203 Intermediate Environmental Design (4)
Applications of basic design fundamentals and skills to the design of environments through design exercises applied to planning. Problem analysis and problem solving skills as applied to environmental design issues. Miscellaneous course fee required—see Class Schedule. 4 laboratories. Prerequisite: CRP 202.

CRP 211 Cities: Form, Culture and Evolution (4)
Historical overview of the evolution of cities—how the form and function of cities evolved among different societies from antiquity to contemporary times. Includes early cities in Mesopotamia, Central America; Greece and Rome; Middle Ages, Renaissance, Baroque; and North America. 4 lectures.

CRP 212 Introduction to Urban Planning (4)
Problems and responses to contemporary urban growth and change. Development of theories of urban planning and design. Introduction to zoning, planning regulations and codes, and professional practice. Relationship of environmental design disciplines, citizen groups, and individuals to planning. 4 lectures.

CRP 213 Population, Housing and Economic Applications (4)
Collection, organization, and presentation of information and data related to population, housing and employment. Analytical applications to estimate population over time, housing demand by type and income and employment by standard classification. Application of urban economic theory related to jobs and housing. 3 lectures, 1 activity. Prerequisite: CRP 212, ECON 201.

CRP 214 Land Use and Transportation Studies (4)
How cities and regions work. Relationship between human activities and patterns of land use and circulation. Spatial analysis and location theories. Methods for conducting studies to describe, analyze, and map land uses. Regional-scale transportation analysis, traffic impact studies, and multimodal transportation plans. 3 lectures, 1 activity. Prerequisite: CRP 212.

CRP 215 Planning for and with Multiple Publics (4) (Also listed as ES 215)
How the social/spatial relationships among racial/ethnic and gender groups are expressed in terms of human settlement patterns, civic

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involvement and everyday negotiations. Ways in which segregation and marginalization are expressed in western and non-western contexts. 3 lectures, 1 activity. Prerequisite: Completion of GE Area D1.

CRP 216 Computer Applications for Planning (4)
Introduction to the use of computer applications for planners. Includes spreadsheets, statistical applications, database, geographic information systems, and graphics. Miscellaneous course fee required—see Class Schedule. 2 lectures, 2 laboratories.

CRP 240 Additional Planning Laboratory (1–2)
Total credit limited to 4 units, with a maximum of 2 units per quarter. 1 or 2 laboratories.

CRP 314 Planning Theory (3)
Theories of planning. Role of planner in society, purpose of planning, administrative framework in which planning takes place. Alternative approaches to planning, values, ethics in planning. 3 lectures. Prerequisite: CRP 212.

CRP 315 Fiscal and Project Feasibility (4) (Also listed as CM 315)
Analysis of the revenue streams and costs involved in project development. Impact analysis of costs and revenues on private and public sectors included. Impact analysis of costs and revenues on private and public sectors included. Construction of pro-formas for various project types. 3 lectures, 1 laboratory. Prerequisite: ECON 201 or ECON 221.

CRP 334 Cities in a Global World (4) GE D5
Examination of the changes in the social and spatial organization of urban settlements in the twenty-first century caused by the urbanization and globalization processes. Comparative analysis of the traditional and contemporary cities in the Pacific Rim, South America and Eastern Europe. 3 lectures, 1 activity. Prerequisite: Completion of Area A and two courses from D1, D2, D3, D4.

CRP 336 Regional and Environmental Planning Foundations (4)
Theories, institutional frameworks, and technologies used in environmental planning for human settlements. Comparative study of practices at international, national, bioregional and state/local levels. Impact assessment technologies used in impact analysis for plan administration. Integration of environmental reviews with community planning. 3 lectures, 1 laboratory. Prerequisite: LA 213 or consent of instructor.

CRP 341 Community Design Laboratory (4)
Built environment of the suburb. Urban theories and design methods related to suburban development. Technical aspects of subdivision site planning. Miscellaneous course fee may be required—see Class Schedule. 4 laboratories. Prerequisite: CRP 201, CRP 202, CRP 203.

CRP 342 Regional and Environmental Planning (4)
Case studies and applications of theory and methods to regional and environmental systems. Interrelationships between natural, economic, and social and political systems. Relationship of local plans to federal mandates and to regional and state plans. Environmental equity and sustainable bioregions. Miscellaneous course fee may be required—see Class Schedule. 2 lectures, 2 laboratories. Prerequisite: CRP 336.

CRP 400 Special Problems for Advanced Undergraduates (1–2)
Individual or group investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of department head.

CRP 402 History of Urban Design in North America (4)
Cultural dimensions and political factors in the organization and design of early and contemporary cities in Western regions of the US and Mexico. Special emphasis given to the contributions of the Spanish, and the indigenous people of the Americas (Mayas, Toltecs, Aztecs, Native Americans) on the form and use of settlement patterns. Impact of major ethnic and cultural groups on the design of contemporary cities. 4 lectures. Prerequisite: ENGL 134.

CRP 404 Environmental Law (3) (Also listed as FNR 404)
Analysis and critique of the law governing use and protection of natural resources with focus on the legal institutions entrusted with the public duty of protecting the environment. 3 lectures. Prerequisite: Senior standing, or consent of instructor.

CRP 408 Water Resource Law and Policy (3) (Also listed as FNR 408)
Detailed examinations of the various legal systems of water use, regulation and management in California and the United States. Discussion of the key concepts and principles of state, federal and interstate water quantity and quality control; focusing on issues and problems, why conflicts occur and how solutions evolve. 3 lectures. Prerequisite: FNR 302 or instructor approval, senior standing.

CRP 409 Planning Internship (2–4) (CR/NC)
Work experience as a supervised employee in a planning or related agency or firm. Prior contract specifying the product of internship required between student, agency and faculty. Thirty hours work experience per unit of credit. Total credit limited to 4 units. Credit/No Credit grading. Prerequisite: Consent of instructor.

CRP 410, 411 Community Planning Laboratory (5) (5)
Case study application of planning theory to the community, its components, and to the city and its region. Relationships of city spaces and structures. Basic planning studies and plan-making. Computer applications. Field trips. Individual, team, and interdisciplinary approaches. Miscellaneous course fee required—see Class Schedule. 5 laboratories. Prerequisite: CRP 341, CRP 342.

CRP 412 Implementation (4)
Theory and practice of plan implementation. Regulation and nonregulatory approaches to plan implementation, including development regulation, economic development, growth management, habitat conservation planning, project phasing, redevelopment programs, and transportation system management. The California Specific Plan will serve as the course model. 3 lectures, 1 activity. Prerequisite: CRP 410, CRP 411, or consent of instructor.

CRP 420 Land Use Law (4)
Public controls protecting natural environmental systems. Land use and environmental controls. Review of control mechanisms. State and federal legislation. Legal implications of controls, public planning and policy issues. 4 lectures. Prerequisite: senior standing, or consent of instructor.

CRP 427 Local Economic Development Planning (3)
Processes, skills and approaches for planning local economic development. Theoretical principles and assumptions underlying local economic development programs. Alternative strategies and analytical techniques for planning and implementing economic development. 3 seminars. Prerequisite: Senior standing.

CRP 430 Public Sector Planning Practice (3)
Relationships of planning agencies to other governmental bodies, public agencies and citizen groups. The public planning agency and the private practitioner. Public and personnel relations. Current topics in public sector planning practice. 3 lectures. Prerequisite: CRP 212.

CRP 435 Transportation Theory (3)
Circulation and transportation elements of the General Plan. Transportation planning theory, methods and tools related to systematic analysis of city and regional transportation problems including environmental impact assessment. Application of techniques for assessing transportation systems, gravity models, route selections, land use models and relationship to transportation. 3 seminars. Prerequisite: CRP 212, or consent of instructor.

CRP 436 Collaborative Planning (4)
Focus on processes and skills of citizen participation and consensus building. Application of mediation and negotiation techniques. Use of
collaboration in forming visions of the future and reaching agreements among multiple interests. Use of group process skills to establish effective communication and agreements. Organizing and operating public meetings. 3 lectures, 1 laboratory. Prerequisite: CRP 212 or consent of instructor.

CRP 438 Pollution Prevention and Control (4)  
Interdisciplinary exploration of policy and planning associated with pollution prevention and control, including institutional, legal, economic, political, social, and technology-related aspects. Includes hands-on activity in small groups. 3 lectures, 1 activity. Prerequisite: Senior standing or consent of instructor.

CRP 442 Housing and Planning Seminar (3)  
Analysis of housing issues, policies and programs from a planning perspective, including the economic underpinnings of land markets and housing markets, housing plans, finance, public programs, affordable housing. 3 seminars. Prerequisite: CRP 315 or consent of instructor.

CRP 444 Infrastructure and Planning Management (4)  
Basic infrastructure systems necessary to support urban development. Basic components of systems and how they are planned, financed and managed. 4 seminars. Prerequisite: CRP 410, ENVE 331 or senior standing.

CRP 446 Development Review and Entitlement (4)  
Application of zoning regulations, subdivision ordinances, design standards, building codes, exactions, fees, and related requirements within the development review process leading to land use entitlement. Land development is evaluated from permit application submittal to condition compliance during the plan check, construction, and operational phases of a project. 3 lectures, 1 activity. Prerequisite: Upper division standing.

CRP 447 Design Regulations (4) (Also listed as ARCH 447)  
Practical application of fundamental zoning, subdivision, design/development standards, and building codes in the design review process, either in the form of a proposed development project or preparation of ordinances, codes, standards, and/or guidelines to apply to a project. 3 lectures, 1 activity. Prerequisite: Fourth year standing, or consent of instructor.

CRP 453 Planning and Design Laboratory (4)  
Selected advanced laboratory applications, including urban and regional design. Miscellaneous course fee required—see Class Schedule. 4 laboratories. Prerequisite: CRP 341, CRP 342.

CRP 457 Planning Information Systems (3)  
Computer based systems to manage information pertinent to planning. Approaches to systematic data acquisition, processing and maintenance. Potential of data base systems for information gathering and analysis. Miscellaneous course fee required—see Class Schedule. 2 seminars, 1 laboratory. Prerequisite: Upper-division standing. Basic GIS course.

CRP 460 Undergraduate Seminar (2)  
Research and problem analysis in planning. Professional practice in planning. Professional ethics. Students present organized material on some subject of interest. 2 seminars. Prerequisite: CRP 342, CRP 409.

CRP 461, 462 Senior Project (2) (2)  
Research and problem analysis in planning. Selection and completion of a project under faculty supervision. Projects typical of problems addressed in planning practice. Project results presented in a formal report. To be completed in two quarters. Minimum 120 hours time. Prerequisite: CRP 341, CRP 342.

CRP 470 Selected Advanced Topics (1–4)  
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. Prerequisite: Consent of instructor.

CRP 471 Selected Advanced Laboratory (1–4)  
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. Prerequisite: Consent of instructor.

CRP 472 Planning Colloquium (1) (CR/NC)  
Lecture and discussion by faculty members and invited guests on controversial or topical planning related subject matter at campus and/or off-campus locations. Topics to be announced in advance by CRP Department. Total credit limited to 3 units. Credit/No Credit grading only. 1 seminar. Prerequisite: Upper division standing.

CRP 483 Special Studies in City and Regional Planning (1-12)  
Study of special issues and problems through field research and other forms of investigation and involvement in an off-campus setting. Requirements determined prior to individual project through contractual arrangement between student and department. Departmental Off-Campus Study Program guidelines apply. Class Schedule will list topic selected. Prerequisite: Junior or senior standing.

CRP 500 Individual Study (2–3)  
Independent research, studies, or surveys of selected subjects. Total credit limited to 9 units. Prerequisite: Graduate standing with minimum of 12 core units.

CRP 501 Foundations of Cities and Planning (4)  
Origins and evolutionary stages of settlement patterns and the use of land and natural environment. Changing spatial structure in the development of cities and regions. Beginnings and the historical development of the planning profession. 4 lectures. Prerequisite: Graduate standing.

CRP 505 Principles of Regional Planning (4)  
History, development and major philosophical approaches of regions and regional planning, both in urban-centered and resource-based regions. Effects of relaxing natural, economic and infrastructure limiting factors on growth and development of regions. Normative hierarchical emphasis of contemporary regional planning compared to emerging paradigms that alter the regional/local planning relationship. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

CRP 510 Planning Theory (4)  
Theory of planning. Development of contemporary planning thought from varying sources and perspectives. Political and social context of planning. Alternative professional roles, and planning processes. Values and ethical issues in planning. 4 seminars. Prerequisite: Graduate standing or consent of instructor.

CRP 513 Planning Research Methods (4)  
Application of research design to planning issues. Comparison of case study, comparative and problem-solving methods. Primary and secondary data sources, including field survey techniques. 3 seminars, 1 supervision. Prerequisite: Graduate standing, STAT 221 or equivalent, or consent of instructor.

CRP 514 Computer Applications for M.C.R.P. (2)  
Microcomputer applications used by planners. Focus on planners’ adaptations of spreadsheets, statistical applications, data base systems, graphic presentation. Miscellaneous course fee required—see Class Schedule. 2 laboratories. Prerequisite: Graduate standing.

CRP 515 Planning Presentation and Communication Techniques (3)  
Basic techniques used in effective planning presentations. Introduction to various drawing media and delineation techniques for planners, three-dimensional visualization, graphic skills. Integration of visual and electronic media in presentations. Miscellaneous course fee required—see Class Schedule. 3 laboratories. Prerequisite: Graduate standing.
CRP 516  Quantitative Methods in Planning (4)
Problem recognition, data selection, analysis and synthesis with applications of system design, statistical techniques and symbolic modeling to urban design and regional growth and development policies. Miscellaneous course fee required—see Class Schedule. 3 seminars, 1 laboratory. Prerequisite: CRP 514, graduate standing or consent of instructor.

CRP 518  Public Policy Analysis (4) (Also listed as POLS 518)
Analysis of the social, economic, environmental, political contexts of public policy decisions. Public policy issues and use of concepts and tools related to monitoring and assessment. 3 lectures, 1 research paper. Prerequisite: CRP 501, POLS 360 or consent of instructor.

CRP 520  Feasibility Studies in Planning (4)
Fundamental analysis for assessing feasibility of public and private development projects. Principles and techniques for analyzing markets and assessing cash flow for individual projects. Economic, fiscal and tax impacts as factors determining public participation in private projects. 4 seminars. Prerequisite: CRP 501 or consent of instructor.

CRP 525  Plan Implementation (4)
Theory and practice of plan implementation. Regulatory and non-regulatory frameworks for plan implementation. Growth management, development regulation, capital improvement programs, redevelopment. 4 seminars. Prerequisite: CRP 510 or consent of instructor.

CRP 530  Planning Agency Management (3)
Preparation for mid-level and higher positions in public planning agencies and private firms. Applications of organization theory to planning agencies and firms. Work programs, staff development, budgets, contracting, proposal preparation, conflict management. Relationships with other agencies and firms, clients, public and media. 3 seminars. Prerequisite: CRP 501, CRP 510 or consent of instructor.

CRP 548  Principles of City Design (3)
Introduction to the philosophy and theory particular to city design. Exploration of evaluation criteria and critical analysis of the human environment related to physical design requirements. Spatial and form relationships, scale, human activities, concept formation, visual organization of the city, landscaping and architecture. 3 seminars.

CRP 549  Thesis/Project (6)
Completion of professional project based on a real world planning task or carefully constructed simulation. Requires demonstration of planning judgment and competence through application of a defined and rigorous planning approach. Can be taken in lieu of a thesis. Prerequisite: CRP 553, advancement to candidacy, and consent of department head.

CRP 596  Professional Project (4)
Completion of professional project based on a real world planning task or carefully constructed simulation. Requires demonstration of planning judgment and competence through application of a defined and rigorous planning approach. Can be taken in lieu of a thesis. Prerequisite: CRP 553, advancement to candidacy, and consent of department head.

CRS–CROP SCIENCE

CRSC 101  Orientation to Crop Science (1) (CR/NC)
Understanding the depth and breadth of field crops, fruit and vegetable production and plant protection. Examination of the potential career opportunities and introduction to both student and professional organizations and affiliations. Required of all Crop Science Department students. Credit/No Credit grading only. 1 activity.

CRSC 123  Forage Crops (4)
Forages as a world resource in food and animal production, soil and water conservation and sustainable agricultural systems. Forage use systems: pasture and range, green chop, silage, hay and cubes. Identification and management of limiting factors of forage plant growth. Botany of legumes and grasses. Grass, legume and weed identification. Forage crop improvement. Forage composition and quality. Antiquity factors. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory.

CRSC 131  Introduction to Crop Science (4)
Production principles for field and vegetable crops. Fundamental botany, taxonomy and cultural practices. Soil tillage, fertilization, seed selection, planting and harvesting methods, irrigation, weed control, pest control, and crop rotation. Production practices for cotton. A field trip to a major California production area is required. Not open to students with credit in CRSC 230. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory.

CRSC 132  Cereal Grain Production (4)
Production, adaptation, distribution, and utilization of major grain crops harvested by combine, including wheat, barley, oats, corn, rice, sorghum, rye, triticale, and millets. Field trips to major California cereal production areas. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CRSC 131 or CRSC 230.

CRSC 133  Row Crop Production (4)
Adaptation, distribution, production, processing, and utilization of major row crops such as potatoes, tomatoes, dry beans, and sugar beets. Special emphasis on working with beds and furrows. Field trip to a major California row crop production area required. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CRSC 131 or VGSC 230.
CRSC 200 Special Problems for Undergraduates (2–4)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of department head.

CRSC 201 Agricultural Chemical and Equipment Safety (1) (CR/NC)
Principles and applications of agricultural chemical and equipment safety for enterprise project participants primarily. Pesticide toxicology, poisoning symptoms, medical treatment, safe handling and application techniques. Pesticide laws and regulations. Safe operation of tractors, implements, and processing equipment. Equipment demonstrations. Repeatable, but not for credit. Credit/No Credit grading only. 1 lecture.

CRSC 202 Enterprise Project (2–4) (CR/NC)
Beginning field experience in production and marketing of an agronomic crop, under faculty supervision. Project participation is subject to approval by the department head and the Cal Poly Foundation. Degree credit limited to 4 units. Credit/No Credit grading only. 1 lecture, variable practicum. Prerequisite: CRSC 201, or consent of instructor.

CRSC 230 Agronomic Crop Production (4)
Production, harvest, and use of important cereal and field crops in California. Production areas, crop rotations, disease and pest control. Field trip required. Not open to students with credit in CRSC 131. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory.

CRSC 244 Precision Farming (4)
Precision agriculture applications. Integrating GIS, GPS, and remote sensing technologies with site-specific farming practices to optimize agricultural productivity. Field trip required. 3 lectures, 1 laboratory. Prerequisite: CRSC 230 or other plant production course.

CRSC 304 Plant Improvement (4)
Principles and techniques used to develop new plant varieties. Sexual reproduction, inheritance, selection and biotechnology methods useful in breeding of plants. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CRSC 131 and BIO 303.

CRSC 330 Advanced Forage Crop Production (4)
Three methods of producing, harvesting and utilizing forage species; grazing, haying and ensiling plant materials. Forage identification, hay grades and quality, preservatives to enhance quality. Grazing systems; forage mixtures versus single species; problems in pasturing, fencing, the silage-making process and silo structures. Field trip to a production area required. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CRSC 123, CRSC 230 or CRSC 230 or consent of instructor.

CRSC 331 Commercial Seed Production and Conditioning (4)
Production and conditioning of field and vegetable seed. Seed technology, germination, quality control, seed enhancement, storage and handling of seed, and seed laws. Field trip to a seed conditioning/seed enhancement facility required. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CRSC 131, CRSC 230 or VGSC 230, EHS 121 or consent of instructor.

CRSC 333 Greenhouse Vegetable Production (4)
Development, practices, history, and future of crop production in greenhouses. Research applications, commercial applications, production problems, marketing, and economics. Special emphasis on growing transplants in greenhouses and use of nutrient solutions. Field trips to a commercial greenhouse operation and/or analysis lab required. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CHEM 111, CRSC 133, SS 221 or consent of instructor.

CRSC 339 Internship in Crop Science (1–12) (CR/NC)
Selected Crop Science students will spend up to 12 weeks with an approved agricultural firm engaged in production or related business. Time will be spent applying and developing production and managerial skills and abilities. One unit of credit may be allowed for each full week of completed and reported internship. Degree credit limited to 6 units. Credit/No Credit grading only. Prerequisite: Consent of internship instructor.

CRSC 400 Special Problems for Advanced Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Any CRSC 100- or 200-level course or consent of department head.

CRSC 402 Enterprise Project Management (2–4) (CR/NC)
Advanced experience in production of an agronomic crop. Development of a plan for field operations, a marketing plan, and a budget. Management decision-making. Project participation is subject to approval by the department head and the Cal Poly Foundation. Degree credit limited to 4 units. Credit/No Credit grading only. 1 lecture, variable practicum. Prerequisite: CRSC 202, and consent of instructor.

CRSC 410 Crop Physiology (4)
Environmental, chemical, and biological interrelationships associated with the physiology of crop production. Field trip is required. 3 lectures, 1 laboratory. Prerequisite: CRSC 131, CRSC 230, FRSC 131, FRSC 230 or VGSC 230, and CHEM 212/312.

CRSC 411 Experimental Techniques and Analysis (4)
Principal experimental designs used in agriculture and methods of statistical analysis of data collected from each. Practice with statistical software. Field practice in planning and layout of typical experiments. 3 lectures, 1 laboratory. Prerequisite: Junior standing and MATH 117 or equivalent, and STAT 218 or consent of instructor.

CRSC 421 Oil and Fiber Crops (4)
Culture, harvest, grading, and marketing of cotton, soybean, sunflower, safflower, and other oil and fiber crops. Field trips to major centers of production and marketing required. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CRSC 133, PPSC 221 and BOT 121.

CRSC 422 Tropical and Subtropical Crop and Fruit Production (4)
(Also listed as FRSC 422)
Production, distribution and utilization of major agronomic, vegetable, fruit and nut crops of economic importance in tropical and subtropical areas. Weather systems, climates, soils, and cropping systems of tropical and subtropical areas. Field trip required. 3 lectures, 1 laboratory. Prerequisite: CRSC, VGSC or FRSC 100/200-level course, or consent of instructor.

CRSC 445 Cropping Systems (4)
Classification and description of agricultural systems of the world. Crop rotations, multiple cropping, and other advances in farming practices. Sustainable agriculture and systems approaches to improvement of complex agricultural situations. Field trip required. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 activity. Prerequisite: SS 121 and BOT 121, or CRSC 131, or BOT 326, or consent of instructor.

CRSC 461, 462 Senior Project (3) (3)
Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 180 hours total time. Prerequisite: CRSC 411.

CRSC 463 Undergraduate Seminar (2)
Oral presentation and leadership of group study on recent developments in the major field. 2 seminars. Prerequisite: Senior standing.
CRSC 470 Selected Advanced Topics (2–4)  
Directed group study of selected topics for advanced undergraduate students. Class Schedule will list topic selected. Total credit limited to 8 units. 2–4 lectures. Prerequisite: Consent of instructor.

CRSC 500 Individual Study in Crop Science (1–6)  
Advanced independent study planned and completed under the direction of a member of the Crop Science faculty. Total credit limited to 6 units. Prerequisite: Consent of department head, graduate adviser and supervising faculty member.

CRSC 521 Advanced Crop Production (4)  
(Also listed as VGSC 521)  
Production and management of crops under intensive and extensive cultural systems and low-input agriculture. Interaction between the various growth factors at various levels of production and interaction of cultural practices and plant requirements. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: Graduate standing and consent of instructor.

CRSC 539 Graduate Internship in Crop Science (1–9)  
Application of theory to the solution of problems of agricultural production or related business in the field of Crop Science. Analyze specific management problems and perform general management assignments detailed in a contract between the student, the firm or organization, and the faculty adviser before the internship commences. Degree credit limited to 6 units. Prerequisite: Consent of internship instructor.

CRSC 570 Selected Topics in Crop Science (1–4)  
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 12 units. 1–4 seminars. Prerequisite: Graduate standing or consent of instructor.

CRSC 571 Selected Advanced Laboratory in Crop Science (1–4)  
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. Prerequisite: Consent of instructor.

CRSC 581 Graduate Seminar in Crop/ Fruit Production (3)  
(Also listed as FRSC 581)  
Group study of current problems, trends and research results pertaining to production or marketing of field, vegetable or fruit crops. 3 seminars. Prerequisite: Graduate standing.

CRSC 599 Thesis in Crop Science (1–9)  
Systematic research of a significant problem in Crop Science. Thesis will include problem identification, significance, methods, data analysis, and conclusion. Students must enroll every quarter in which facilities are used or advisement is received. Degree credit limited to 6 units. Prerequisite: Graduate standing and consent of instructor.

**CSC–COMPUTER SCIENCE**

CSC 100 Computer Science Orientation (2)  
Introduction to the computer science discipline for majors. Computer problem solving and the use of computers. Success skills for computer science majors. Career paths and opportunities. Ethical behavior in the computer science discipline. Interaction with upper division students, alumni and faculty. 2 seminars. Prerequisite: Computer science major.

CSC 101 Fundamentals of Computer Science I (4)  
(Also listed as CPE 101)  
Basic principles of algorithmic problem solving and programming using methods of top-down design, stepwise refinement and procedural abstraction. Basic control structures, data types, and input/output. Introduction to the software development process: design, implementation, testing and documentation. The syntax and semantics of a modern programming language. 3 lectures, 1 laboratory. Prerequisite: CSC 100 or CSC 111 or consent of instructor.

CSC 102 Fundamentals of Computer Science II (4)  
(Also listed as CPE 102)  
Continuation of the software development process: requirements analysis, specification, design, implementation and testing of abstract data types. Application development using abstract data types. Introduction to the analysis of algorithms. Software design case studies and practice. 3 lectures, 1 laboratory. Prerequisite: CSC 101 with a C- grade or better and either MATH 141 or MATH 221 with a C- grade or better, or consent of instructor.

CSC 103 Fundamentals of Computer Science III (4)  
(Also listed as CPE 103)  
Continuation of material from CSC 102: abstract data types specification and implementation, the analysis of algorithms and the software development process. Introduction to a specific high level design notation. Recursive algorithms. Software design case studies and practice. Software testing and program verification. 3 lectures, 1 laboratory. Prerequisite: CSC 102 with a C- grade or better and CSC 141 with a C- grade or better, or consent of instructor.

CSC 109 Accelerated Introduction to Computer Science (5)  
(Also listed as CPE 109)  
Accelerated coverage of the material in CSC 101, CSC 102, and CSC 103. 4 lectures, 1 activity. Corequisite: CSC 141, significant background in computer science, and consent of instructor.

CSC 110 Computers and Computer Applications: Windows (3)  
The computer as a problem-solving tool. A practical introduction to microcomputers, timeshared computer systems and fundamental computing concepts. Use of applications software. Credit not allowed for CSC majors. Miscellaneous course fee may be required—see Class Schedule. 2 lectures, 1 activity.

CSC 111 Computer Applications for Scientists and Engineers (3)  
Use of computers in science and engineering, with examples from physics, chemistry and biology. Credit not allowed for CSC majors. 2 lectures, 1 activity. Prerequisite: MATH 118 or equivalent.

CSC 113 Computers and Computer Applications: Macintosh (3)  
The computer as a problem-solving tool. A working introduction to microcomputers and fundamental computer concepts. Use of applications software. Credit not allowed for CSC majors. Miscellaneous course fee required—see Class Schedule. 2 lectures, 1 activity.

CSC 119 Information Retrieval and Management (4)  
Use of applications software, including database software, to create and manage information. Credit not allowed for CSC majors. Miscellaneous course fee may be required—see Class Schedule. 4 lectures. Prerequisite: Completion of ELM requirement.

CSC 141 Discrete Structures I (4)  
Introduction to structures of computer science: numbers, sets, relations, functions and trees. Propositional and predicate logic. Applications of predicate logic: preconditions, postconditions, invariants, guards. Inductive proofs. Applications to verification of algorithms. Introduction to complexity of algorithms. 4 lectures. Corequisite: CSC 102. Prerequisite: MATH 118 and MATH 119, or high school equivalent.

CSC 142 Discrete Structures II (4)  
CSC 200 Special Problems for Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of instructor.

CSC 205 Software Engineering I (4) (Also listed as CPE 205)
Introduction to the software lifecycle. Methods and tools for the analysis, design, and specification of large, complex software systems. Project documentation, organization and control, communication, and time and cost estimates. Group laboratory project. Graphical User Interface Design. Technical presentation methods and practice. Software design case studies and practices. Ethical and societal issues in software engineering. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CSC 103.

CSC 206 Software Engineering II (4) (Also listed as CPE 206)
Continuation of the software lifecycle. Methods and tools for the implementation, integration, testing and maintenance of large, complex software systems. Program development and test environments. Group laboratory project. Technical presentation methods and practice. Ethical and societal issues in software engineering. 3 lectures, 1 laboratory. Prerequisite: CSC 205.

CSC 215 Computer Architecture I (4) (Also listed as CPE 215)
Assembly level computer organization. Basic machine representation of numeric and non-numeric data. Assembly level instruction sets, address modes and the underlying computer architecture. Intended for CPE and CSC majors. Miscellaneous course fee required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CPE 219 and CSC 102.

CSC 231 Fortran for Engineering Students (2)
Programming techniques and procedures with applications to engineering problems in FORTRAN. Introduction to numerical methods and simulation. 2 activities. Prerequisite: MATH 142 or MATH 152; PHYS 121 or PHYS 131.

CSC 233 COBOL Programming (3)
Structure of the Common Business-Oriented Language (COBOL). CODING fundamentals and program logic. Writing of complete COBOL programs applied to typical business data processing problems. 3 lectures. Prerequisite: Any computer programming course.

CSC 234 C and Unix (3)
The C programming language. Operators, standard I/O functions, strings, pointers and arrays, data types and storage classes. The Unix programming environment: shell features, shell programming and system calls. Credit not allowed for CSC majors. 3 lectures.

CSC 239 Selected Programming Languages (3)
A programming language will be selected from languages of current interest. Intended for proficient programmers who want to learn another programming language. Class Schedule will list topic selected. 3 lectures. Prerequisite: Knowledge of a programming language.

CSC 270 Computer Graphics Applications (4)
(Also listed as CPE 270)
Use of common graphics applications packages. Business graphics, figure editing, animation and image editing, photorealistic image generation, scientific visualization and multimedia. 2 lectures, 2 activities.

CSC 300 Professional Responsibilities (4)
The responsibilities of the computer science professional. The ACM Code of Ethics, software economics, quality tradeoffs, software safety, intellectual property, history of computing and the social implications of computers in the modern world. Technical presentation methods and practice. 4 lectures. Prerequisite: CSC 206.

CSC 302 Computers and Society (4)
Social, ethical, political and technological implications and effects of computers in the modern world. Examination of the benefits and side-effects of computer applications and automation. Case study review and analysis. Technical elective credit not allowed for CSC/CPE majors. 4 lectures. Prerequisite: Completion of GE Area B.

CSC 305 Individual Software Design and Development (4)
(Also listed as CPE 305)
Practical software development skills needed for construction of mid-sized production-quality software modules, using the CSC upper division programming language. Topics include inheritance, exceptions, and memory and disk-based dynamic data structures. Students must complete an individual programming project of mid-level complexity. 3 lectures, 1 laboratory. Prerequisite: CSC 103.

CSC 310 Computers for Poets (4)  GE Area F
How computers and computer devices work. Introduction to software systems and applications. How computers connect with various media including images, speech and data. How information is encoded and transmitted across networks. Relationship between the computer and human information processing. Technical elective credit not allowed for CSC/CPE majors. 4 lectures. Prerequisite: Junior standing and completion of GE Area B.

CSC 315 Computer Architecture II (4) (Also listed as CPE 315)
Intermediate architecture topics. Levels of virtual machines and their languages. Special emphasis on data paths and microprogramming. Design of conventional machines; study of tradeoffs in various designs. Miscellaneous course fee required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CSC 103, CSC/CPE 215, CPE/EE 219.

CSC 316 Computer Architecture III (4) (Also listed as CPE 316)
Microprocessor architecture and interfacing. Emphasis on study of one microprocessor and how it interfaces with other logical components of a computer system. Serial and parallel I/O, static and dynamic RAM, ROM, DMA and Disk Controllers. 3 lectures, 1 laboratory. Prerequisite: CSC 315.

CSC 330 Programming Languages I (4)
Comparison of structure and semantics of various high level programming languages. BNF grammars. Language design issues and techniques, including parameter passing, storage allocation, storage mapping and binding concepts. 4 lectures. Prerequisite: CSC 103 and CSC/CPE 215.

CSC 334 Advanced Topics in Unix (4)
Advanced topics in Unix, system calls, library functions, shell scripts, and selected Unix tools. 4 lectures. Prerequisite: CSC 103 or CSC 234.

CSC 341 Numerical Engineering Analysis (4)  GE B6
An intensive survey of numerical analysis techniques used for solving engineering problems. Topics include solution of nonlinear equations, solution of linear systems, interpolation, numerical quadrature, ordinary differential equations and boundary value problems. Not open to students who have completed CSC 342. 4 lectures. Prerequisite: MATH 242 and knowledge of Fortran or C.

CSC 342 Numerical Analysis I (3)
Computer solutions of nonlinear equations and systems of linear equations. Polynomial interpolation. Numerical quadrature. Introduction to the solution of ordinary differential equations. 3 lectures. Prerequisite: MATH 143 and knowledge of Fortran, Pascal, Ada, or C.

CSC 343 Numerical Analysis II (3)
Solution of systems of differential equations, predictor-corrector methods, stiff equations. Approximation methods: cubic splines, B-splines, Bezier curves, least squares, methods for solving boundary value problems. 3 lectures. Prerequisite: CSC 342 or equivalent.

CSC 348 Bioinformatics (4)  GE Area F
(Also listed as BIO/CHM/CPE 348)
Introduction to problems in molecular biology and the use of computers to address them. The computational perspectives on problems involving nucleic acid and protein analysis, and the algorithmic and database approaches to their solution. The ethical and societal challenges of
message switching, and communications protocol standards. 3 lectures, 1 laboratory. Prerequisite: CSC 141 and CSC 315.

**CSC 465 Computer Networks II (4) (Also listed as CPE 465)**
Network architectures and protocols; network performance analysis; the theory of error detection and correction; other advanced topics such as routing, network management, integrated services, satellite networks, fiber optics. 3 lectures, 1 laboratory. Prerequisite: CSC/CPE 464.

**CSC 468 Database Management Systems Implementation (4) (Also listed as CPE 468)**
Data structures and algorithms used in the implementation of database systems. Implementation of data and transaction managers: access methods interfaces, concurrency control and recovery, query processors and optimizers. Introduction to implementation of distributed database systems. 3 lectures, 1 laboratory. Prerequisite: CSC 365.

**CSC 471 Introduction to Computer Graphics (4) (Also listed as CPE 471)**
Graphics hardware and primitives. Modeling and rendering, geometric transforms, hidden-surface removal, the graphics pipeline, scan-conversion and graphics applications. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CSC 103 and CSC 141.

**CSC 473 Advanced Rendering Techniques (4) (Also listed as CPE 473)**
Illumination models, reflectance, absorption, emittance, Gouraud shading, Phong shading, raytracing polyhedra and other modeling primitives, coherence, acceleration methods, radiosity, form factors, advanced algorithms. 3 lectures, 1 laboratory. Prerequisite: CSC 471.

**CSC 474 Computer Animation (4) (Also listed as CPE 474)**
Basic and advanced algorithms for generating sequences of synthetic images. Interpolation in time and space, procedural and keyframe animation, particle systems, dynamics and inverse kinematics, morphing and video. Miscellaneous course fee may be required—see Class Schedule. 3 lectures, 1 laboratory. Prerequisite: CSC 471.

**CSC 475 Multimedia Tool Development (4) (Also listed as CPE 475)**
Algorithms and techniques for creating multimedia applications. Topics include audio and video compression techniques, multimedia network architectures, synchronization of audio and video, multimedia toolkits, user interfaces and file systems. 3 lectures, 1 laboratory. Prerequisite: CSC 471.

**CSC 476 Introduction to Virtual Environment Systems (4)**

**CSC 477 Computer Vision (4) (Also listed as CPE 477)**
Fundamental issues in computer vision. Convolution, edge detection and image segmentation. Pattern classification methods and neural networks. Stereoscopic vision and optical flow. 3 lectures, 1 laboratory. Prerequisite: CSC 103 and MATH 206.

**CSC 479 Computer Graphics Seminar (2)**
Current topics in computer graphics. Total credit limited to 4 units. 2 seminars. Prerequisite: CSC 471.

**CSC 480 Artificial Intelligence (4) (Also listed as CPE 480)**
Programs and techniques that characterize artificial intelligence. Programming in a high level language. 3 lectures, 1 laboratory. Prerequisite: CSC 103 and CSC 141.

**CSC 481 Knowledge Based Systems (4) (Also listed as CPE 481)**
In-depth treatment of knowledge representation, utilization and acquisition in a programming environment. Emphasis on the use of domain-specific knowledge to obtain expert performance in programs. 3 lectures, 1 laboratory. Prerequisite: CSC 480.

**CSC 484 User-Centered Interface Design and Development (4) (Also listed as CPE 484)**
Introduction to the importance of user-centered principles in the design of good interfaces and effective human-computer interaction. Topics include: study of human characteristics affected by interface design, effective requirements data collection and analysis, user-centered approaches to software engineering, and evaluation of interface and interaction quality. 3 lectures, 1 laboratory. Prerequisite: CSC 205.

**CSC 486 Human–Computer Interaction Theory and Design (4)**
Application of the theories of human-computer interaction to the task of user-centered design. Survey of techniques for studying and involving users in different aspects of the design process, and demonstration of where and when applicable. Combining of theoretical understanding with practical experience to design solutions to problems facing interactive systems designers. 4 seminars. Prerequisite: CSC/CPE 484.

**CSC 487 Graphical User Interface Systems (4) (Also listed as CPE 487)**
Further study of graphical user interface (GUI) programming systems. Structure of tools and underlying systems to build such interfaces. Human factors including considerations of good and bad interfaces. 3 lectures, 1 laboratory. Prerequisite: CSC 435.

**CSC 488 Performance Analysis (4) (Also listed as CPE 488)**
Statistical and mathematical techniques for modeling and analyzing the performance of computer and communication systems. Tools and methodologies for the design, procurement and evaluation of systems. Introduction to elementary concepts of discrete event simulation. 3 lectures, 1 laboratory. Prerequisite: STAT 321 or consent of instructor.

**CSC 490 Selected Advanced Topics (1–4)**
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. Prerequisite: Consent of instructor.

**CSC 491, 492 Senior Project (2) (3)**
Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 150 hours total time. Prerequisite: CSC 206 and consent of instructor.

**CSC 494 Cooperative Education Experience (6) (CR/NC)**
Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.

**CSC 495 Cooperative Education Experience (12) (CR/NC)**
Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. Prerequisite: Sophomore standing and consent of instructor.
CSC 500 Directed Study (2–3) (CR/NC)
Individual directed study of advanced topics. Total credit limited to 4 units. Credit/No Credit grading only. Prerequisite: Fully classified graduate standing and consent of instructor.

CSC 508 Software Engineering I (4)
In-depth study of requirements engineering, software project management, formal specifications and object-oriented analysis. 4 seminars. Prerequisite: CSC 205 and graduate standing, or consent of instructor.

CSC 509 Software Engineering II (4)
In-depth study of software modeling and design. Formal design methodologies. Design patterns. Detailed case studies of existing projects. Tools and methods for designing large software systems. 4 seminars. Prerequisite: CSC 508 and graduate standing, or consent of instructor.

CSC 520 Computer Architecture (4) (Also listed as CPE 520)
Comparative study and design of multiprocessor, dataflow, RISC, high level language and other new computer architectures. VLSI processor design techniques. 3 seminars, 1 laboratory. Prerequisite: CSC/CPE 315 and graduate standing, or consent of instructor.

CSC 530 Languages and Translators (4)
Advanced programming language and translator concepts. Language concepts to be covered will be selected from current state-of-the-art languages and current issues in language design. Compiler concepts will include retargetable code generation, use of translator-writing systems, and error recovery. 4 seminars. Prerequisite: CSC 430 and graduate standing, or consent of instructor.

CSC 540 Theory of Computing (4)
Advanced topics in theoretical computer science from such areas as automata theory, cellular automata theory, computational complexity, and program verification. 4 seminars. Prerequisite: CSC 445 and graduate standing, or consent of instructor.

CSC 541 Numerical Methods (4)
Introduction to advanced methods used in numerical analysis. Finite element methods for one and two-dimensional problems. Study of transforms including the Fast Fourier Transform and the Fast Hartley Transform. Review of the software supporting these methods. 4 seminars. Prerequisite: CSC 342 and graduate standing, or consent of instructor.

CSC 550 Operating Systems (4)
General concepts of computer architecture and operating systems. Design features of advanced computers, general time-sharing systems and schemes for dynamic memory allocation, scheduling and protection. Dynamic linkage between subroutines. Intercommunication between input/output and processors. 4 seminars. Prerequisite: CSC 453 and graduate standing, or consent of instructor.

CSC 560 Database Systems (4)
Current topics in database systems: distributed databases and transactions, nested and long-running transactions, distributed concurrency control, semantic and object-oriented data models, database systems for non-traditional applications: engineering design databases, active, logic, temporal, multi-media, and real-time databases. 4 seminars. Prerequisite: CSC 468 and graduate standing, or consent of instructor.

CSC 569 Distributed Computing (4)
Exploration of distributed systems as a computing paradigm, the client-server model, socket API, remote procedure calls, object-based technology, distributed algorithms, interprocess communication (messages and broadcast), distributed computing environment, data replication, and fault tolerance. Emphasis on distributed software above the operating system layer. 3 lectures, 1 laboratory. Prerequisite: CSC 103 and graduate standing, or consent of instructor.

CSC 570 Current Topics in Computer Science (2–4)
Directed group study of selected topics for graduate students. Topics will normally consist of continuations of those in CSC 501–CSC 506 and other topics as needed. Class Schedule will list topic selected. Topic credit limited to 12 units. 2 to 4 seminars. Prerequisite: Graduate standing and evidence of satisfactory preparation in computer science.

CSC 580 Artificial Intelligence (4) (Also listed as CPE 580)
Current research in the field of artificial intelligence with emphasis on cooperative agents, distributed agents, and decision making in complex, concurrent environments. AI programming in a distributed environment. 3 lectures, 1 laboratory. Prerequisite: CSC 481 and graduate standing, or consent of instructor.

CSC 583 Computer-Based Educational Systems (3)
Comparison of several authoring languages and systems as they affect the design of multi-media computer-based educational systems. Emphasis on features for special purposes such as education of the handicapped. 3 seminars. Prerequisite: Graduate standing, or consent of instructor.

CSC 587 Computer Simulation I (4)
Principles and organization of simulation software. Executive programs for interactive control of continuous, discrete and combined system simulations. Specification, design and development of simulation support packages. Structure and techniques for development of real-time, queue management, graphics interface, and validation components of simulation systems. 4 seminars. Prerequisite: STAT 211 or STAT 321; graduate standing or consent of instructor.

CSC 588 Computer Simulation II (4)
Advanced topics in simulation. Simulation languages and systems, distributed simulation, training systems. Management of simulation projects. Verification and validation methodologies. 3 seminars, 1 laboratory. Prerequisite: CSC 587, graduate standing or consent of instructor.

CSC 590 Seminar in Computer Science (3)
Current problems and research in the field of computer science through discussions and selected readings. Group study of selected advanced topics. 3 seminars. Prerequisite: Graduate standing or consent of instructor.

CSC 594 Cooperative Education Experience (6) (CR/NC)
Advanced study analysis and part-time work experience in student's career field; current innovations, practices, and problems in administration, supervision, and organization of business, industry, and government. Must have demonstrated ability to do independent work and research in career field. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

CSC 595 Cooperative Education Experience (12) (CR/NC)
Advanced study analysis and full-time work experience in student's career field; current innovations, practices, and problems in administration, supervision, and organization of business, industry, and government. Must have demonstrated ability to do independent work and research in career field. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

CSC 599 Thesis/Project (2–3) (2–3)
Individual research or activity under faculty supervision leading to an acceptable thesis or project. Prerequisite: Graduate standing and consent of instructor.

DANC–DANCE

DANC 130 Pilates/PhysicalMind Conditioning Method (2)
Introduction to Joseph Pilates PhysicalMind conditioning method, providing the ideal physical fitness for the attainment and maintenance of a uniformly developed body and sound mind. Total credit limited to 6 units. 2 activities.
DANC 131 Beginning Ballet (2)  
Fundamentals of ballet technique stressing alignment, turn-out, five basic positions, seven movements of dance, and terminology. 2 activities.

DANC 132 Beginning Modern Dance (2)  
Fundamentals of modern technique stressing alignment, off-centered use of torso, floorwork, movement phrases, and improvisation exercises. 2 activities.

DANC 133 Beginning Jazz Dance (2)  
Introduction of jazz dance techniques stressing a variety of styles, alignment, isolation, polyrhythms, syncopation, improvisation, and phrasing. Performance technique and presentation of simple dance phrases. 2 activities.

DANC 134 Beginning Ballroom Dance (2)  
Selected ballroom dances including the cha-cha-cha, foxtrot, merengue, rumba, samba, swing, tango, waltz, and line dance hustle. Emphasis on alignment, etiquette, leading and following, performance techniques, and presentation of simple dance phrases. 2 activities.

DANC 135 International Folk Dance (2)  
Introduction to international folk dances including round, longway, and square sets. Study of various dance steps, formation, positions, historical and cultural background. Total credit limited to 4 units. 2 activities.

DANC 139 Beginning Tap (2)  
Introduction to tap dance technique stressing rhythms and breaks, syncopation, and improvisation. Study of different tap styles and related cultural influences. Performance of beginning tap dance phrases. Total credit limited to 6 units. 2 activities.

DANC 211 Dance Fundamentals (2)  
Body placement, alignment, rhythmic analysis and movement techniques. Theory and practice of fundamentals to promote ease and efficiency of movement. Introduction to dance forms such as ballet, modern, jazz, folk, square and social. 2 activities.

DANC 221 Dance Appreciation (4)  
Diverse dance forms. Focus on major western dance artists and their works from the 19th century to the present. Cultural context, style and forms in dance. Introductory survey of major experiments in dance. 4 lectures.

DANC 231 Intermediate Ballet (2)  
Continuation of training in basic technical skills in ballet stressing phrasing, performance, and more complex step patterns. 2 activities. Prerequisite: Consent of instructor.

DANC 232 Intermediate Modern Dance (2)  
Continuing study of DANC 132 with emphasis on various movement styles, phrasing, more complex step patterns, and performance. 2 activities. Prerequisite: Consent of instructor.

DANC 233 Intermediate Jazz Dance (2)  
Continuation of DANC 133 with emphasis on more extensive movement vocabulary. 2 activities. Prerequisite: Consent of instructor.

DANC 234 Intermediate Ballroom Dance (2)  
Continuation of DANC 134. Selected ballroom dances: cha cha, foxtrot, merengue, rumba, swing, tango, hustle, paso doble, polka and samba. Emphasis on variations, styles, and performance skill. Total credit limited to 4 units. 2 activities. Prerequisite: DANC 134 or consent of instructor.

DANC 311 Dance in American Musical Theatre (4)  
Cultural norms portrayed through dance and musical production. Major works with multicultural, racial, class, and gender issues associated with American themes. The artists, the role of dance in the musical theatre, and the significance of dance in human society. 4 lectures. Prerequisite: Completion of GE Area A and one course in Area C3.

DANC 320 Dance Notation (3)  
Introduction to the major dance notation systems, emphasizing the theory, reading and writing of Labonotation. 1 lecture, 2 activities. Prerequisite: One DANC activity class or consent of instructor.

DANC 321 Cultural Influence on Dance in America (4)  
A multicultural approach to the history of dance in America, with emphasis on American Indian, West African, Caribbean, Mexican, European, and Asian contributions and influences. Explores culture through dance in lecture, readings, video samples, and written observations of dance performance. Purchase of concert ticket(s) required. 4 lectures. Prerequisite: Completion of GE Area A and one lower division Area C course.

DANC 331 Advanced Ballet and Repertory (2)  
Advanced ballet technique and reconstruction of historical ballet repertories from the romantic, classical, neoclassical, and modern periods. Participation in dance performance of selected repertory. Total credit limited to 6 units. 2 activities. Prerequisite: DANC 231 or consent of instructor.

DANC 332 Modern Dance Repertory (2)  
Intermediate to advanced dance skills learned through the study and performance of selected modern dance repertory. Addresses problems in advanced performance technique. Informal presentation in performance situation. Total credit limited to 6 units. 2 activities. Prerequisite: Intermediate dance technique level or consent of instructor.

DANC 340 Dance Composition (4)  
Principles of dance composition. Exploration of the creative potential of movement and development of movement motifs through choreographic studies. Preparation for informal public presentation of student generated solo or group choreographic works. Total credit limited to 8 units. 1 lecture, 1 laboratory, 2 activities. Prerequisite: Intermediate dance technique level or consent of instructor.

DANC 345 Choreography and Workshop in Dance Concert Preparation (4)  
Problems connected with dance choreography. Workshop in concert preparation for major public dance production. Attendance of professional dance concert required. Attendance of professional dance concert(s) required. Total credit limited to 16 units. 2 activities, 2 laboratories. Prerequisite: By audition only.

DANC 346 Dance Production (4)  
Directed experience in production of annual Orchesis Dance Company Concert and other public performances. Attendance of professional dance concert(s) required. Total credit limited to 16 units. 1 activity, 3 laboratories. Prerequisite: DANC 345.

DANC 381 Methods of Teaching Dance (4)  
Dance forms such as folk, social, square, modern, ballet and jazz studies. Rhythmic structure and analysis of dance steps. Development of teaching methods and techniques, curricular materials and evaluation procedures related to teaching dance forms. 2 lectures, 2 activities. Prerequisite: DANC 131, 132, 133, or 134 and consent of instructor.

DANC 400 Special Problems for Advanced Undergraduates (1–2)  
Individual investigation, research and studies or survey of selected problems in dance and related areas. Total credit limited to 4 units with a maximum of 2 units per quarter. Prerequisite: Consent of instructor and department head.

DANC 470 Selected Advanced Topics (1–4)  
Directed study of selected topics for advanced dance students. Class Schedule will list topics selected. Total credit limited to 8 units. 1–4 lectures. Prerequisite: Consent of instructor.
DANC 471 Selected Advanced Laboratory (1–4)
Directed group laboratory study of selected topics for dance students. Class Schedule will list topics selected. Total credit limited to 8 units. 1–4 laboratories. Prerequisite: Consent of instructor.

DSCI—DAIRY SCIENCE

DSCI 100 Enterprise Project (1–4) (CR/NC)
Selection and completion of a management/production project under faculty supervision. Project participation is subject to approval by the project supervisor and the Cal Poly Foundation. Degree credit limited to 12 units. Credit/No Credit grading only.

DSCI 101 Dairy Feeds and Feeding (4)
Introduction to Dairy Cattle/Ruminant Nutrition. Classification and metabolism of nutrients. Nutrient content and identification of feeds common to dairy cattle. Nutrient analysis procedures and requirements. Ration formulation, feeding practices for maximizing growth and milk production. 3 lectures, 1 laboratory.

DSCI 121 Elements of Dairying (4)
General information on statistics and opportunities in the dairy industry. Composition and food value of dairy products. Common tests to determine quality of products. Principles and practices of the feeding and management of dairy cattle. 3 lectures, 1 laboratory.

DSCI 134 Introduction to Dairy Products Technology (4)
Science and technology in the development and manufacture of dairy food products. Equipment and dairy processing techniques for fluid milk, butter, cheeses, ice cream, yogurt, concentrated dairy foods and dried dairy foods. 3 lectures, 1 laboratory.

DSCI 200 Special Problems for Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of instructor.

DSCI 202 Dairy Promotion and Marketing (4)
National and state dairy promotional programs, advertising and merchandising. Marketing and pricing of milk and dairy products at the state and national level. 4 lectures. Prerequisite: DSCI 134 or consent of instructor.

DSCI 223 Frozen Dairy Foods (4)
Technology, equipment, mix calculations and preparation required to process, freeze, package, harden and distribute ice cream and related products. 3 lectures, 1 laboratory. Prerequisite: DSCI 134.

DSCI 230 General Dairy Husbandry (4)
Selection, breeding, feeding, and management of dairy cattle. Composition and food value of dairy products. Milk pricing, political influences, dairy industry statistics and opportunities. Producing and handling products. Intended as introductory course for non-dairy science majors. 3 lectures, 1 laboratory.

DSCI 231 General Dairy Manufacturing (4)
Composition and properties of fluid milk and manufactured milk products. Chemistry and microbiology of dairy products. Processes and equipment involved in the manufacture of butter, cheeses, and other fermented dairy products, frozen, condensed, and dried dairy foods. Intended as introductory course for non-dairy science students. Survey course for dairy husbandry majors. 3 lectures, 1 laboratory.

DSCI 233 Milk Processing and Inspection (4)
Composition and properties of fluid milk and its constituents. Equipment used to handle, process, and distribute fluid milk and related products. California dairy codes used for dairy farms and plants, with practice inspections of dairy farms and factories. 3 lectures, 1 laboratory. Prerequisite: DSCI 134.

DSCI 234 Dairy Foods Evaluation (2)
Basic principles of sensory evaluation of dairy foods, physiology of various senses and their relationship to distinguishing the quality of dairy products by sight, flavor, body and texture. Product defects, causes, and methods of prevention. 1 lecture, 1 laboratory.

DSCI 241 Dairy Cattle Selection, Breeds, Fitting and Showing (4)
Selection of dairy cattle on type conformation and the correlation between type and production. Dairy cattle breeds and breed comparisons. Techniques to properly condition, groom and present dairy cattle for evaluation and merchandising. 2 lectures, 2 activities. Prerequisite: DSCI 121 or DSCI 230.

DSCI 301 Dairy Cattle Nutrition (4)
Principles of dairy cattle nutrition and management and their application to economical feeding practices and computerized ration formulation. 3 lectures, 1 activity. Prerequisite: DSCI 101 and DSCI 121 or DSCI 230.

DSCI 321 Lactation Physiology (4)
Mechanisms of milk component secretion, including protein, lactose and fat metabolism. Disorders of the mammary gland (mastitis) and control strategies. Endocrine aspects of mammary gland development and lactogenesis. 4 lectures. Prerequisite: DSCI 101, DSCI 121, BIO 151, CHEM 111.

DSCI 330 Artificial Insemination and Embryo Biotechnology (4)
Techniques in the collection, evaluation and processing of semen, along with embryo culturing and manipulation. Insemination procedures, fertility problems, record keeping, estrous synchronization, endocrine control of reproduction, treating reproductive disorders and embryo transfer. 3 lectures, 1 laboratory. Prerequisite: DSCI 121 or DSCI 230 or VS 223 or consent of instructor.

DSCI 333 Dairy Cattle Management, Safety and Animal Well-Being (4)
Modern dairy management techniques, livestock handling and animal comfort. Dairy safety and development of an injury illness prevention program. Animal well-being issues and the Pasteurized Milk Ordinance. 3 lectures, 1 activity. Prerequisite: DSCI 121 or DSCI 230.

DSCI 339 Internship in Dairy Science (1–12) (CR/NC)
Selected Dairy Science students will spend up to 12 weeks with an approved agricultural firm engaged in production or related business. Time will be spent applying and developing production and managerial skills and abilities. One unit of credit may be allowed for each full week of completed and reported internship. Degree credit limited to 12 units. Credit/No Credit grading only. Prerequisite: Consent of internship instructor.

DSCI 350 Dairy Industry Communications (2)
Application of information and computer technology to creation of dairy publications. Exploration of Web resources for dairy-related current events and information. Financial, promotional, creative and technical aspects of producing dairy brochures, catalogs, annuals and pamphlets. Total credit limited to 8 units. 2 activities. Prerequisite: ENGL 134, DSCI 121, AG 250 or consent of instructor.

DSCI 400 Special Problems for Advanced Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Consent of instructor.

DSCI 401 Physical and Chemical Properties of Dairy Products (4)
Composition, structure and properties of milk and milk products. Physical and chemical changes that occur during processing and storage of dairy products. Objective measurement of chemical and physical properties. 3 lectures, 1 laboratory. Prerequisite: CHEM 212/312 or consent of instructor.

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DSCI 402 Quality Assurance and Control of Dairy Products (4)
Current methods used to evaluate dairy products with respect to plant economics and consumer safety. Accurate procedures for chemical and biological testing, statistical approach to sampling and design and interpretation of HACCP programs for assuring product quality and safety. 3 lectures, 1 laboratory. Prerequisite: DSCI 233 and MCRO 221.

DSCI 422 Breeding and Genetics of Dairy Cattle (4)
Evaluation of inherited characteristics in dairy cattle from an economic standpoint. Proving and selecting sires and dams. 3 lectures, 1 laboratory. Prerequisite: DSCI 241.

DSCI 432 Advanced Dairy Herd Management (4)
Dairy herd management skills needed in dairy operations. Instruction and lab experience in management, records, feeding and nutrition, herd health, milk secretion, reproduction, mating and selection. 4 lectures. Prerequisite: DSCI 301, DSCI 241, DSCI 330, and DSCI 422.

DSCI 433 Dairy Plant Management and Equipment (4)
Basic management principles applied to the dairy industry. Industrial organization and control. Dairy plant design, facilities, layout. Inventory control and records. Milk pooling and stabilization records. Maintenance and operation of equipment. 3 lectures, 1 laboratory. Prerequisite: DSCI 233, DSCI 434.

DSCI 434 Cheese and Fermented Dairy Foods (4)
Scientific methods, ingredients, and equipment used in the manufacture of various fermented dairy products, including cheeses, butter milk, sour cream, and yoghurt. 3 lectures, 1 laboratory. Prerequisite: DSCI 134, MCRO 221.

DSCI 435 Concentration/Fractionation and Butter Technology (4)
Technology of evaporation, drying and membrane separation processes applied to dairy fluids. Design and performance of evaporators, driers, and membrane processing systems. Equipment, ingredients, and methods needed to manufacture butter and dairy spreads. 3 lectures, 1 laboratory. Prerequisite: DSCI 134.

DSCI 444 Dairy Microbiology (4)
Microorganisms involved in the fermentation and ripening processes in the dairy industry, as well as those involved in spoilage of milk and dairy products, in the transmission of disease through these products, and indicator systems used to determine sanitary quality of these products. 2 lectures, 2 laboratories. Prerequisite: MCRO 221.

DSCI 461, 462 Senior Project (2) (2)
Selection and completion of research-oriented projects under faculty supervision. Project results are presented in a formal report. Minimum 120 hours total time. DSCI 461: 1 seminar and supervision. DSCI 462: Supervision.

DSCI 463 Undergraduate Seminar (2)
Reports on student papers, bulletins, periodical articles, and dairy research experiments. Sources of dairy husbandry information. Practice in oral reporting. Recent developments and research work in the dairy industry. 2 seminars.

DSCI 470 Selected Advanced Topics (1–4)
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. Prerequisite: Consent of instructor.

DSCI 500 Individual Study in Dairy Science (1–6)
Advanced independent study planned and completed under the direction of a member of the Dairy Science faculty. Total credit limited to 6 units. Prerequisite: Consent of department head, graduate adviser and supervising faculty member.

DSCI 522 Bioseparation Processes in Dairy Product Technology (4)
Physical and chemical principles governing bioseparation processes in dairy product technology. Factors influencing mass transport phenomena as it relates to filtration, chromatography, ion exchange, dialysis, centrifugation, adsorption, crystallization and other unit operations. Laboratories to emphasize application of bioseparations of commercial importance. Field trips to be required. 3 lectures, 1 laboratory. Prerequisite: DSCI 401, FSN 444.

DSCI 539 Graduate Internship in Dairy Science (1–9)
Application of theory to the solution of problems of agricultural production or related business in the field of Dairy Science. Analyze specific management problems and perform general management assignments detailed in a contract between the student, the firm or organization, and the faculty adviser before the internship commences. Degree credit limited to 6 units. Prerequisite: Consent of internship instructor.

DSCI 560 Recent Developments in Dairy Science and Technology (1–3)
Presentation and critical review of current research publications. Methodological advances and applications in dairy food systems. Class Schedule will list topic selected. Total credit limited to 6 units. 1–3 seminars. Prerequisite: Senior or graduate standing and approval of instructor.

DSCI 570 Selected Topics in Dairy Science (1–4)
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 12 units. 1 to 4 seminars. Prerequisite: Graduate standing or consent of instructor.

DSCI 571 Selected Advanced Laboratory in Dairy Science (1–4)
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. Prerequisite: Consent of instructor.

DSCI 581 Graduate Seminar in Dairy Science (1–3) (CR/NC)
Current findings and research problems in the field and their application to industry. Group study of current problems of industry. Current experimental and research findings as applied to production and marketing. Credit/No Credit grading only. 1 or 3 seminars. Credit/ no credit grading only. Prerequisite: Graduate standing or consent of instructor.

DSCI 585 Cooperative Education Experience in Dairy Science (1–6) (CR/NC)
Advanced study, analysis and part-time work experience in the field; current innovations, practices, and problems in administration, supervision, and organization of business, industry, and government. Must have demonstrated ability to do independent work and research in career field. Total credit limited to 9 units. Credit/No Credit grading only. Prerequisite: Graduate standing and consent of instructor.

DSCI 599 Thesis in Dairy Science (1–9)
Systematic research of a significant problem in Dairy Science. Thesis will include problem identification, significance, methods, data analysis, and conclusion. Students must enroll every quarter in which facilities are used or advisement is received. Degree credit limited to 6 units. Prerequisite: Graduate standing and consent of instructor.

ECON—ECONOMICS

ECON 105 Personal and Consumer Economics (4)
Personal choices–goals, savings, investment, buying methods, borrowing, taxes, insurance. Practical applications of principles of marginalism, present value indexing, expected value, etc. Emphasizes personal welfare with some social welfare analysis and contemporary consumer issues. 4 lectures.
ECON 200 Special Problems for Undergraduates (1–2)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units, with a maximum of 2 units per quarter. Prerequisite: Sophomore standing and consent of department head.

ECON 201 Survey of Economics (4)  GE D2
Basic principles of microeconomics and macroeconomics. Emphasis on applications to current national and global economic issues. For majors requiring one quarter of economics. Not open to students having previous credit in ECON 222 or equivalent. 4 lectures.

ECON 211 Microeconomics (4)
Microeconomic principles. Marginal and equilibrium analysis of commodity and factor markets in determination of price and output. Normative issues of efficiency and equity. 4 lectures.

ECON 212 Macroeconomics (4)  GE D2
Introduction to economic problems. Macroeconomic analysis and principles. Aggregate output, employment, prices, and economic policies for changing these variables. 4 lectures. Prerequisite: Completion of GE Areas A, D1, and ECON 201 or 222.

ECON 303 Economics of Poverty, Discrimination and Immigration (4)  GE D5 USCP
Economic analysis of the cause, extent and impact of poverty, discrimination and immigration and of the policies designed to address these socioeconomic issues. Emphasis on the experience of African-Americans, Latinos, and women in the United States. 4 lectures. Prerequisite: Completion of GE Areas A, D1, and ECON 201 or 222.

ECON 304 Comparative Economic Systems (4)  GE D5
Analysis of economic systems as a set of mechanisms and institutions for decision making, and the implementation of decisions regarding income distribution, the levels of consumption and production, and the level of economic welfare. 4 lectures. Prerequisite: Completion of GE Areas A, D3, and ECON 201 or 222.

ECON 310 Quantitative Methods in Economics (4)
Applications of quantitative techniques to topics in microeconomic and macroeconomic theory. Use of multivariate calculus and linear algebra in formulating static economic models. Applications of statistical inference, estimation and forecasting in economic models. 4 lectures. Prerequisite: MATH 221, STAT 252, ECON 221, ECON 222.

ECON 311, 312 Intermediate Microeconomics (4) (4)
Economics of prices and markets. Demand and supply. Returns and costs, factor pricing and income distribution, welfare and economic progress. 4 lectures. Prerequisite: ECON 310. For ECON 312: ECON 311.

ECON 313, 314 Intermediate Macroeconomics (4) (4)
Analysis of national income, price level, employment, international trade and economic growth. Development of the theory of national income determination. Evaluation of roles of monetary and fiscal policy. Applications of computer simulation for analysis, forecasting and control. 4 lectures. Prerequisite: ECON 222, MATH 221, STAT 252. For ECON 314: ECON 313.

ECON 322 Economic History of the Advanced World (4)  GE D5
Analysis of the growth of economic institutions from about 600. Includes the spread of economic structures and institutions to colonies. Analyzes the internal development of the industrial economy in Europe and its expansion to other parts of the globe. 4 lectures. Prerequisite: Completion of GE Areas A, D1, and ECON 201 or 222.

ECON 324 American Economic History (4)
Topical and statistical analysis of the major trends and events of American economic history. Examines the causes and evolution of the United States economy from colonial times to the present. Assessment of agriculture, transportation, industrial and government sectors and their interconnections. 4 lectures. Prerequisite: ECON 201 or ECON 221 or ECON 222.

ECON 325 Economics of Development and Growth (4)
Analysis of the economy of less developed countries, and a survey of public policies designed to stimulate economic growth and reduce poverty. Topics include financing development, technology, population problems, human capital, rural and urban development, trade policy and the economic relationships between developed and developing nations. 4 lectures. Prerequisite: ECON 201 or ECON 221 or ECON 222.

ECON 337 Money, Banking and Credit (4)
Principles and practices of monetary banking and credit institutions as applied to business activity and public policy. Use of mathematical analysis and computer simulation. 4 lectures. Prerequisite: ECON 222.

ECON 339 Econometrics (4)
Application of statistical methods useful in economics. General linear regression model. Specific issues and problems related to economic models: multicollinearity, autocorrelation, heteroscedasticity, dummy variables, lagged variables, and simultaneous equation estimation. Application and evaluation of selected examples of empirical economic research. Microcomputer applications. 4 lectures. Prerequisite: MATH 221, MATH 222, STAT 251, STAT 252, or consent of instructor.

ECON 400 Special Problems for Advanced Undergraduates (1–4)
Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units. Prerequisite: Consent of department head.

ECON 401 International Trade (4)
Theory of comparative advantage, gains from trade, and recent developments in trade theory; examination of tariffs, quotas, exchange controls, other trade barriers and underlying policy issues; review of U.S. commercial policy, GATT, the common market, regional and world economic organizations. 4 lectures. Prerequisite: ECON 221.

ECON 403 Industrial Organization (4)
Application of basic tools of economics to American Industry. Case studies of individual firms and industries. Performance of various business structures, such as monopoly and oligopoly. Effects of government regulation and antitrust policy. 4 lectures. Prerequisite: ECON 312.

ECON 404 International Trade Theory (4)
Theory of comparative advantage, neoclassical model of trade, offer curves and terms of trade, edgeworth boxes, valuation of factor inputs, effects of migration and mobility of funds, emerging growth and trade distortions, welfare effects of trade, and recent developments in trade theory. 4 lectures. Prerequisite: ECON 312 or equivalent.

ECON 405 International Monetary Economics (4)
Nature of international payments, U.S. balance of payments. Theory and practice of foreign exchange rate determination under the gold standard, paper standard, and IMF system; international money and capital markets; problems of international liquidity and monetary stability. 4 lectures. Prerequisite: ECON 222, ECON 401.

ECON 406 Applied Forecasting (4)
Causes and measurement of business fluctuations. Techniques of forecasting with microcomputer applications. 3 lectures, 1 activity. Prerequisite: ECON 201 or ECON 222, and STAT 252.

ECON 410 Public Finance and Cost-Benefit Analysis (4)
Principles of rational decision making with respect to government revenues and spending. Measurement of costs and benefits, and criterion selection. Taxation, user fees, deficit financing, public goods, neighborhood effects and zoning. Microcomputer applications. 4 lectures. Prerequisite: ECON 312.
ECON 413 Labor Economics (4)
Wage determination theory, basic economic factors that affect the labor movement, economic impact of union activities on employment, output, income, wages, prices, and national economic policy. 4 lectures. Prerequisite: ECON 221.

ECON 417 Development of Economic Analysis (4)
Analysis of ideas related to the development of economic theory in the Western civilization from the Greeks through the classical, neoclassical, and Keynesian to the current post-Keynesian concepts. 4 lectures. Prerequisite: ECON 221, ECON 222.

ECON 431 Environmental Economics (4)
Economic dimensions of environmental abuse and protection. Use of simple economic models in developing and evaluating environmental policies. Overview of current environmental problems. Issues related to the sustainability of economic growth at the national and international levels. 4 lectures. Prerequisite: ECON 201 or ECON 221.

ECON 432 Economics of Energy and Resources (4)
Economic theory and public policies as applied to problems of natural resources and energy. Dynamic resource and energy models developed with reference to public and private sector growth. Application of the principles of capital theory emphasized. Case studies. Computer software applications in the study of natural resources and energy under uncertainty. 4 lectures. Prerequisite: ECON 201 or ECON 222.

ECON 433 Transportation Economics (4)
Analysis of the allocation of resources to the U.S. transport sector and specific transport modes as a result of their natural economic characteristics and public policy. 4 lectures. Prerequisite: ECON 201 or ECON 222.

ECON 434 Urban Economics (4)
Application of basic tools of economic analysis to problems of urban regions. Causes and possible cures for inadequate growth rate, income levels, and the quality of life in urban regions. 4 lectures. Prerequisite: ECON 201 or ECON 221.

ECON 461, 462 Senior Project (2) (2)
Selection and analysis of a problem under faculty supervision. Problems typical of those which graduates must solve in their fields of employment. Formal report is required. Minimum 120 hours total time.

ECON 470 Selected Advanced Topics (1–4)
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. Prerequisite: Consent of instructor.

ECON 500 Independent Study (1–4)
Advanced study planned and completed under the direction of a departmental faculty member. Open only to graduate students demonstrating ability to do independent work. Enrollment by petition. Prerequisite: Consent of department head.