

BRAE 533 Irrigation Project Design (4)
(formerly AE 533)

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 (1–3)
(formerly AE 570 & ASM 570)

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 9 units. 1 to 3 seminars. Prerequisite: Graduate standing or consent of instructor.

BRAE 571 Selected Advanced Laboratory in Bioresource and Agricultural Engineering (1–3)
(formerly AE 571 & ASM 571)

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 6 units. 1–3 laboratories. Prerequisite: Consent of instructor.

BRAE 581 Graduate Seminar in Bioresource and Agricultural Engineering (3)
(formerly AE 581)

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)
(formerly AE 599)

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)
(formerly MGT 118)

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)
(formerly MGT 200)

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)
(formerly ACTG 211)

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)
(formerly ACTG 224)

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)
(formerly ACTG 225)

Applications of accounting to management decision-making, planning and control including cost behavior, budget preparation, performance reporting, motivational and behavioral considerations, and ethics. 4 lectures. Prerequisite: MATH 221, STAT 252, ECON 222, CSC 119 or equivalent, and BUS 212 or BUS 214 or consent of instructor.

BUS 245 Elements of Marketing (4)
(formerly MKTG 204)

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)
(formerly MGT 201)

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)*(formerly MGT 206)*

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)*(formerly MGT 332)*

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 repatriation, 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 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 314 Tax Accounting (4)*(formerly ACTG 304)*

Federal income taxation of individuals. 4 lectures. Prerequisite: BUS 212 or BUS 214 or consent of instructor.

BUS 321, 322, 323 Intermediate Accounting I, II, III (4) (4) (4)*(formerly ACTG 321, 322, 323)*

Comprehensive coverage of financial reporting. 321 covers financial statements, assets, leases, and long-term debt. 322 covers revenue recognition, income taxes, pensions, liabilities, equities, accounting changes, and cash flows. 323 covers accounting for inflation, international accounting, interim and segment reporting, special measurement problems, financial disclosures and analysis. 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 Financial Management (4)*(formerly FIN 342)*

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: ECON 222, MATH 221, STAT 252, BUS 215. Junior standing required.

BUS 346 Principles of Marketing (4)*(formerly MKTG 301)*

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: ECON 222, STAT 252, and junior standing, the equivalent or permission of instructor.

BUS 347 Marketing Research I (4)*(formerly MKTG 302)*

Market planning and information systems, Bayesian decision analysis. Survey research 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)*(formerly MKTG 303)*

Applied study of behavior that affects marketing decisions in both consumer and industrial markets. 4 lectures. Prerequisite: BUS 346.

BUS 349 Selling: Building Partnerships (4)*(formerly MKTG 304)*

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 roleplays. 4 lectures. Prerequisite: Junior standing.

BUS 371 Production and Operations Management (4)*(formerly MGT 301)*

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: MATH 131 or MATH 221, and STAT 211 or STAT 252, and junior standing.

BUS 381 Industrial Management (4)*(formerly MGT 311)*

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)*(formerly MGT 312)*

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)*(formerly MGT 313)*

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)*(formerly MGT 314)*

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)
(formerly *MGT 317*)

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: STAT 252.

BUS 391 Management Information Systems (4)
(formerly *MIS 321*)

Applications of computers in business and industry. Management information systems and integrated systems concepts. Data organizations, file processing, spreadsheets, data base management, and functional information systems. Data communication and distributed data processing. 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 119 and junior standing.

BUS 393 Advanced Management Information Systems I (2)

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 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 event-driven, 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) (formerly also *ACTG & MGT 400*)

Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units. Prerequisite: Senior standing or consent of instructor.

BUS 401 Seminar in General Management and Strategy (4)
(formerly *MGT 414*)

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: All 300-level Business core courses and senior standing.

BUS 402 International Business Management (4)
(formerly *MGT 406*)

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) (formerly *MGT 489*)

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) **GE D4b**

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 409 Law of Real Property (4)
(formerly *FIN 412*)

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) (formerly *BUS 490*)

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 411 Managing Technology in the International Legal Environment (4)

Practical legal decisions required to conduct business for or with high technology companies. Examination of methods to protect high technology developments in international markets, including copyrights, patents, trade secrets, trademarks and contracts. Case studies. 4 lectures. Prerequisite: BUS 207 or equivalent.

BUS 412 Advanced Cost Accounting (4)
(formerly *ACTG 402*)

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)
(formerly *ACTG 404*)

Federal income taxation of sales and exchanges, Subchapter S corporations, partnerships, estates and trusts. Federal gift and estate taxes. 4 lectures. Prerequisite: BUS 314.

BUS 415 Corporate Tax Accounting and Tax Administration (4) (formerly ACTG 405)

Federal income taxation of regular corporations, tax research, tax administration, and IRS practice. 4 lectures. Prerequisite: BUS 314.

BUS 416 Volunteer Income Tax Assistance (2) (formerly ACTG 406)

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. Prerequisite: BUS 314.

BUS 420 Advanced Accounting (4)

Three financial accounting and reporting topics: accounting for state and local governments, accounting for private not-for-profit entities, and accounting for multi-corporate enterprises. Emphasis on (a) governmental concepts and practices for fund structures, budgets, the modified accrual basis of accounting, and financial reporting, (b) concepts and practices utilized by private not-for-profit entities for the preparation of financial reports and to account for contributions, other revenues, and expenditures, and (c) the preparation of consolidated financial statements for poolings of interests and for purchase acquisitions. 4 lectures. Prerequisite: BUS 322.

BUS 423 Financial Reporting by Public Companies (2) (formerly ACTG 423)

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: BUS 323 with minimum grade of C-, or consent of instructor.

BUS 424 Professional Accounting (4) (formerly ACTG 431)

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: BUS 323 with minimum grade of C-, or consent of instructor.

BUS 425 Auditing (4) (formerly ACTG 446)

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: BUS 323 with minimum grade of C-, or consent of instructor. Recommended: BUS 391.

BUS 426 Advanced Auditing (4) (formerly ACTG 447)

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) (formerly ACTG 453)

Consideration of conceptual, managerial, professional and institutional issues of international accounting. 4 lectures. Prerequisite: BUS 321.

BUS 428 Accounting Policy (4) (formerly ACTG 489)

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 430 Internship (2-4) (CR/NC) (formerly MGT 430)

Placement as an employee in a business firm approved by the area coordinator. Periodic written progress reports required. Collateral reading correlated with the work experience. Credit/No Credit grading. Prerequisite: Approval of area coordinator.

BUS 431 Security Analysis and Portfolio Management (4) (formerly FIN 411)

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.

BUS 433 International Business Finance (4) (formerly FIN 430)

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) (formerly FIN 432)

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) (formerly FIN 434)

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) (formerly FIN 440)

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) (formerly FIN 466)

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)
(formerly *FIN 480*)

Current topics in investments. An in-depth analysis of derivatives, the efficient markets hypothesis and capital market theory. 4 seminars. Prerequisite: BUS 431.

BUS 443 Case Studies in Finance (4)
(formerly *FIN 489*)

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 342, BUS 321, and BUS 431.

BUS 446 International Marketing (4)
(formerly *MKTG 401*)

Marketing activities necessary to direct the flow of a company's goods and services to customers in global markets. 4 lectures. Prerequisite: BUS 346 and senior standing.

BUS 447 Marketing Research II (4)
(formerly *MKTG 402*)

Emphasizes market data analysis. 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)
(formerly *MKTG 404*)

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)
(formerly *MKTG 405*)

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

BUS 450 Promotion Strategies (4)
(formerly *MKTG 408*)

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 451 Direct Marketing (4)
(formerly *MKTG 450*)

Direct response marketing including the use of mail, space advertising, radio and television media in marketing products and services to consumer and industrial markets. 4 seminars. Prerequisite: BUS 347 and senior standing.

BUS 452 Product Management (4)
(formerly *MKTG 409*)

Focuses on developing objectives and strategies for a variety of goods and services throughout their lifecycle. Decisions on price,

sales projection, distribution and product (goods and services) to achieve objectives. 4 lectures. Prerequisite: BUS 346 and senior standing.

BUS 453 Marketing Law (4)
(formerly *MKTG 412*)

Law of marketing from a comprehensive management perspective: products, channels, pricing, promotion and credit. Information on patents, copyrights and trademarks. 4 lectures including case analysis. Prerequisite: Senior or graduate standing, BUS 207 and BUS 404 recommended.

BUS 454 Developing and Presenting Marketing Plans (4) (formerly *MKTG 420*)

Developing and presenting professional marketing plans. Focus on activities most relevant to junior-level managers: analysis of information pertaining to a product's/service's environment, customers and competitors. 4 lectures. Prerequisite: BUS 346, BUS 347 and BUS 348.

BUS 455 Marketing Management (4)
(formerly *MKTG 460*)

Policymaking and decisionmaking applications in the planning, organizing, operating, controlling and evaluating of individual products 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)
(formerly *IT 404*)

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)
(formerly *IT 405*)

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 461, 462 Senior Project (2) (2)
(formerly also *ACTG & MGT 461, 462*)

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 470 Selected Advanced Topics (1–3)
(formerly also *ACTG, MGT, & MKTG 470*)

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 6 units. 1–3 lectures. Prerequisite: Consent of instructor.

BUS 471 Compensation (4)
(formerly *MGT 410*)

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 or consent of instructor.

BUS 472 Labor Relations (4)
(formerly MGT 412)

Union organizing. Negotiation and administration of collective agreements. Simulation of bargaining, grievance, and arbitration processes. 4 lectures. Prerequisite: Junior standing.

BUS 473 Labor Law (4)
(formerly MGT 413)

Federal and state labor policy as expressed in common law, relevant statutes, and executive orders. Effects upon labor, management, minorities, and the public. Current rules analyzed in a contemporary and historical context. Understanding important industrial relations and manpower problems. 4 lectures. Prerequisite: Senior standing and completion of all 300-level Business core courses or consent of instructor.

BUS 475 Staffing (4) (formerly MGT 415)

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.

BUS 476 Employee Training and Development (4)
(formerly MGT 416)

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)
(formerly MGT 417)

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)
(formerly MGT 418)

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)
(formerly MGT 442)

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)
(formerly MGT 441)

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)
(formerly MGT 440)

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)
(formerly MGT 445)

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)
(formerly MGT 475)

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)
(formerly IT 420)

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: ENGL/PHIL/SPC 125, BUS 371, and senior standing.

BUS 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.

BUS 487 Seminar in Quality Management (4)
(formerly MGT 487)

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)
(formerly MGT 488)

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 and Control in Business (4) (formerly MIS 418)

Quantitative controls and decision support as applied to the operations of business. For the senior student who needs operational knowledge for applications in business analysis and decision support. Development of decision support system. 3 lectures, 1 activity. Prerequisite: BUS 391.

BUS 492 Expert Systems Applications in Business (4) (formerly MIS 419)

Impact of expert systems on business. Concepts and methods of logical inference using a computer. Knowledge engineering and fuzzy systems. Structure and function of an expert system. Development of business expert systems. 3 lectures, 1 activity. Prerequisite: BUS 391.

BUS 494 Small Business Information Systems (4) (formerly MIS 425)

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 214, BUS 215 or consent of instructor.

BUS 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.

BUS 497 Multimedia Presentation Systems in Business (4) (formerly MIS 435)

Use of front-end software development tools 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 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.

CD-CHILD DEVELOPMENT**CD 102 Orientation to Child Development (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 infants and toddlers. Participant observation, data collection skills, planning and conducting activities for individuals and groups in educational or childcare facilities.

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 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, perpetual, and volitional development. 4 lectures. Prerequisite: CD 128, CD 209, F1 computer literacy (CSC 111, CSC 113 or CSC 118 recommended).

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 and PSY 323 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.

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 230, CD 311, CD 324, PSY 323, KINE 280 or equivalent first aid certification, junior standing and consent of instructor.

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 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 330.

CD 405 Advanced Administration of Child Development Centers (3)

Problems of organization in site-specific child care programs. Personnel and child care legal issues. Finance and tax concerns. Public policy and current research. 3 seminars. Prerequisite: CD 404.

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 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 6 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)

GE F2

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: CE 114, 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 405 Advanced Strength of Materials (3)

Equations of equilibrium and continuity in elastic solids. Generalized Hooke's Law. Two-dimensional solutions of beams, disks, rings under various loading conditions. Stress concentrations and their engineering significance. Strain-energy methods of solution. Fundamentals of plates and shells. 3 lectures. Prerequisite: CE 351, senior standing.

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, overtopping, 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)

Differential equations of groundwater flow, Darcy Law, solutions of the steady and unsteady flow, differential equations for confined and unconfined flows. Pumping test design. Groundwater models, leaky aquifers. Saltwater intrusion. 3 lectures. Prerequisite: CE 336.

CE 440 Hydraulic Systems Engineering (3)

Water and wastewater flows. Design of water distribution systems, transmission and storage reservoirs, wastewater collection systems, and storm water systems. Pumps and pump systems, flow measurements. Water sources for municipal supply. 3 lectures. Corequisite: CE 336.

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 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 470 Selected Advanced Topics (1–3)

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 6 units. 1 to 3 lectures. Prerequisite: Consent of instructor.

CE 471 Selected Advanced Laboratory (1–3)

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 6 units. 1 to 3 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)

Application of geotechnical engineering principles to environmental engineering problems. Site characterization and assessment. Sampling and monitoring procedures. Design of waste containment systems. Site remediation. Computer-aided analysis. 4 lectures. Prerequisite: CE 481.

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 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 geometrics. 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 multimodal 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 554 Matrix Analysis of Structures (3)

Matrix terminology and operations. Matrix procedures for analysis of continuous beams, plane frames, and space frames under static and quasi-static loading. Stiffness and flexibility methods. Computer applications. Special techniques for larger systems. 3 lectures. Prerequisite: CE 351, or graduate standing.

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 558 Introduction to Finite Element Analysis (3)

Formulation of the finite element method. Finite elements and their properties. Analysis of plates, shells and framed structures under static and dynamic loads. Digital computer implementation of the finite element method. 3 lectures. Prerequisite: CE 554.

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 (1-3)

Directed group study of selected topics for advanced students. Open to graduate students. *Class Schedule* will list topic selected. Total credit limited to 6 units. 1-3 seminars. Prerequisite: Graduate standing or consent of instructor.

CE 571 Selected Advanced Laboratory (1-3)

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 6 units. 1-3 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)

Analysis of stability by planar, circular arc, piecewise-linear, and composite-surface techniques. Analysis of earth-fill dams and reservoirs for static, steady flow, sudden drawdown, and seismic loading conditions. Field instrumentation. Methods for slope remediation and stabilization. Computer-aided analysis. 4 lectures. Prerequisite: CE 481 or graduate standing.

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 – Essentials (4) GE B1a

Fundamentals of chemical cause and effect – structure/ function relationships. Basic principles of chemistry and their applications to solving human problems in organic materials science, biochemistry, toxicology, environmental science, agriculture, nutrition, and medicine. 3 lectures, 1 laboratory. Prerequisite: Must satisfy ELM requirement.

CHEM 111 Survey of Chemistry (5) GE B1a

Introduction to atomic theory, chemical reactions, bonding, stoichiometry, nomenclature, and solutions. Intended for students who are preparing for CHEM 212. 4 lectures, 1 laboratory. Prerequisite: CHEM 106 or equivalent, intermediate algebra, appropriate score on ELM. Not open to students with credit for CHEM 128.

CHEM 124 General Chemistry for the Engineering Disciplines (4) GE B1a

General chemistry concepts presented using a materials science approach with engineering applications. Thermochemistry, atomic theory, bonding, solid state structures, fundamentals of organic chemistry including polymers. Laboratory work is closely coordinated with theory; computers integrated into the curriculum for data collection as well as multimedia work and tutorials.

Guided inquiry and collaborative methods are emphasized. Not open to students with credit for CHEM 111 or CHEM 127. 3 lectures, 1 laboratory. Prerequisite: Intermediate algebra or MATH 104; and high school chemistry, CHEM 106 or equivalent.

CHEM 125 General Chemistry for the Engineering Disciplines (4) GE B1a

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.

CHEM 127 General Chemistry (4) GE B1a

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: Intermediate algebra or MATH 104; and high school chemistry, CHEM 106 or equivalent.

CHEM 128 General Chemistry (4) GE B1a

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) GE B1a

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) GE B1a

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 Survey of Organic Chemistry (5) GE B1a

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 216. 4 lectures, 1 laboratory. Prerequisite: CHEM 111, or CHEM 128, or equivalent.

CHEM 216 Organic Chemistry I (4) GE B1a

Structure, bonding, nomenclature, isomerism, stereochemistry and physical properties of organic compounds. Reactions and

mechanisms of alkanes, alkenes, alkynes, cycloalkanes.

Laboratory techniques in organic preparations. 3 lectures, 1 laboratory. Prerequisite: CHEM 125 or CHEM 128.

CHEM 217 Organic Chemistry II (5) GE B1a

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.

CHEM 231 Quantitative Analysis I (5) GE B1a

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 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) GE B1a

Fundamentals and applications of chemical thermodynamics of particular interest to engineers. Chemical and phase equilibria. 3 lectures. Prerequisite: PHYS 123 or PHYS 133, CHEM 125 or CHEM 129, MATH 143.

CHEM 306 Physical Chemistry (3) GE B1a

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

CHEM 313 Survey of Biochemistry and Biotechnology (5) GE B1a

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 or equivalent.

CHEM 318 Organic Chemistry III (5) GE B1a

Chemistry of amines, aromatic compounds, heterocycles, macromolecules, some biomolecules, carbanions, rearrangements; mass spectrometry. Practice in organic synthesis. 3 lectures, 2 laboratories. Prerequisite: CHEM 217.

CHEM 332 Quantitative Analysis II (3) GE B1a

Theory and analytical techniques associated with gravimetric analysis and titrimetric precipitometry. Continuation of redoximetry. Introduction to instrumental methods of analysis, with theory and application of electrogravimetry, potentiometry and spectrophotometry. 2 lectures, 1 laboratory. Prerequisite: CHEM 231.

CHEM 337 Clinical Chemistry I (2) GE B1a

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; CHEM 231 recommended.

CHEM 338 Clinical Chemistry I Laboratory (1) (CR/NC) GE B1a

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 strongly recommended.

CHEM 341 Environmental Chemistry: Water Pollution (3) GE B1a

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 or CHEM 216.

CHEM 342 Environmental Chemistry: Air Pollution (3) GE B1a

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 or CHEM 216.

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 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 or equivalent.

CHEM 351 Physical Chemistry I (3) GE B1a

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) GE B1a

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) GE B1a

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. 2 laboratories. Prerequisite: CHEM 231 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 359 Chemical Literature (2)

Information searches in primary and secondary chemical literature and computer database. Organizing and presenting chemical information in written documents. 1 lecture, 1 activity. Prerequisite: CHEM 216 or CHEM 212.

CHEM 371 Biochemical Principles (5) GE B1a

Chemical and physical factors in biological processes. Chemistry and function of major cellular constituents: proteins, lipids, carbohydrates. 4 lectures, 1 laboratory. Prerequisite: CHEM 212 or CHEM 217. Recommended: CHEM 231.

CHEM 372 Metabolism (3) GE B1a

Intermediary 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) GE B1a

Synthesis, conformation and structure of biopolymers: nucleic acids and proteins. Function of macromolecular complexes: cell walls, ribosomes, membranes, and others. Biochemical genetics, cell differentiation and regulation, viruses and biochemical evolution. 3 lectures. Prerequisite: CHEM 371.

CHEM 374 Biochemistry Laboratory (2) GE B1a

Experiments in metabolism, including animal and microbial studies; isolation and characterization of enzymes and nucleic acids. 2 laboratories, offered during the same day or on consecutive days to simulate biochemical research conditions. Prerequisite: CHEM 371.

CHEM 375 Molecular Biology Laboratory (2) GE B1a
(Also listed as BIO 375)

Introduction to techniques used in molecular biology and biotechnology; plasmid DNA extraction, agarose gel electrophoresis, restriction endonuclease mapping, transduction, transformation, and gene cloning. 2 laboratories. Prerequisite: MCRO 221 or MCRO 224, and BIO 351 or CHEM 373.

CHEM 377 Chemistry of Drugs and Poisons (3) GE B1a

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) GE B1a

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 elements. 3 lectures. Prerequisite: CHEM 216, CHEM 231.

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. 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 318.

CHEM 420 Advanced Organic Chemistry-Synthesis (3)

Modern methods of organic synthesis. Carbon-carbon bond forming reactions, functional group transformations, protecting groups, strategies of total synthesis of natural products. 3 seminars. Prerequisite: CHEM 318.

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, 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.

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.

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)

Synthesis and characterization of polymers. Experimental techniques of step growth and chain growth polymerization. Experimental methods of molecular weight determination. Experimental methods of thermal, spectroscopic, and mechanical analysis. 2 laboratories. Prerequisite: CHEM 444. Recommended: CHEM 445 or concurrent.

CHEM 448 Polymers and Coatings Laboratory II (2)

Experimental techniques of producing and characterizing coatings. Compounding and formulating modern protective coatings. Modern methods of testing protective coatings. Surface preparation techniques. 2 laboratories. Prerequisite: CHEM 444, CHEM 445.

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 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 or CHEM 216.

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. 1 laboratory. Prerequisite: CHEM 318.

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 spectroscopy, and techniques in high resolution FT-NMR. 1 lecture, 2 laboratories. Prerequisite: CHEM 318.

CHEM 459 Undergraduate Seminar (2)

Oral presentation of current developments in chemistry based on current literature. 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 Research (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 (or permission of instructor), evidence of satisfactory preparation in chemistry. Department chair approval required.

CHEM 470 Selected Advanced Topics (1–3)

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 6 units. 1 to 3 lectures. Prerequisite: CHEM 305, or CHEM 351, or CHEM 217 or consent of instructor.

CHEM 473 Immunochemistry (3)

Theory and practice of immunochemistry including the structure, genetics, chemical modification and production of antibodies, immunochemical 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: BACT 221, 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 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. 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 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 211 or ECON 222 and third-year standing 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 activities. 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) (1) (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 (1–3)

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 6 units. Miscellaneous course fee required—see *Class Schedule*. 1 to 3 lectures. Prerequisite: Consent of instructor.

CM 471 Selected Advanced Laboratory (1–3)

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 6 units. 1–3 laboratories. Prerequisite: Consent of instructor.

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 (3)

Directed study of selected topics in Construction Management. *Class Schedule* will list topic selected. Total credit limited to 9 units. 3 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)

(formerly CSC 118)

(Also listed as CSC 101)

GE F1

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)

(formerly CSC 218) (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 activity. Prerequisite: CPE 101. Corequisite: CSC 141.

CPE 103 Fundamentals of Computer Science III (4)

(formerly CSC 345) (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 activity. Prerequisite: CPE 102 and CSC 141.

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. Prerequisite: 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)

(formerly CSC 440) (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)

(formerly CSC 441) (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. Combinational 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 231 Fortran for Engineering Students (2)

GE F1

(formerly CSC 251) (Also listed as CSC 231)

Programming techniques and procedures with applications to engineering problems in FORTRAN. Introduction to numerical methods and simulation. 2 activities. Prerequisite: MATH 142 or MATH 132; PHYS 121 or PHYS 131.

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)

(formerly CSC 255) (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 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 tradeoffs 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 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)
(formerly CSC 347) (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)

The database modeling problem. Database modeling levels: external, conceptual, logical and physical. Database models: entity-relationship, relational, object-oriented, semantic, and object-relational. Normal forms. Distributed database design. Functional analysis of database applications and transaction specification, design, and implementation. 3 lectures, 1 laboratory. Prerequisite: CPE 365.

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 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)
(formerly CSC 450) (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)
(formerly CSC 451) (Also listed as CSC 431)

Intermediate translation forms. Runtime representations. Generation of object code by compilers. Local optimization: constant propagation, folding, common subexpression removal. Global optimization, invariant code removal, operator strength reduction. Register allocation. 3 lectures, 1 laboratory. Prerequisite: CPE 430.

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.

CPE 436 Microprocessor System Design Methodologies and Laboratory (4)
(Also listed as EE 436)

Classification hardware/software trade-offs, system economics and functional configurations of existing microprocessor and hardware system designs. Interface design techniques utilizing programmable I/O interfaces, real-time clocks, interrupts, and DMA channels. Representative applications. Design, construction, performance evaluation and laboratory testing of microprocessor based systems.

3 lectures, 1 laboratory. Prerequisite: CPE 215, CPE/EE 319/359, or consent of instructor.

CPE 437 Digital Computer Subsystems (3)
(Also listed as EE 437)

Design of registers, counters, sequencers, encoders, decoders, memories, and other computer subsystems. Use of modern techniques and devices in implementation. Consideration given to cost, speed, and dependability. 3 lectures. Prerequisite: CPE 319. Concurrent: CPE 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 (paper devices, floppy disks, etc.) 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 436, 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)
(formerly CSC 401) (Also listed as CSC 459)

Analysis and synthesis of robust real-time systems including imbedded 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 (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 453.

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) (formerly CSC 447)
(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 (1–3)

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 6 units. 1 to 3 lectures. Prerequisite: Consent of instructor.

CPE 471 Introduction to Computer Graphics (4)
(formerly CSC 455) (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)
(formerly CSC 456) (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)
(formerly CSC 484) (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 Systems Laboratory (1) (Also listed as EE 478)

Laboratory analysis and synthesis of digital computer subsystems. Microprogramming of a simple digital computer via computer simulation. Interfacing with digital systems. 1 laboratory. Prerequisite: CPE 359. Concurrent: CPE 437.

CPE 480 Artificial Intelligence (4)
(formerly CSC 420) (Also listed as CSC 480)

Programs and techniques that characterize artificial intelligence. Programming in LISP. 3 lectures, 1 laboratory. Prerequisite: CPE 103 and CSC 141.

CPE 481 Knowledge Based Systems (4)
(formerly CSC 421) (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 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 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)
(formerly CSC 504) (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)
(formerly CSC 506) (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.

CRP 111 Introduction to Drawing and Perspective (3)

Basic graphic communication techniques for planning. Orthographic and isometric projection. 3 laboratories.

CRP 112 Basic Graphics (3)

Drawing as a communication tool in planning. Exercises to develop basic skills and speed in the representation of ideas. Use of various drawing media. 3 laboratories. Prerequisite: CRP 111.

CRP 201, 202 Environmental Design Fundamentals (3) (3)

Elements and principles of visual and environmental design; analysis, program development, problem solving and design. Implications of design decisions and solutions. Assignments of object, project and system scale in an urban planning context. 3 laboratories. Prerequisite: CRP 111, CRP 112.

CRP 203 Applied Design and Planning Fundamentals (3)

Applications of basic design fundamentals and the design of environments through exercises applied to planning. Miscellaneous course fee required—see *Class Schedule*. 3 laboratories. Prerequisite: CRP 202, LA 213.

CRP 211 Introduction to Urbanization (3) GE F2

Evolution, planning, and design of cities in different cultures and eras. Interpretation of environmental, social, economic, and technological factors that have influenced the physical organization, planning, and design of cities. 3 lectures.

CRP 212 Introduction to Urban Planning (3) GE F2

Problems and responses to contemporary urban growth and change. Development of theories of urban planning and design. Introduction to planning regulations and codes, professional practice and linkage between knowledge and action. Relationship of environmental design disciplines, citizen groups, and individuals to planning. 3 lectures.

CRP 213 Population and Housing Studies (3)

Collection, organization, analysis and presentation of information and data related to city and regional planning. Analytical applications to population composition and distribution; housing needs, characteristics and markets; community services. 3 lectures. Prerequisite: CRP 212.

CRP 214 Land Use and Transportation Studies (3)

How cities and regions work. Relationship between human activities and patterns of land use and circulation. Spatial analysis and locational theories. Methods for conducting studies to describe, analyze, and map land uses. Transportation analysis, traffic impact, and circulation patterns. 3 lectures. Prerequisite: CRP 212.

CRP 215 Planning for and with Multiple Publics (4) (Also listed as ES 215) USCP

Understanding social/cultural factors that influence how people interact at neighborhood, community and city scale. Exploring how race, gender, ethnicity and age influence use and adaptation

of urban spaces, and how understanding these factors can improve the way we design cities and human settlements. 4 lectures.

CRP 216 Computer Applications for Planning (3)

Use of microcomputer applications to assemble, display and analyze planning data. Includes spreadsheets, statistical applications, database, Internet and graphics. Miscellaneous course fee required—see *Class Schedule*. 1 lecture, 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 Economic and Fiscal Analysis for Planning (3)

Basic theoretical frameworks for understanding regional economic trends. Techniques for analyzing the strengths and weaknesses of local and regional economies. Fiscal impact analysis and feasibility studies at the local level. 3 lectures. Prerequisite: CRP 212, CRP 213, CRP 214, ECON 211, ECON 212, ENGL 215 or 218.

CRP 347, 348 Urban and Regional Design (3) (3)

Three-dimensional design of urban and regional areas within the comprehensive planning process. Effect of human activities on the form of the natural and built environment at differing scales. Miscellaneous course fee required—see *Class Schedule*. 3 laboratories. Prerequisite: CRP 203, CRP 347 (for CRP 348).

CRP 351, 352, 353 Community Planning Laboratory (4) (4) (4)

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, plan-making and implementation. Computer applications. Field trips. Individual, team, and interdisciplinary approaches. Miscellaneous course fee required—see *Class Schedule*. 4 laboratories. Prerequisite: CRP 213, CRP 214, CRP 216, LA 213, GEOL 201, STAT 221, ENGL 215 or ENGL 218, ECON 211, ECON 212.

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 114.

**CRP 404 Environmental Law (3)
(Also listed as FNR 404)**

Detailed examination 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 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)

Goals, processes and approaches for planning local economic development. Theoretical principles and assumptions underlying local economic development programs. Alternative strategies and analytical techniques for planning economic development programs and projects. 3 seminars. Prerequisite: Senior standing.

CRP 430 Planning Administration (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 planning administration. 3 lectures. Prerequisite: Senior standing.

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 442 Housing and Planning Seminar (3)

Investigation 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 353 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 352, ENVE 331 or senior standing.

CRP 447 Design Regulations (3)

Practical application of fundamental building code requirements and zoning regulations in the design process. Codes and regulations used including city zoning regulations, city parking and driveway standards, the Uniform Building Code, and the architectural barrier laws. 3 lectures. Prerequisite: ARCH 342, or consent of instructor.

CRP 451, 452 Regional and Environmental Planning Laboratory (4) (4)

Case study application of planning theory and methods to regional and environmental systems. Regional spatial development and resource use. Interrelationships between natural, economic, social and political systems. Field trips. Individual, team and interdisciplinary approaches. Miscellaneous course fee required—see *Class Schedule*. 4 laboratories. Prerequisite: CRP 314, CRP 353, FNR 306.

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 348, CRP 452.

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: CRP 353.

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 409, CRP 452.

CRP 461, 462 Senior Project (2) (2)

Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in public planning settings. Project results presented in a formal report. To be completed in two quarters. Minimum 120 hours time. Prerequisite: CRP 353, CRP 460.

CRP 470 Selected Advanced Topics (1–3)

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 6 units. 1 to 3 lectures. Prerequisite: Consent of instructor.

CRP 471 Selected Advanced Laboratory (1–3)

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 6 units. 1–3 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 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 211 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 Policy Analysis for Planners (4)

Analysis of social, economic, and environmental context of public planning decisions. Externalities and other rationales for planning activities. Policy analysis tools for evaluating equity and efficiency aspects of plan implementation. Local funding options for

community development and redevelopment. Non-monetary issues and techniques. 4 seminars. Prerequisite: CRP 501, CRP 510, CRP 514.

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 545 Environmental Planning, Policies and Principles (4)

Environmental planning as a field of inquiry and action. Review and application of policies and techniques used in environmental planning, including analysis of environmental programs and processes within the land use planning context. 3 seminars, 1 laboratory. Prerequisite: Graduate standing 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 552 Community Planning Laboratory (4)

Application of planning theory and methods to community planning. Analysis of issues, consideration of future alternatives, preparation of plan elements. Interrelationships and impacts of natural and built environments, economic and social conditions. Field trips. Individual, team and interdisciplinary approaches. Miscellaneous course fee required—see *Class Schedule*. 4 laboratories. Prerequisite: CRP 501.

CRP 553 Project Planning Laboratory (4)

Project-scale planning problems. Arranging structures, circulation systems, utilities and plant material on natural and urban sites to support human activity while minimizing disruption to natural systems. Includes planned unit developments, waterfronts, hillsides, campuses and commercial centers. Field trips. Miscellaneous course fee required—see *Class Schedule*. 4 laboratories. Prerequisite: CRP 515, CRP 548.

CRP 554 Regional Planning and Analysis (4)

Application of planning theory and methods to regional problems and issues. Research, analysis, synthesis and implementation practice. Interrelationships between natural, economic and political regions, technology, resource use. Field trips. Individual, team and interdisciplinary approaches. Miscellaneous course fee required—see *Class Schedule*. 3 seminars, 1 laboratory. Prerequisite: CRP 501.

CRP 570 Selected Topics in Planning (3)

Directed group study of selected topics in planning theory. Total credit limited to 9 units. 3 seminars. Prerequisite: Graduate standing or consent of instructor.

CRP 597 Policy, Planning and Management (4)

This course provides a synthesis of the M.C.R.P. program. Expansion and integration of material on planning principles, practice, theory and quantitative methods. 4 seminars. Prerequisite: CRP 409, CRP 420, CRP 510, CRP 516, CRP 518, CRP 525, CRP 530, CRP 552, CRP 554 and advancement to candidacy.

CRP 599 Thesis/Project (6)

Individual research under the general supervision of the faculty, leading to a graduate thesis or project of suitable quality. Prerequisite: CRP 513, advancement to candidacy, consent of department head.

CRSC—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 221 Weed Science (4)

Identification, life histories, and control of common, noxious, and poisonous California weeds. Weed control chemicals and equipment for cultivated crops, irrigation systems, range, wastelands, aquatics, forests. 3 lectures, 1 laboratory. Prerequisite: BOT 121 or CRSC 131 or FRSC 131.

CRSC 230 Agronomic Crop Production (4) GE F2

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 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 311 Insect Pest Management (4)

Principles of controlling insect pests including biological, cultural, physical, and chemical controls. Identification of insects injurious to California field, fruit, and vegetable crops. Insecticide formulation and methods of application. Pesticide laws and regulations. 3 lectures, 1 laboratory. Miscellaneous course fee may be required—see *Class Schedule*. Prerequisite: CHEM 111 or introductory courses in biology, botany or zoology or consent of instructor.

CRSC 327 Vertebrate Pest Management (4)

Vertebrate pests injurious to crops, livestock, forest products, wildlife, stored products and humans. Life habits, identification, control methods, and materials. Related laws and regulations. Miscellaneous course fee may be required—see *Class Schedule*. 3 lectures, 1 laboratory. Prerequisite: Junior standing.

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 131 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 405 Advanced Weed Science (4)

Group study and discussion of the importance of the ecology and biology of weeds for successful management; integrated weed management; herbicide selectivity based on mode of actions; herbicides and the environment; regulatory aspects of weed control. Field trip required. Miscellaneous course fee may be required—see *Class Schedule*. 3 seminars, 1 laboratory.

Prerequisite: CRSC 221 or 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.

CRSC 411 Experimental Techniques and Analysis (4)

Principle 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, CRSC 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 431 Advanced Insect Pest Management (4)

Strategies and case studies of modern insect pest management. Group study and discussion of integrated pest management (IPM) of insects and mites. Pesticide resistance management, insect and mite monitoring, pest management regulatory issues, biotechnology applications, biological/ microbial control, and preparation for Pest Control Advisor's licensing. Industry speakers. Field trips required. Miscellaneous course fee may be required—see *Class Schedule*. 3 lectures, 1 laboratory. Prerequisite: CRSC 311 or consent of instructor.

CRSC 441 Biological Control of Insects (4)

Biological control of insects to include history of classical methods, biology, augmentation and inundative release of beneficial arthropods. Identification of beneficial arthropods to appropriate taxonomic level. Technology, laws and regulations governing use of biocontrol agents. Field trips to insectaries, quarantine facilities and/or crop production areas. 3 lectures, 1 laboratory. Prerequisite: CRSC 311 or consent of instructor.

CRSC 444 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 445 Cropping Systems (4)

Classification and description of agricultural systems of the world. Cropping systems as land management plans. Systems approaches to improvement of agricultural situations. Consideration of human factors and the agroecosystem in efforts to create a more sustainable agriculture. 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 6 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 (1–3)

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 9 units. 1–3 seminars. Prerequisite: Graduate standing or consent of instructor.

CRSC 571 Selected Advanced Laboratory in Crop Science (1–3)

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 6 units. 1–3 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)
(formerly CSC 118) (Also listed as CPE 101) GE F1

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)
(formerly CSC 218) (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 activity. Prerequisite: CSC 101. Corequisite: CSC 141.

CSC 103 Fundamentals of Computer Science III (4)
(formerly CSC 345) (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 activity. Prerequisite: CSC 102 and CSC 141.

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) GE F1

The computer as a problem-solving tool. A practical introduction to microcomputers, timeshared computer systems and fundamental computing concepts. Use of applications software for word processing, spreadsheets, and communications. Credit not allowed for CSC majors. Miscellaneous course fee may be required—see *Class Schedule*. 2 lectures, 1 activity.

CSC 111 Introduction to Computer Applications for the Sciences (3) GE F1

Use of computers in science, with examples from biology, physics and chemistry. Credit not allowed for CSC majors. 2 lectures, 1 laboratory.

CSC 113 Computers and Computer Applications: Macintosh (3) GE F1

The computer as a problem-solving tool. A working introduction to microcomputers, timeshared computer systems and fundamental computer concepts. Use of applications software for word processing, spreadsheets and communications. Credit not allowed for CSC majors. Miscellaneous course fee required—see *Class Schedule*. 2 lectures, 1 activity.

CSC 119 Principles of Data Processing (4)
(formerly CSC 120) GE F1

Fundamental concepts of digital computing. Survey of computing devices, systems, and applications software for database processing. Credit not allowed for CSC majors. Miscellaneous course fee may be required—see *Class Schedule*. 4 lectures. Prerequisite: High school algebra.

CSC 141 Discrete Structures I (4)
(formerly CSC 245)

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)

Advanced structures of computer science: sequences, strings, graphs, networks. Recursion and recurrence relations. Introduction to combinatorics. Proof techniques. Complexity of algorithms. Advanced application to verification of algorithms. 4 lectures. Prerequisite: CSC 102 and CSC 141.

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)
(formerly CSC 440) (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)
(formerly CSC 441) (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) **GE F1**
(formerly CSC 251) (Also listed as CPE 231)

Programming techniques and procedures with applications to engineering problems in FORTRAN. Introduction to numerical methods and simulation. 2 activities. Prerequisite: MATH 142 or MATH 132; PHYS 121 or PHYS 131.

CSC 233 COBOL Programming (3)
(formerly CSC 203)

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) (formerly CSC 204) **GE F1**

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)
(formerly CSC 209)

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)
(formerly CSC 255) (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 (3) **GE F2**

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. Technical elective credit not allowed for CSC majors. 3 lectures. Prerequisite: junior standing and F.1. computer literacy course.

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/CPE 315.

CSC 330 Programming Languages I (4)
(formerly CSC 351)

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, CSC/CPE 215.

CSC 334 Advanced Topics in Unix (4)
(formerly CSC 241)

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)
(formerly CSC 311)

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 143 and knowledge of Fortran or C.

CSC 342 Numerical Analysis I (3)
(formerly CSC 332)

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)
(formerly CSC 333)

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 349 Design and Analysis of Algorithms (4)

Intermediate and advanced algorithms and their analysis. Mathematical, geometrical, and graph algorithms. NP-complete problems. Additional topics will be chosen from pattern matching, file compression, cryptology, dynamic and linear programming, and exhaustive search. 4 lectures. Prerequisite: CSC 103, MATH 142 and completion of all mathematics/statistics support courses.

CSC 358 Computer System Administration (2)
(formerly CSC 248)

Fundamental concepts of Unix system administration. Use of shell scripts and utilities. Techniques of networks and data communications. Methods of system maintenance and accounting. 2 seminars. Prerequisite: CSC 103 or permission of instructor.

CSC 361 File Structures (4)
(formerly CSC 346)

External storage devices. Character, record, and block I/O. Blocking and buffering. File structures: sequential, indexed sequential, B trees, hashing, multi-key and linked. Primary and secondary indexing. Design and implementation of record and object storage managers. Data compression. Multi-media file formats. 4 lectures. Prerequisite: CSC 103.

CSC 365 Introduction to Database Systems (4)
(formerly CSC 347) (Also listed as CPE 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: CSC 103.

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

The database modeling problem. Database modeling levels: external, conceptual, logical and physical. Database models: entity-relationship, relational, object-oriented, semantic, and object-relational. Normal forms. Distributed database design. Functional analysis of database applications and transaction specification, design, and implementation. 3 lectures, 1 laboratory. Prerequisite: CSC 365.

CSC 369 Introduction to Distributed Computing (4)
(Also listed as CPE 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: CSC 103.

CSC 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.

CSC 430 Programming Languages II (4)
(formerly CSC 450) (Also listed as CPE 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.

CSC 431 Programming Languages III (4)
(formerly CSC 451) (Also listed as CPE 431)

Intermediate translation forms. Runtime representations. Generation of object code by compilers. Local optimization: constant propagation, folding, common subexpression removal. Global optimization, invariant code removal, operator strength reduction. Register allocation. 3 lectures, 1 laboratory. Prerequisite: CSC 430.

CSC 434 Compilers – Hardware/Software Interface (4)
(Also listed as CPE 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: CSC 205 and CSC/CPE 315.

CSC 435 Introduction to Object Oriented Design Using Graphical User Interfaces (4)
(Also listed as CPE 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: CSC 103 or equivalent.

CSC 436 Graphical User Interface Systems (4)

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 445 Theory of Computing (4)

Finite state machines and regular languages. Pushdown automata and context-free languages. Turing machines. Computation theory and computational complexity. Proofs of classical theorems and the theory of computation. 4 lectures. Prerequisite: CSC 103.

CSC 453 Introduction to Operating Systems (4)
(Also listed as CPE 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: CSC/CPE 315.

CSC 454 Implementation of Operating Systems (4)
(Also listed as CPE 454)

Design and implementation of multiprogramming kernels, systems programming methodology, interprocess communications, synchronization, device drivers and network access methods. 3 lectures, 1 laboratory. Prerequisite: CSC 453.

CSC 459 Real-Time Systems (4)
(formerly CSC 401) (Also listed as CPE 459)

Analysis and synthesis of robust real-time systems including imbedded 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: CSC 315.

CSC 464 Computer Networks I (4)
(Also listed as CPE 464) (formerly CSC 404)

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 CSC 453.

CSC 465 Computer Networks II (4)
(Also listed as CPE 465) (formerly CSC 405)

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)
(formerly CSC 447) (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)
(formerly CSC 455) (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)
(formerly CSC 456) (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)

Components and design of virtual environment simulation systems. Human sensory perception simulation. Modeling virtual worlds:

objects, behaviors. Hardware: sensors, displays, architectures. Software: design, low-level drivers, function library toolkits, integrated applications. System integration: configuration, calibration, testing. Survey of applications. 3 lectures, 1 laboratory. Prerequisite: CSC 471.

CSC 477 Computer Vision (4)
(formerly CSC 484) (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)
(formerly CSC 458)

Current topics in computer graphics. Total credit limited to 4 units. 2 seminars. Prerequisite: CSC 471.

CSC 480 Artificial Intelligence (4)
(formerly CSC 420) (Also listed as CPE 480)

Programs and techniques that characterize artificial intelligence. Programming in LISP. 3 lectures, 1 laboratory. Prerequisite: CSC 103 and CSC 141.

CSC 481 Knowledge Based Systems (4)
(formerly CSC 421) (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 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: Junior standing and consent of instructor.

CSC 488 Performance Analysis (4)
(Also listed as CPE 488) (formerly CSC 410)

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.

CSC 490 Selected Advanced Topics (1-3)
(formerly CSC 470)

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 6 units. 1 to 3 lectures. Prerequisite: Consent of instructor.

CSC 491, 492 Senior Project (2) (3)
(formerly CSC 461, 462)

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)
(formerly CSC 485)

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)
(formerly CSC 504) (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)
(formerly CSC 501)

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 431 and graduate standing, or consent of instructor.

CSC 540 Theory of Computing (4)
(formerly CSC 505)

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)
(formerly CSC 531)

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)
(formerly CSC 503)

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)
(formerly CSC 502)

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 (2–3)

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 9 units. 2 to 3 seminars. Prerequisite: Graduate standing and evidence of satisfactory preparation in computer science.

CSC 580 Artificial Intelligence (4)
(formerly CSC 506) (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)
(formerly CSC 527)

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)
(formerly CSC 507)

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)
(formerly CSC 517)

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)
(formerly CSC 585)

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 Social Dance (2)

Selected ballroom dances including the cha-cha-cha, foxtrot, merengue, rumba, samba, swing, tango, waltz, and discotheque. Emphasis on alignment, etiquette, leading and following, performance techniques, and presentation of simple dance phrases. 2 activities.

DANC 135 International Folk Dance (1)

Introduction to international folk dances including round, longway, and square sets. Study of various dance steps, formation, positions, historical and cultural background. 1 activity.

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)

GE C2

Explores the world of dance with introduction to diversified dance forms. Concentrates on western major dance artists and their works from the 19th century to present. Includes 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 Social Dance (2)

Continuation of DANC 134. Emphasis on variations, styles, and performance skill. 2 activities. Prerequisite: Consent of instructor.

DANC 311 Dance in American Musical Theatre (4)

GE C3

Exploration of 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: Any GE C2 course from Art, Dance, Music or Theatre, and junior standing.

DANC 320 Dance Notation (3)

Introduction to the major dance notation systems, emphasizing the theory, reading and writing of Labanotation. 1 lecture, 2 activities. Prerequisite: One DANC activity class or consent of instructor.

DANC 321 Dance History (3)

GE C3

Historical influences on contemporary Western dance from prehistoric times to the present, with special emphasis on European, African and Latino sources. 3 lectures. Prerequisite: One DANC activity class or consent of instructor.

DANC 331 Advanced Ballet and Repertory (2)

Advanced ballet technique and reconstruction of historical ballet repertoires 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 Improvisation and Composition (3)

Principles of dance composition and improvisation. Exploring movement potentials through studies in use of various stimuli, process of construction, and structuring of compositional forms. 1 lecture, 2 activities. Prerequisite: Consent of instructor.

DANC 345 Choreography and Workshop in Concert Preparation (3)

Problems connected with dance choreography. Workshops in concert preparation for Cal Poly's major dance production. Total credit limited to 12 units. 1 seminar, 2 laboratories. Prerequisite: By audition only.

DANC 346 Dance Production (3)

Directed experience in production of annual Orchesis Dance Concert and other public performances. Total credit limited to 12 units. 3 laboratories. Prerequisite: DANC 345 or consent of instructor.

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 (1-3)

Directed study of selected topics for advanced dance students. *Class Schedule* will list topics selected. Total credit limited to 6 units. 1-3 lectures. Prerequisite: Consent of instructor.

DANC 471 Selected Advanced Laboratory (1-3)

Directed group laboratory study of selected topics for dance students. *Class Schedule* will list topics selected. Total credit limited to 6 units. 1-3 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)**GE F2**

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. 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. Elective 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 6 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 114, 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 or consent of instructor.

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 BACT 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, buttermilk, sour cream, and yogurt. 3 lectures, 1 laboratory. Prerequisite: DSCI 134, BACT 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: BACT 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 (1–3)

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 6 units. 1 to 3 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 or FSN 407, 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 (1–3)

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 9 units. 1 to 3 seminars. Prerequisite: Graduate standing or consent of instructor.

DSCI 571 Selected Advanced Laboratory in Dairy Science (1–3)

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 6 units. 1–3 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 (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 D3**

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 211, ECON 212, ECON 221, ECON 222 or equivalent. 4 lectures.

ECON 211 Principles of Economics (3)**GE D3**

Macroeconomics: principles and applications in the theory of national income, output and employment. Determination and measurement of the national product. Inflation, money, banking, monetary and fiscal policies. Not open to majors in Economics and Business. Not open to students with credit in ECON 222. 3 lectures.

ECON 212 Principles of Economics (3)

Microeconomics: principles and applications in the theory of producer and consumer behavior, and the distribution of factor income with focus on the output market. Effect on the national economy. Not open to majors in Economics and Business. Not open to students with credit in ECON 221. 3 lectures.

ECON 221 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. Not open to students with credit in ECON 212 or equivalent. 4 lectures.

ECON 222 Macroeconomics (4) GE D3

Macroeconomics analysis and principles. Aggregate output, employment, prices, and economic policies for changing these variables. Not open to students with credit in ECON 211 or equivalent. 4 lectures. Prerequisite: ECON 221.

ECON 303 Economics of Poverty, Discrimination and Immigration (4) GE D4b USCP

Economic analysis of the cause, extent and impact of poverty, discrimination and immigration and of the policies designed to address these socioeconomic issues. Introduction to the measurement of poverty, welfare reform, glass ceilings in the workplace, affirmative action and equal opportunity programs, and assimilation and adaptation of immigrants. Emphasis on the experience of African-Americans, Latinos and women in the United States. 4 lectures. Prerequisite: ECON 201, ECON 212 or ECON 221.

ECON 304 Comparative Economic Systems (4) GE D4b

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 effect on human welfare. 4 lectures. Prerequisite: ECON 201 or ECON 211 or ECON 222.

ECON 306 Applied Forecasting (4)

Causes and measurement of business fluctuations. Techniques of forecasting with microcomputer applications. 3 lectures, 1 activity. Prerequisite: ECON 201 or ECON 211 or ECON 222, CSC 119 and STAT 252.

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: CSC 119, 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. ECON 313: Miscellaneous course fee required—see *Class Schedule*. 3 lectures, 1 activity. Prerequisite: ECON 211 or ECON 222, MATH 221, STAT 252. For ECON 314: ECON 313.

ECON 323 Economic History of the Advanced World (4)

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: ECON 201 or ECON 211 or ECON 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 211 or ECON 221 or ECON 222.

ECON 325 Economics of Development and Growth (4) GE D4b

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 211 or ECON 212 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 211 or 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. Miscellaneous course fee may be required—see *Class Schedule*. 3 lectures, 1 activity. Prerequisite: CSC 119, 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 212 or ECON 221.

ECON 402 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 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 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, CSC 119.

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 212 or 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 211, ECON 212 or ECON 221, ECON 222.

ECON 430 Internship (2–8) (CR/NC)

Placement of student for part-time supervised work experience in a business enterprise or government agency approved by the department head. Collateral reading correlated with work assignments and periodic written progress reports required. Credit/No Credit grading. Prerequisite: Junior standing.

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 211 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 211 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 211 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 212 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 6 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.