CD Communication Disorders

CD 277 INTRODUCTION TO DISORDERS OF SPEECH AND LANGUAGE. (3)
An introduction to developmental aspects of speech and language. Definitions, symptoms, and etiologies of articulation, language, fluency, and voice disorders.

CD 285 APPLIED PHONETICS. (3)
Study of the phonetic structure of the English language with requirement of mastery of International Phonetic Alphabet. Emphasis will be placed on phonetic transcription, and application will be made for students interested in general speech, speech correction, radio, television, and theatre. (Same as COM 285.)

CD 378 ANATOMY AND PHYSIOLOGY OF SPEECH. (3)
A detailed investigation of structures and functions supporting speech production: respiration, phonation, articulation, and resonance. Neural bases of speech and language will also be introduced. Prereq: CD 277 or permission of instructor.

CD 379 FUNDAMENTALS OF HEARING. (3)
Investigation of the anatomical, physiological, and neurological bases of hearing; physics of sound; and elementary psychoacoustics. Prereq: CD 379 or permission of instructor.

CD 380 PATHOLOGIES OF THE AUDITORY SYSTEM. (3)
Detailed investigation of various definitions, symptomatologies, etiologies, and treatments of hearing impairment. Surveys of definitions, symptomatologies, etiologies, and treatments of central and functional hearing impairment. Prereq: CD 379 or permission of instructor.

CD 382 CLINICAL ORIENTATION IN SPEECH-LANGUAGE PATHOLOGY I. (3)
A lecture-laboratory experience designed to orient the student to the professional activities in speech-language pathology. Lecture: one hour; laboratory: four hours per week. Prereq: CD 277, CDI majors only.

CD 383 CLINICAL ORIENTATION IN SPEECH-LANGUAGE PATHOLOGY II. (3)
A lecture-laboratory experience designed to orient the student to the professional activities in speech-language pathology. Lecture: one hour; laboratory: four hours per week. Prereq: CD 382 or permission of instructor; CDI majors only.

CD 384 INTRODUCTION TO DIAGNOSTIC PROCEDURES IN SPEECH-LANGUAGE PATHOLOGY. (3)
Introduction to the principles, techniques, and tools used to develop and implement a diagnostic protocol. Prereq: CD 588 or permission of instructor; CDI majors only.

CD 511 SPEECH-LANGUAGE DEVELOPMENT AND DISORDERS FOR THE SEVERELY HANDICAPPED. (3)
An introduction to communication development and intervention for language disordered individuals whose language age is at or below four years, including cognitive, social, auditory, visual, and motor components. Topics include prerequisites for language, normal communication development, evaluation of language functioning, and approaches to altering communication behavior. Prereq: CD 277 or EDS 375 or consent of instructor. (Same as EDS 511).

CD 512 SPEECH-LANGUAGE DEVELOPMENT AND DISORDERS FOR THE MILDLY HANDICAPPED. (3)
An introduction to the characteristics of receptive and expressive language disorders in language-disordered children whose language age is four years or higher, including auditory, visual, cognitive, and motor components. Topics include language development, language disorders, language evaluation, and techniques for receptive and expressive language stimulation. Prereq: CD 277 or EDS 375 or permission of instructor. (Same as EDS 512).

CD 514 LANGUAGE DEVELOPMENT THROUGH THE LIFESPAN. (3)
An introduction to the normal development of language in individuals from birth to advanced age. Topics include theories of language acquisition; prelinguistic development; development in each of the language domains (phonology, semantics, morphology and syntax, and pragmatics); the relationships between oral language, written language, and academic progress; and cultural differences. Prereq: CD 277 or permission of instructor.

CD 515 LANGUAGE ASSESSMENT AND REMEDIATION. (3)
An introduction to the assessment and remediation of language disorders in individuals from birth to adulthood. Topics include characteristics of language disorders, assessment of prelinguistic and linguistic skills, methods of language remediation, and techniques for stimulating the development of prelinguistic and linguistic skills. Prereq: CD 514 or permission of instructor.

CD 521 NONSPEECH COMMUNICATION. (3)
Addresses the use of nonspeech communication systems with moderately to severely handicapped individuals. This course encompasses two basic components: 1) a lecture/discussion component which examines the full range of nonspeech communication systems, including evaluation and training considerations, and 2) a manual sign component which provides students with a basic functional receptive and expressive manual sign vocabulary. Prereq: EDS 375 or equivalent or permission of instructor.

CD 555 PROBLEMS IN COMMUNICATION DISORDERS (Subtitle required). (1-4)
In-depth study of a current topic or issue in communication disorders. A specific topic will be assigned each time the course is offered. May be repeated to a maximum of nine credits.

CD 585 SPEECH SCIENCE. (3)
To provide basic information concerning the physics of sound and the scientific bases of speech production and perception. Emphasis is placed on the acoustic nature of speech and the perception of spoken information. Instrumentation in speech science will be demonstrated. Prereq: CDI major or permission of instructor.

CD 588 DISORDERS OF ARTICULATION. (3)
Analysis, identification, and management of articulation disorders. Application of physiological phonetics to training is included. Prereq: CD 285 and CD 277, or permission of instructor.

CD 589 CRANIOFACIAL ANOMALIES. (3)
Analysis, identification, and management of communication deficits associated with craniofacial abnormalities. Prereq: CD 378 and CD 588, or permission of instructor.

CD 591 AURAL REHABILITATION. (3)
Introduction to management strategies, exclusive of language, for the hearing impaired. Topics include: variables affecting hearing handicap; hearing aid characteristics, selection, and orientation; acoustic and visual aspects of speech; auditory and visual perception and training; speech conservation. Prereq: CD 587.

CD 592 PROBLEMS AND NEEDS OF THE HEARING IMPAIRED. (3)
Effects of hearing impairment on mental development, language acquisition, and personality adjustment; current research and clinical trends in auditory rehabilitation and the education of the deaf.

CD 610 ETHICS IN CLINICAL SCIENCES RESEARCH. (1)
Students will examine ethical issues in biomedical research using a case-study approach. Representative issues addressed may include data selection and retention, plagiarism, scientific review of grants and manuscripts, scientific misconduct, and informed consent. Prereq: Graduate student status. (Same as CLS/CNU/PT/RAS 610.)

CD 647 ADVANCED LANGUAGE DISORDERS. (3)
Developmental and structured approaches to language evaluation and remediation. Assessment of language levels, knowledge of the language system and variables influencing language functioning in children in relation to devising intervention strategies. Presentation of remediation techniques for children aged 0 to 21. Prereq: CD 514 and CD 515, or permission of instructor.

CD 655 ADVANCED DIAGNOSTIC PROCEDURES IN SPEECH-LANGUAGE PATHOLOGY. (3)
Study of the principles of assessment and a critical review of existing standardized and non-standardized assessment tools in the field of speech-language pathology. Emphasis on selection of assessment tools for clients from diverse ethnic backgrounds with a variety of communication disorders, administration of selected tools, and organization of diagnostic information. Prereq: CD 384 or permission of instructor; CDI majors only.
CD 656 CLINICAL PRACTICUM IN DIAGNOSTIC PROCEDURES FOR SPEECH-LANGUAGE PATHOLOGY. (1)
Experience in the assessment of speech and language skills in children and adults. Emphasis on organization of all behavioral and test data and on report writing. Laboratory, two hours per week. May be repeated to a maximum of two credits. Prereq: CD 384 or equivalent; permission of instructor.

CD 657 CLINICAL PRACTICUM IN SPEECH-LANGUAGE PATHOLOGY. (3)
Experience with children and adults in the management of speech and language disorders. May be repeated to a maximum of twelve credits. Prereq: CD 382 and CD 383 or equivalent; permission of instructor.

CD 658 CLINICAL PRACTICUM IN AUDIOLOGY. (1)
Experience in management and/or basic evaluation of hearing impairment. Primary emphasis on planning and executing management techniques. May be repeated to a maximum of three credits. Prereq: CD 387, CD 591, and CD 515, or equivalent; permission of instructor.

CD 659 CLINICAL ROTATION IN SPEECH-LANGUAGE PATHOLOGY. (1-12)
Supervised clinical experience in the evaluation and management of communication disorders of children and adults who are served by agencies other than the University Speech-Language-Hearing Clinic. Up to forty laboratory hours per week (at site all day). May be repeated up to 36 hours. Prereq: CODI majors only. Must successfully complete nine hours of clinical practicum (graduate level) and consent of instructor.

CD 670 DISORDERS OF PHONATION. (3)
Analysis, identification, and management of disorders of phonation and resonance, including the specific communication problems of the laryngectomized adult. Prereq: Permission of instructor.

CD 672 APHASIA AND RELATED NEUROGENIC DISORDERS OF LANGUAGE. (3)
Analysis, identification, and management of neurogenic disorders of language and cognition. Primary emphasis is given to the acquired disorders of aphasia, traumatic brain injury, dementia, and right hemisphere dysfunction. Prereq: CD 378, CD 514, CD 515, or permission of instructor.

CD 673 NEUROGENIC DISORDERS OF SPEECH. (3)
Analysis, identification and management of neurogenic disorders of speech and related disorders. Primary emphasis is given to dysarthria, apraxia of speech, and dysphagia. Prereq: CD 378, CD 588 or permission of instructor.

CD 674 DISORDERS OF FLUENCY. (3)
Analysis, identification and management of fluency disorders. Prereq: Permission of instructor.

CD 701 RESEARCH METHODOLOGY IN COMMUNICATION DISORDERS. (3)
Principles and methods for designing research in communication sciences and disorders. Topics include: introduction to the scientific method, research designs, measurement techniques, formulating research questions, writing and evaluating research reports, and ethics of research. Prereq: Graduate standing in Communication Disorders.

CD 702 SEMINAR IN SPEECH PATHOLOGY (Variable topic). (1-3)
Advanced coverage of the clinical and research literature on the etiology, description, assessment, and management of specific speech and language disabilities. The semester topic will be rotated. Topics will include: stuttering, developmental language disabilities, cleft palate, cerebral palsy, etc. May be repeated to a maximum of nine credits.

CD 759 INDEPENDENT STUDY IN COMMUNICATION DISORDERS. (1-6)
Independent study for graduate students with an interest in a specific problem in communication disorders. May be repeated to a maximum of 12 credits. Lecture, 1-6 hours; laboratory, 2-12 hours per week. Prereq: Graduate status and consent of instructor.

CDE Community Dentistry

CDE 830 DENTAL PRACTICE MANAGEMENT I. (2)
This course is designed to assist the third-year student in examining and formulating attitudes and values regarding current issues in the dental profession and the health care system. A clinical experience introducing students to use of a dental assistant is also included. Students are provided an opportunity to begin a process of career planning by examining how current issues may affect career options and selection in the future. Prior to a summer dental practice field experience. Lecture, 36 hours; clinic, 15 hours. Prereq: Third-year standing in the College of Dentistry.

CDE 841 DENTAL PRACTICE FIELD EXPERIENCE. (6-10)
Students are provided a full-time, off-campus assignment to a dental practice environment for a period of 6-10 weeks. Students spend an average of 32 hours each week participating in practice management and patient treatment activities under the supervision of a dentist. Approximately eight hours a week are spent in career plan development and in study of the community or region, particularly its health care delivery system and the role of dentistry in that system. Prereq: CDE 830.

CDE 844 DENTAL PRACTICE MANAGEMENT II. (7)
This course will provide fourth-year dental students with information needed to establish, manage and maintain a vital dental practice. Recognizing that the career goals of students vary, the course material will encompass a broad range of management principles. This course also includes a seven-week clinical rotation in dental auxiliary utilization. Lecture, 69 hours; clinic, 147 hours. Prereq: CDE 830 or consent of course director.

CDE 850 COMMUNITY DENTISTRY ELECTIVE. (1-10)
Elective courses offered by the Department of Community Dentistry provide opportunities for further study of or experience in various aspects of community dentistry. Topics may include analysis and evaluation of scientific literature, principles of scientific communication, dental practice field experiences during the summer and academic year, and principles of health care organization. Hours variable, ranging from a maximum of 16 hours lecture/discussion to a maximum of 10 weeks clinical experience. May be repeated to a maximum of 10 credits. Prereq: The minimum year in dental school and any course prerequisites will be announced for each topic.

CDS Conjoint Dental Science

CDS 611 CHILD GROWTH AND DEVELOPMENT PART I. (2)
A seminar course on nature and physiologic control of physical growth, for graduate students in dentistry. Prereq: Admission to a graduate program of the College of Dentistry; D.D.S. or D.M.D. degree.

CDS 612 CHILD GROWTH AND DEVELOPMENT PART II. (2)
A seminar course for graduate students in dentistry covering emotional and intellectual growth of children, and diseases and congenital anomalies of children. Prereq: Admission to graduate program of the College of Dentistry; D.D.S. or D.M.D. degree.

CDS 631 PRINCIPLES OF DENTAL OCCLUSION. (2)
This course is designed to give the student as broad as possible a view of the complex subject of dental occlusion. Prereq: Admission to dental graduate program; D.D.S. or D.M.D. degree.

CDS 748 MASTER’S THESIS RESEARCH. (0)
Half-time to full-time work on thesis. May be repeated to a maximum of six semesters. Prereq: All course work toward the degree must be completed.

CDS 768 RESIDENCE CREDIT FOR THE MASTER’S DEGREE. (1-6)
May be repeated to a maximum of 12 hours.

CDS 770 GERIATRIC DENTISTRY SEMINAR – CLINIC. (2)
In this course participants plan, discuss and evaluate oral health care provided to older adult patients in various settings. Clinic/laboratory, eight hours per week. May be repeated to a maximum of eight credits. Prereq: Admission to the Geriatric Dentistry Fellowship Program.

CDS 790 RESEARCH IN GERIATRICS. (1-4)
This course involves student planning and writing of a research protocol, and execution of the research project. Projects and thesis are approved by the course director. Projects may include original or ongoing research within the department of Oral Health Science or other Departments of the Medical Center. Lecture: one to four hours; laboratory: two to 24 hours per week. May be repeated to a maximum of eight credits. Prereq: Admission to Postdoctoral Geriatric Dentistry Program.
CDS 810 NEW DEVELOPMENTS IN DENTISTRY I. (1-2)
This course will cover selected new developments in dentistry or treat with added emphasis established dental skills and knowledge. The topics will be in such areas as the basic sciences, behavioral science, clinical dentistry, dental practice management, and community dentistry. Methods of instruction will vary, depending on topics. When offered, this course will be required of first-year dental students. May be repeated to a maximum of four credits. Prereq: First-year standing in the College of Dentistry; any course prerequisite will be announced.

CDS 812 NORMAL HUMAN GROWTH AND DEVELOPMENT. (1)
This is a lecture course which introduces basic concepts of normal human growth and development from birth through adolescence. Lectures emphasize the time-dependent changes that normally occur during physical and psychological maturation. A special emphasis is directed toward basic knowledge and understanding of craniofacial growth and development of the teeth and occlusion. Lecture, 18 hours. Prereq: ANA 530, ANA 536; concur: ANA 532, ANA 534.

CDS 813 MANAGEMENT I: INTRODUCTION TO MANAGEMENT FOR THE DENTIST. (2)
In this introductory course in management for the dentist, basic concepts will be presented which can be applied in the management of time, people, facilities and money. Instruction leading to certification in cardiopulmonary resuscitation is included. Lecture, 45 hours. Prereq: Admission to the College of Dentistry.

CDS 815 INTRODUCTION TO ORAL HEALTH PRACTICE. (5)
This course presents a systematic approach to examination and evaluation of the dental patient, including techniques of examination and basic diagnostic procedures. In addition, an introduction to preventative dentistry and infection control is included, as well as rotations through various specialty clinics. Lecture, 66 hours; laboratory, 39 hours; clinic, 15 hours. Prereq: Admission to the College of Dentistry.

CDS 816 THE PROFESSION OF DENTISTRY. (1)
This course is an introduction to the practice of dentistry. The course will explore the history of dentistry to enable the student to place the profession of dentistry in cultural and historical perspective. Prereq: Admission to the College of Dentistry.

CDS 820 NEW DEVELOPMENTS IN DENTISTRY. (1-2)
This course will cover selected new developments in dentistry or treat with added emphasis established dental skills and knowledge. The topics will be in such areas as the basic sciences, behavioral science, clinical dentistry, dental practice management, and community dentistry. Methods of instruction will vary, depending on topics. When offered, this course will be required of second-year dental students. May be repeated to a maximum of four credits. Prereq: Second-year standing in the College of Dentistry; any course prerequisite will be announced.

CDS 821 LOCAL ANESTHESIA. (1)
The action and dosage of local anesthetic agents used in dentistry are taught as are the proper injection techniques. The technique of venipuncture and administration of intravenous drugs are also included. Patient evaluation and emergency techniques for cardiac and respiratory resuscitation are reviewed. Lecture, six hours; self-instruction, 10 hours; clinic, five hours. Prereq: ANA 534; corequisite: OBI 822.

CDS 823 MANAGEMENT II: PATIENT COMMUNICATION. (1)
The primary purpose of this course is to improve students’ ability to interact with patients in an empathetic and professional manner. Proper management of all assigned patients is required. Instruction leading to recertification in cardiopulmonary resuscitation is provided. Lecture, 26 hours. Prereq: CDS 813.

CDS 824 PRINCIPLES OF PATIENT MANAGEMENT I. (1)
This course presents the rationale for the development of the University of Kentucky College of Dentistry Preliminary, Phase I and Phase II treatment plans and a method of critically evaluating treatment results. Basic UKCD clinical protocol is presented and discussed. Lecture, 25 hours. Prereq: CDS 811 or consent of course director.

CDS 830 NEW DEVELOPMENTS IN DENTISTRY III. (1-2)
This course will cover selected new developments in dentistry or treat with added emphasis established dental skills and knowledge. The topics will be in such areas as the basic sciences, behavioral science, clinical dentistry, dental practice management, and community dentistry. When offered, this course will be required of third-year dental students. May be repeated to a maximum of four credits. Prereq: Third-year standing in the College of Dentistry; any course prerequisite will be announced.

CDS 831 CONSCIOUS SEDATION. (1)
This course is designed to teach the principles of nitrous oxide-oxygen inhalation sedation and intravenous sedation in dentistry. The management of emergencies associated with these techniques and an introduction to the principles of general anesthesia are also included. Lecture, 21 hours; clinic, four hours. Prereq: CDS 821, OBI 824.

CDS 833 MANAGEMENT III: SPECIAL PATIENT MANAGEMENT. (1)
This course introduces the dental student to various handicapping conditions and teaches the proper methods of physical management of handicapped patients needed to provide dental care. Proper management of all assigned dental patients is required. Instruction leading to recertification in cardiopulmonary resuscitation is also included. Lecture, 26 hours; laboratory, 3 hours; clinic, 3 hours per term. Prereq: CDS 823.

CDS 836 DIAGNOSIS AND MANAGEMENT OF FACIAL PAIN. (2)
An interdisciplinary approach will be used to teach current concepts of the diagnosis and management of facial pain. The course content will be presented in both lecture and clinical laboratory format. Information and physical examination skills presented in the classroom will be reinforced by attendance and active participation in the Facial Pain Clinic. Lecture, 29 hours; laboratory, 2 hours; clinic, 6 hours. Prereq: ANA 538, OBI 824, OSG 820, RSD 822.

CDS 840 NEW DEVELOPMENTS IN DENTISTRY IV. (1-2)
This course will cover selected new developments in dentistry or treat with added emphasis established dental skills and knowledge. The topics will be in such areas as the basic sciences, behavioral science, clinical dentistry, dental practice management, and community dentistry. Methods of instruction will vary, depending on topics. When offered, this course will be required of fourth-year dental students. May be repeated to a maximum of four credits. Prereq: Fourth-year standing in the College of Dentistry; any course prerequisites will be announced.

CDS 843 MANAGEMENT IV: GERIATRIC DENTISTRY. (2)
Emphasis in this course is placed on developing abilities to make individual treatment decisions for elderly dental patients and acquiring positive attitudes towards the provision of oral health care to the aged. Students will make site visits to residential centers for the elderly. Proper management of all assigned dental patients and instruction leading to recertification in cardiopulmonary resuscitation are also included. Lecture, 23 hours; laboratory, 12 hours. Prereq: CDE 810 and CDS 833 or consent of course director.

CE 106 COMPUTER GRAPHICS AND COMMUNICATION. (3)
Introduction to the use of scale, dimensioning, and orthographic projections. Graphical solution of spatial problems. Integrated application of computer graphics. Lecture, two hours; laboratory, four hours per week. Prereq: High school algebra and trigonometry or equivalent.

CE 120 INTRODUCTION TO CIVIL ENGINEERING. (1)
An introduction to the civil engineering profession and the use of computer hardware and software in CE systems analysis and design. Presentations will be used to illustrate the conception, design, construction, and operation processes. Sample problems and class exercises on the various technical areas of civil engineering will make use of existing computer software packages and teamwork principles.

CE 121 INTRODUCTION TO CIVIL ENGINEERING SYSTEMS. (3)
An introduction to the civil engineering profession from a systems point of view and the use of computer hardware and software in CE systems analysis and design. A project will be used to illustrate the conception, design, construction and operation processes. Other small projects in transportation, structural, foundation and water resources systems will make use of existing computers software packages and spreadsheets. Emphasis throughout the course will be on computational, oral, and writing skill improvement.

CE 211 SURVEYING. (4)
A comprehensive course in the art and science of surveying as applied to civil and mining engineering, including the use and care of surveying instruments; measurement of horizontal and vertical distances, angles and directions; collection of ground and underground data for the design and layout of roads, buildings, various mineral workings and other structures; and some aspects of the precise determination of position and direction for survey control. Lecture, three hours; laboratory, three hours per week. Prereq: CE 106, CE 121 or MNG 102, MA 114. (Same as MNG 211.)
### CE 250 TECHNOLOGY AND THE ENVIRONMENT. (3)
An introduction to the issues associated with environmental pollution and the role of technology in the solution to environmental problems. Topics to be discussed include air pollution, water treatment, water pollution sources and control measures, environmental concerns arising from the use of nuclear and fossil fuels, solid and hazardous waste management, and economic and regulatory constraints. This course may not be taken by CE majors.

### CE 303 INTRODUCTION TO CONSTRUCTION ENGINEERING. (3)
The study of the planning, administration, and management of construction projects and an introduction to the methodology utilized in executing specified designs. Emphasis is placed on the organization of construction firms, development of construction documents, theory of estimating and quantity take-offs, contractual and management systems, scheduling project administration, and inspection of construction operations. Prereq: Registration in College of Engineering.

### CE 331 TRANSPORTATION ENGINEERING. (3)

### CE 341 FLUID MECHANICS I. (3)
Fundamental principles of fluid flow. Includes fluids at rest (hydrostatics) and fluids in motion. Continuity, momentum and energy relations, ideal and viscous fluids. Emphasis on incompressible fluids. (liquids). Prereq: ME 220 and registration in the College of Engineering.

### CE 351 INTRODUCTION TO ENVIRONMENTAL ENGINEERING. (3)
Overview of environmental chemistry and microbiology, water quality, water and wastewater treatment, solid and hazardous wastes management, hazardous waste remediation, and air pollution control. Emphasis on the basic science and engineering principles required to understand both natural and engineered systems, as well as the engineering approach to understanding the natural environment and specific treatment mitigation methods. Prereq: CHE 107, MA 214, PHY 231, and registered in the College of Engineering, or consent of instructor.

### CE 381 CIVIL ENGINEERING MATERIALS. (3)
A study of the microscopic and macroscopic structures and properties of materials used in civil engineering construction with emphasis on the relationships of their physical and mechanical properties to engineering design and application. Written reports and oral presentation of results will be required. Lecture, two hours; laboratory, three hours per week. Prereq: EM 302 and registration in College of Engineering.

### CE 382 STRUCTURAL MECHANICS. (3)

### CE 395 INDEPENDENT WORK IN CIVIL ENGINEERING. (1-6)
Individual work on some selected problem in the field of civil engineering. May be repeated for a maximum of six credits. Prereq: Engineering standing, consent of department chairperson and the instructor.

### CE 401 SEMINAR. (1)
A discussion of the ethical and professional aspects of civil engineering practice. Concepts of loss prevention and conflict resolution. Structured small group discussion, oral presentations, and role playing. Lecture, two hours per week. Prereq: Senior classification and engineering standing.

### CE 403 CONSTRUCTION METHODOLOGY. (3)
A study of the methodology used in construction, with an emphasis on the selection and application of resources: labor, materials, equipment, money and time. The importance of cost and quality is stressed. Weekly lab periods are used to acquaint the student with actual construction documents and to provide supervised work sessions in plan reading and basic estimating. Lecture, two hours; laboratory, three hours per week. Prereq: CE 303, CE 381, engineering standing.

### CE 421 CIVIL ENGINEERING SYSTEMS ANALYSIS. (3)
An introduction to systems analysis and operation research, with applications in civil engineering. Probability and statistics, regression analysis, linear and nonlinear analysis, numerical calculus, and linear and nonlinear optimization techniques, and mathematical simulation. Emphasis on setting up mathematical models to analyze civil engineering systems. Prereq: CS 221 or CS 223; prereq or concur: CE 303, 331, 341, 382, and engineering standing.

### CE 441 FLUID MECHANICS II. (3)
Application of basic fluid mechanics to problems of importance to civil engineering practice. This includes pipe flow (pipe networks), open channel flow, culvert flow, flow through meters, pumps, and turbines. Prereq: CE 341, CS 221 or CS 223 and engineering standing.

### CE 451 WATER AND WASTEWATER TREATMENT. (3)
Fundamentals of the design and operation of water and wastewater treatment facilities. Prereq: CE 341, CE 351, and engineering standing or consent of instructor.

### CE 460 FUNDAMENTALS OF GROUNDWATER HYDROLOGY. (3)
The first course in the physics of saturated flow in porous media. Topics include groundwater occurrence, Darcian flow, well hydraulics, flow nets and layered systems flow. The basic concepts of pollutant movement and unsaturated flow are introduced and case studies are analyzed. Prereq: ME 330 or CE 341 or consent of instructor. (Same as AEN 438G.)

### CE 461G HYDROLOGY. (3)
A study of the factors affecting the occurrence, movement and utilization of water including meteorological considerations, evaporation, transpiration, runoff relationships, hydrograph analysis, and ground water management. Prereq: CE 341, engineering standing or consent of instructor.

### *CE 471G SOIL MECHANICS. (3)
A study of the strength, deformation and hydraulic properties of soils and their relationships to settlement, stress distribution, bearing capacity and slope stability. Written and oral presentations of student projects will be required. Lecture, two hours; laboratory, three hours per week. Prereq: EM 302; or prereq or concur: GLY 240; and engineering standing or consent of instructor.

### CE 482 ELEMENTARY STRUCTURAL DESIGN. (3)
Application of principles of solid mechanics to the design of steel, timber, and reinforced concrete members and structures. Emphasis on basic ideas and their application to practical design of relatively simple structures according to the building code. Credit may not be used to satisfy degree requirements if credit is earned in CE 485G, or CE 486G, or CE 487G. Prereq. CE 382 and engineering standing.

### *CE 486G REINFORCED CONCRETE STRUCTURES. (3)
Theory and design of beams, slabs, girders and columns as related to building frames and bridges. Introduction to pre-stressed concrete, elastic design and ultimate strength design. Concur: CE 487G; prereq: CE 382 and engineering standing, or consent of instructor.

### *CE 487G STEEL STRUCTURES. (3)

### CE 503 CONSTRUCTION ESTIMATING. (3)
This course investigates the principles of predicting and controlling the cost of construction projects. Items studied include feasibility studies, preliminary and detailed estimating, budgeting, monitoring and variance analysis. Computer applications for construction estimating will be stressed. Prereq: CE 403 and engineering standing or consent of instructor.

### CE 505 CONSTRUCTION PROJECT PLANNING AND MANAGEMENT. (3)
A study of the planning process and fundamental management procedures for construction projects. Special attention given to: planning of methods and resources; use of schedules; monitoring time; managing cash flow and costs; and overall project administration and record keeping. Prereq: CE 403 and engineering standing; or consent of instructor.

### CE 506 THE ENGINEER, THE LAW, AND THE ENVIRONMENT. (3)
The impact of engineering activities on the environment and the resulting legal implications. The interrelationships between engineering and law as they affect such areas as water quality and pollution, air quality and pollution, noise pollution, visual pollution, land use planning and energy considerations and the conservation and (or) preservation of natural resources. Prereq: Engineering standing, or consent of instructor.

### CE 517 BOUNDARY LOCATION PRINCIPLES. (3)
Procedures for locating or relocating the boundaries of real property; records searching, technical aspects of field work, preparation of descriptions and survey reports, land data systems, legal aspects, special problems. Prereq: CE 211 or CE 215, engineering standing or consent of instructor.

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**KEY:** # = new course  * = course changed  † = course dropped

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CE 518 ADVANCED SURVEYING. (3)
Principles of precise survey procedures in triangulation, trilateration, traverse and leveling; adjustment computations; theory and practice of electronic distance measurement; basic geodesy and state plant coordinate systems; applications to the horizontal and vertical control of engineering projects; review of modern land surveying problems and procedures. Lecture, two hours; laboratory, three hours per week. Prereq: MA 214, CE 211 or CE 215, and engineering standing.

CE 521 ENGINEERING ECONOMY. (3)
Economic evaluation and financial analysis of engineering alternatives in which the goal of economic efficiency is applied to engineering design. Prereq: Engineering standing.

CE 531 TRANSPORTATION SYSTEMS OPERATIONS. (3)
Analysis of transportation infrastructure problems through diagnostic study of existing transportation systems operations with emphasis on capacity and safety objectives. Engineering practice oriented toward open-ended solutions. Prereq: CE 211 or CE 215, CE 331, engineering standing.

CE 533 RAILROAD FACILITIES DESIGN AND ANALYSIS. (3)
Principles of railroad location, construction, rehabilitation, maintenance, and operation with emphasis on track structure design and analysis, bridges and bridge loading, drainage considerations, track geometry effects, and operating systems analysis. Prereq: CE 331, CE 381, CE 382; concur: CE 471G and engineering standing.

CE 534 PAVEMENT DESIGN, CONSTRUCTION AND MANAGEMENT. (3)
Design, analysis, construction, and management of flexible and rigid pavements. Stresses and strains, pavement materials, subgrade soil stabilization, bases and subbases, quality control, drainage, pavement-type selection, and pavement management. Prereq: CE 381, prerequisite or concurrent CE 471G, and engineering standing.

CE 539 TRANSPORTATION SYSTEMS DESIGN. (4)
Introduction to the processes and procedures for transportation systems design. Policy design, functional design and sizing, operation and schedule design, location and geometric design, supporting structures design as they individually and collectively affect the efficacy of transportation systems. Written and oral presentation of student projects will be required. Lecture, three hours; laboratory, three hours per week. Prereq: CE 211 or CE 215 and CE 331 and engineering standing.

CE 546 FLUVIAL HYDRAULICS. (3)
Rainfall physics, principles of erosion on upland areas and construction sites, stable channel design in alluvial material, mechanics of sediment transport, river mechanics, reservoir sedimentation. Prereq: CE 461G, ME 330 and engineering standing. (Same as AEN 536.)

CE 549 ENGINEERING HYDRAULICS. (3)
Analysis of flow in closed conduits and natural and artificial open channels. Design of hydraulic structures. Prereq: CE 341, CE 441 and engineering standing. (Same as AEN 545.)

CE 556 SOLID AND HAZARDOUS WASTE MANAGEMENT. (3)
Study of the generation and management of solid and hazardous wastes. Application of engineering principles to the collection, transport, processing, resource recovery and ultimate disposal of these wastes. Prereq: CE 471G, CE 521 or consent of instructor and engineering standing. (Same as AEN 556.)

CE 560 GROUNDWATER MODELING. (3)
An introduction to the practical aspects of numerical modeling techniques as applied to the solution of groundwater flow and groundwater pollution problems. Steady state and transient models of regional groundwater flow. Effect of river, pumping wells, and natural geological barriers. Models of regional groundwater pollution. Delineation of capture zones and particle tracking models. Modeling of remedial actions at contaminated sites. Prereq: CE 461G or equivalent and CS 221 or CS 223 or equivalent.

CE 569 WATER RESOURCES SYSTEM DESIGN. (4)
Application of principles of hydrology, hydraulics, and environmental engineering in the planning, design, and analysis of a comprehensive water resource project. Emphasis on basic ideas and their application to the practical design of water supply, distribution, collection and treatment facilities. Written and oral presentation of student projects will be required. Lecture, three hours; laboratory, three hours per week. Prereq: CE 451, 461G, 549 and engineering standing. (Same as AEN 569.)

CE 579 GEOTECHNICAL ENGINEERING. (3)
Application of the principles of soil mechanics and structural mechanics to the design of retaining walls, bracing for excavations, footings, mat and pile foundations and to the analysis of the stability of earth slopes. Prereq: CE 471G and engineering standing.

CE 582 ADVANCED STRUCTURAL MECHANICS. (3)
Approximate methods of frame analysis; energy principles; flexibility and stiffness methods for trusses, frames, arches, nonprismatic members and flexible connections/supports; influence lines for statically indeterminate structures; introduction to plastic analysis; and use of available computer programs for structural analysis and matrix operations. Prereq: CE 382 and engineering standing.

CE 583 SUSPENSION BRIDGES. (3)
Analysis and design of suspension bridges. Derivation of governing equations and application to existing structures. Prereq: CE 487G and engineering standing.

CE 586 Prestressed Concrete. (3)
Fundamental basis and underlying principles for the analysis and design of prestressed concrete. Working stress and ultimate strength design methods, full and partial prestressing. Design for shear and torsion, deflection, crack control, and long-term effects, and prestress losses. Composite beams, continuous beams, slabs, short and slender columns, precast structures and their connections. Prereq: CE 486G and engineering standing.

CE 589 DESIGN OF STRUCTURAL SYSTEMS. (4)
Design loads and structural systems. Systems concepts in planning analysis, design and construction of structures. Buildings, bridges, special structures and foundations. Computer aided design and drafting (CADD) utilizing microcomputers and the mainframe computer. Written and oral presentations of student projects will be required. Lecture, three hours; laboratory, three hours per week. Prereq: CE 487G and CE 486G and engineering standing or consent of instructor; Coreq: CE 579.

CE 599 TOPICS IN CIVIL ENGINEERING (Subtitle required). (1-4)
A detailed investigation of a topic of current significance in civil engineering such as: design of small earth dams, man and the environment, drilling and blasting, scheduling construction operations, construction equipment and methods, traffic safety, optimum structural design, environmental impact analysis, systems analysis in civil engineering, motor vehicle noise and its control. May be repeated to a maximum of eight credits, but only four credits can be earned under the same title. A particular topic may be offered at most twice under the CE 599 number. Prereq: Variable; given when topic is identified; plus engineering standing.

PREREQUISITE FOR GRADUATE WORK: Students desiring to take any of the following courses should have a thorough working knowledge of chemistry, physics and mathematics. For major work, a candidate must hold a bachelor’s degree in civil engineering or its equivalent.

CE 601 CONSTRUCTION EQUIPMENT. (3)
Analysis of construction equipment use and economics. Selection and matching equipment for productivity and cost effectiveness. Mathematical simulation of construction operations. Prereq: CE 403, CE 503, or consent of instructor.

CE 602 CONSTRUCTION ADMINISTRATION. (3)
Administration of construction companies and projects, organization, economics, material management, productivity models, labor and equipment tracking, quality control and managerial accounting. Construction labor relations, claims and construction financing are also discussed. Prereq: CE 403, CE 506, or consent of instructor.

CE 633 AIR TRANSPORT ENGINEERING. (3)
Planning location and design of airports, STOL ports, and heliports. Air traffic operations, performance and control as related to facility requirements. Role of governmental agencies. Prereq: CE 531 or consent of instructor.

CE 634 TRAFFIC CHARACTERISTICS. (3)
Vehicle operating characteristics; driver, pedestrian and roadway characteristics as they individually, and collectively as traffic stream characteristics, are related to the planning design and operation of highway facilities. Prereq: CE 331.

CE 636 OPERATIONAL EFFECTS OF GEOMETRICS IN TRANSPORTATION. (3)
Operational effects of the geometry of transportation facilities includes capacity, safety, and economic considerations prompting current and impending changes in geometric design of intersections, interchanges, horizontal and vertical alignment, clearances, cross section elements and interfaces between elements of the transportation system. Prereq: CE 331.

CE 641 MECHANICS OF LIQUID FLOW IN PIPES. (3)
CE 642 OPEN CHANNEL FLOW. (3)
The hydraulics of free surface flow including such topics as uniform flow, varied flow, unsteady flow, the hydraulic jump flow transitions, spillways and channel delivery. Prereq: CE 341. (Same as AEN 642).

CE 651 FUNDAMENTALS OF WATER QUALITY CONTROL I. (3)
Theory and practices of water and wastewater treatment with emphasis on physical and chemical processes for municipal and industrial wastewater treatment. Prereq: CE 451 or consent of instructor.

CE 652 FUNDAMENTALS OF WATER QUALITY CONTROL II. (3)
Theory and practices of wastewater treatment with emphasis on biological treatment processes for municipal and industrial wastewater treatment. Prereq: CE 451 or consent of instructor.

CE 653 WATER QUALITY IN SURFACE WATERS. (3)
Water quality requirements for various beneficial uses. An analysis of dispersion, advection, evaporation, natural aeration, biological oxidation and photosynthesis; their effects on the physical, chemical and biological quality of waters in streams, lakes, reservoirs, estuaries and other surface waters. Eutrophication. Prereq: MA 214 and CE 451, or consent of instructor. (Same as AEN 653).

CE 654 PRINCIPLES OF WATER AND WASTEWATER TREATMENT PROCESSES. (3)
Physical, chemical, and biological principles of water and wastewater treatment processes. Basic concepts such as chemical kinetics and equilibrium, acid-base chemistry, oxidation-reduction reactions and acid mine drainage, reactor design, mass transfer, and microbial metabolism are emphasized. Prereq: CE 451 or consent of instructor.

CE 660 GROUNDWATER HYDROLOGY. (3)
The equations of saturated and unsaturated groundwater flow, the formulation of boundary value problems, and some analytical methods of solution. Solutions using Fourier series, solutions involving the Fourier transform and the Fourier sine and cosine transforms. The Boltzmann transformation, development of the Hilbert solution for horizontal and vertical flow. Mathematical statement of the saturated and unsaturated groundwater pollution problem and some analytical methods of solution. The semigroup solution of the resulting evolution equation, examples of solutions using the Laplace transform and the Fourier transform, more complex solutions in two-dimensional and three-dimensional domains, solutions for distributed sources in time and space, solutions for time-varied boundary conditions. Prereq: MA 214, CE 461G or equivalent. (Same as AEN 668).

CE 662 STOCHASTIC HYDROLOGY. (3)

CE 665 WATER RESOURCES SYSTEMS. (3)
Application of systems analysis, mathematical modeling, and optimization in water resources management and design. Solution of engineering problems found in water supply, water quality, urban drainage, and river basin development and management by use of linear, nonlinear, and dynamic programming models. Prereq or concur: CE 421 and CE 569 or consent of instructor. (Same as AEN 665).

CE 667 STORMWATER MODELING. (3)
Introduction to deterministic and parametric modeling approaches for mathematically simulating stormwater runoff and quality. Emphasis on modeling concepts and model formulation. Analysis of deterministic component models and their linkage. Formulation of existing parametric models. Presentation of methods for parameter optimization and regionalization. Demonstration of linkage between the two approaches with illustrative examples. Prereq: CE 341 and CE 461G, or consent of instructor. (Same as AEN 667).

CE 671 ADVANCED SOIL MECHANICS. (3)
Detailed study of soil behavior. Specific topics include soil classification and structure, strength and deformational behavior, compaction, consolidation, and stress distribution in earth masses. Prereq: CE 471G or consent of instructor.

CE 676 GROUNDWATER AND SEEPAGE. (3)

CE 679 SOIL-STRUCTURE DYNAMICS AND EARTHQUAKE ENGINEERING. (4)
Dynamic and earthquake response of soils and structures using standard analysis and design techniques. Time discretization topics include fast Fourier transforms, central differences, Newmark’s method and Rayleigh–Ritz modal decomposition. Elastic wave propagation and measurement methods for obtaining the dynamic properties of soils and structures are considered. Earthquake terminology, analysis and design methods. Prereq: CE 579 and CE 582.

CE 681 ADVANCED CIVIL ENGINEERING MATERIALS. (3)

CE 682 ADVANCED STRUCTURAL ANALYSIS. (3)
Theory and application of energy principles for plane and space frames; material and geometric nonlinearities; and nonlinear solution schemes. Prereq: CE 582 or consent of instructor.

*CE 684 SLAB AND FOLDED PLATE STRUCTURES. (3)
Design and analysis of reinforced concrete floor slabs and folded plate roofs. Elastic and inelastic methods. Prereq: CE 582 or consent of instructor.

*CE 686 ADVANCED REINFORCED CONCRETE THEORY. (3)
Background and origin of modern reinforced concrete design procedures and codes. Comparison of American and foreign methods of analysis. Review of current research and projection to anticipated future changes in design and construction practices. Prereq: CE 486G or consent of instructor.

*CE 687 ADVANCED METAL STRUCTURES. (3)
Background and origin of modern structural steel design procedures and codes. Applications of various methods to structural buckling problems. Instability of beams, columns, frames, and plates. Considerations of buckling and interaction of buckling modes in design. Post-buckling analysis and design of cold-formed steel, and other metal structures. Plastic analysis and design of steel frames. Factors related to metal structural design. Prereq: CE 582 or consent of instructor.

*CE 699 TOPICS IN CIVIL ENGINEERING (Subtitle required). (1-4)
An advanced level presentation of a topic from one of the major areas of civil engineering such as hydraulics, geotechnics, structures, transportation, surveying, or water resources. Course with a given subtitle may be offered not more than twice under this number. Prereq: Variable; given when topic identified; graduate standing.

CE 709 COMPUTER APPLICATIONS IN CONSTRUCTION. (3)
This course is an advanced design class where students, using the knowledge gained in 500 and 600 level construction courses, learn how to select and implement automation into the construction process. Students investigate commercially available software and its use in managing construction projects. Prereq or concur: CE 503, 505, 602.

CE 748 MASTER’S THESIS RESEARCH. (0)
Half-time to full-time work on thesis. May be repeated to a maximum of six semesters. Prereq: All course work toward the degree must be completed.

CE 749 DISSERTATION RESEARCH. (0)
Half-time to full-time work on dissertation. May be repeated to a maximum of six semesters. Prereq: Registration for two full-time semesters of 769 residence credit following the successful completion of the qualifying exams. Prereq or concur: CE 671 or consent of instructor.

CE 768 RESIDENCE CREDIT FOR MASTER’S DEGREE. (1-6)
May be repeated to a maximum of 12 hours.

CE 769 RESIDENCE CREDIT FOR DOCTOR’S DEGREE. (0-12)

CE 772 EXPERIMENTAL METHODS IN SOIL MECHANICS. (3)
A comprehensive study, including literature review, and experimentation of the instrumentation, methods, and problems associated with the measurement of the behavior and the properties of soil. Laboratory and field methods used in research and practice. Lecture and recitation, two hours; laboratory, three hours. Prereq or concur: CE 671 or consent of instructor.

CE 779 ADVANCED GEOTECHNICAL ENGINEERING. (3)
Application of the principles of soil mechanics to the design and analysis of foundations and earth structures. Prereq: CE 579 and CE 671 or consent of instructor.

*CE 782 DYNAMICS OF STRUCTURES. (3)
CHE 784 SHELL STRUCTURES.  (3)
Design and analysis of reinforced concrete shell structures, including domes, barrel shells, hyperbolic paraboloids and cylindrical tanks. Prereq: CE 684 or consent of instructor.

CHE 790 SPECIAL RESEARCH PROBLEMS IN CIVIL ENGINEERING.  (1-6)
Individual work on some selected problems in one of the various fields of civil engineering. Laboratory, six hours. May be repeated to a maximum of nine credits. Prereq: Consent of the chairperson of the department.

CHE 791 SPECIAL DESIGN PROBLEMS IN CIVIL ENGINEERING.  (1-6)
Individual work on some selected problems in one of the various fields of civil engineering. Laboratory, six hours. May be repeated to a maximum of nine credits. Prereq: Consent of the chairperson of the department.

CEP Cooperative Education

CEP 399 COOPERATIVE EDUCATION.  (1)
A course designed for undergraduate students who, through the appropriate cooperative education office, secure full-time, salaried, career-related positions under the supervision of a sponsoring employer. Enrollment in the course constitutes full-time status. Course may be taken on a pass-fail basis only and may be repeated on a rotational basis to a maximum of six credit hours. Prereq: Prior approval from the director of co-op education in participating academic unit.

CEX Cooperative Extension

CEX 501 PRINCIPLES OF COOPERATIVE EXTENSION.  (3)
Philosophy, history and development of cooperative extension service; evaluation of instructional techniques; leadership training; and practice in use of extension methods. Open to junior, senior and graduate students.

CHE Chemistry

CHE 104 INTRODUCTORY GENERAL CHEMISTRY.  (3)
A study of the general principles including laws of definite and multiple proportions, stoichiometry, gases, electronic structure, chemical bonding, periodic relationships, oxidation-reduction, acid bases, chemical equilibrium and acids/bases. Intended for students interested in a one-semester course in general chemistry and recommended for students seeking careers in nursing, nutrition and allied health science fields. Not open to students who have already completed both CHE 105 and 107. Prereq: A working knowledge of algebra such as is acquired in two years of high school algebra, CHE 105, or MA 108R, or a composite ACTE score of 22 or above.

CHE 105 GENERAL COLLEGE CHEMISTRY I.  (3)
A study of the principles of chemistry and their application to the more important elements and their compounds. Not open to students who have already completed both CHE 104 and 106, but is open to students who have completed just CHE 104. Prereq: Math ACTE of 21 or above, or MA 109 (or Math placement test), or Chemistry placement test, or the Community College course CHE 102R or CHM 100.

CHE 106 INTRODUCTION TO INORGANIC, ORGANIC AND BIOCHEMISTRY.  (4)
A continuation of CHE 104. A study of selected aspects of inorganic, organic and biochemistry including the chemistry of metals and nonmetals, introduction to organic functional group chemistry, proteins, nucleic acids and lipids. Lecture, three hours; laboratory, three hours per week. Not open to students who have already completed CHE 105 and 107. Not recommended for students seeking careers in medicine, science, dentistry, engineering, veterinary science, agricultural sciences, education, or allied fields for which the recommended sequence is CHE 105-107-115. Prereq: CHE 104 or the community college course CHM 100.

CHE 107 GENERAL COLLEGE CHEMISTRY II.  (3)
A continuation of CHE 105. A study of the principles of chemistry and their application to the more important elements and their compounds. Not open to students who have completed only CHE 104 but is open to students who have completed both CHE 104 and 106. Prereq: CHE 105 or both CHE 104 and 106.

CHE 115 GENERAL CHEMISTRY LABORATORY.  (3)
An introductory laboratory course dealing with chemical and physical properties, qualitative analysis, and an introduction to quantitative analysis. Lecture, one hour; laboratory, four hours. Prereq or concord: CHE 107.

CHE 226 ANALYTICAL CHEMISTRY.  (3-5)
An introduction to the theory and practice of quantitative analysis. Lecture, two hours; laboratory, three to six hours. Prereq: CHE 107 and 115.

CHE 230 ORGANIC CHEMISTRY I.  (3)
Fundamental principles and theories of organic chemistry. Prereq: CHE 107 and 115.

CHE 231 ORGANIC CHEMISTRY LABORATORY I.  (2)
Laboratory for CHE 230 or CHE 236. Laboratory, six hours per week. Prereq or concord: CHE 230 or CHE 236.

CHE 232 ORGANIC CHEMISTRY II.  (3)

CHE 233 ORGANIC CHEMISTRY LABORATORY II.  (2)
Laboratory for CHE 232. Laboratory, six hours per week. Prereq: CHE 231. Prereq or concord: CHE 232.

CHE 235 SPECIAL ORGANIC LABORATORY.  (1)
Special laboratory for students majoring in chemical engineering, materials science engineering, or clinical laboratory sciences. Laboratory, three hours per week. Prereq or concord: CHE 230 or CHE 236.

CHE 236 SURVEY OF ORGANIC CHEMISTRY.  (3)
A one-semester course in organic chemistry. Not open to students who have already completed both CHE 230 and 232. Prereq: CHE 115.

CHE 395 INDEPENDENT WORK IN CHEMISTRY.  (1-3)
May be repeated to a maximum of nine credits. Prereq: Major and a standing of 3.0 in the department.

CHE 440G PHYSICAL CHEMISTRY.  (4)
An introduction to the laws of thermodynamics, the thermo-dynamic functions and their application to phase equilibria, chemical equilibria, solutions and electrochemistry. Chemical kinetics, including rate laws, reaction mechanisms, Arrhenius, collision, and activated complex theories, and catalysis. Quantum theory including an elementary introduction to spectroscopy. The fourth hour to be devoted to problem solving and problem-solving techniques. Prereq: CHE 226; MA 114; PHY 213 or 232.

CHE 441G PHYSICAL CHEMISTRY LABORATORY.  (2)
Laboratory studies in physical chemistry to accompany CHE 440G or 444G. Laboratory, six hours. Prereq: CHE 440G or 444G.

CHE 442G PHYSICAL CHEMISTRY.  (3)
A further development of the material introduced in CHE 440G. Advanced thermodynamic methods, statistical thermodynamics, quantum chemistry, and spectroscopy. Prereq: CHE 440G or 444G.

CHE 446G PHYSICAL CHEMISTRY FOR ENGINEERS.  (3)
An introductory course in physical chemistry for engineering students. Kinetic theory, thermodynamics, phase diagrams, colligative properties, electrochemistry, transport properties, kinetics, quantum theory, spectroscopy. Prereq: CHE 107, 115; PHY 232; MA 213.

CHE 450G PRACTICAL INORGANIC CHEMISTRY.  (3)
A combined lecture and laboratory course which will acquaint the student with the synthesis, characterization and properties of inorganic and organometallic compounds of both main-group and transition elements. Lecture, one hour; laboratory, six hours per week. Prereq: CHE 231 and CHE 232; prerequisite or concord: CHE 440G or CHE 444G.

CHE 510 ADVANCED INORGANIC CHEMISTRY.  (3)
A course dealing with the concepts of inorganic chemistry with emphasis on atomic structure, periodicity, nomenclature, bonding, reaction mechanisms and acid-base theories. Prereq: CHE 107 or 226.

CHE 514 DESCRIPTIVE INORGANIC CHEMISTRY.  (3)
A course dealing in detail with descriptive chemistry of the elements and their compounds, excluding the hydrocarbons and their derivatives. Prereq: CHE 226 and CHE 232, or CHE 450, or permission of instructor.

CHE 520 RADIOCHEMISTRY.  (3)
Applications of radionuclides in chemistry with emphasis on principles of radioactive decay, interactions of radiation with matter, use of isotopic tracers, activation analysis, isotope dilution analysis, hot atom chemistry and nuclear dating methods. Prereq: CHE 107, or 226.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
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<tr>
<td>CHE 521</td>
<td>RADIOCHEMISTRY LABORATORY.</td>
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<tr>
<td></td>
<td>Introductory radiochemistry laboratory. Emphasis on nuclear radiation</td>
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<td></td>
<td>detection and radiochemical techniques including activation analysis,</td>
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<td></td>
<td>isotopes dilution, liquid scintillation counting, hot-atom chemistry,</td>
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<td></td>
<td>X-ray fluorescence, nuclear spectroscopy, and radiochemical separations.</td>
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<td></td>
<td>Three or six (laboratory and discussion) hours per week.</td>
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<tr>
<td>Prereq:</td>
<td>CHE 520.</td>
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</table>

| CHE 522    | INSTRUMENTAL ANALYSIS.                                               |
|            | The theory and application of instrumental methods of analysis.       |
|            | Lecture, two hours; laboratory, six hours.                           |
| Prereq or  | CHE 442G or 444G.                                                    |

| CHE 524    | CHEMICAL INSTRUMENTATION.                                           |
|            | Aspects of electronics, microcomputers, computer interfacing and     |
|            | data analysis as they apply to chemical measurements and measurement |
|            | systems. Lecture, two hours; laboratory, six hours per week.         |
| Prereq:    | CHE 440G or 444G or consent of instructor.                           |

| CHE 526    | CHEMICAL SEPARATIONS.                                               |
|            | An advanced study of the theory, instrumentation, and analytical     |
|            | applications of chemical separation methods. Prereq: CHE 440G or      |
|            | 444G or consent of instructor.                                       |

| CHE 532    | SPECTROMETRIC IDENTIFICATION OF ORGANIC COMPOUNDS.                   |
|            | Problems involving the use of nuclear magnetic resonance, ultraviolet|
|            | and infrared spectroscopy, mass spectrometry and differential       |
|            | chemical reactivity in determining the structure of organic         |
|            | compounds. Discussion of chemical and physical methods for          |
|            | separation of mixtures of organic compounds. Prereq: CHE 231 and    |
|            | CHE 232.                                                            |

| CHE 533    | QUALITATIVE ORGANIC ANALYSIS LABORATORY.                             |
|            | The identification of unknown organic compounds using nuclear        |
|            | magnetic resonance, ultraviolet and infrared spectroscopy, mass     |
|            | spectrometry and traditional chemical techniques. Separation         |
|            | techniques are also emphasized. Laboratory, six hours.              |
| Prereq:    | Prereq: CHE 231 and CHE 232.                                        |

| CHE 535    | SYNTHETIC ORGANIC CHEMISTRY.                                        |
|            | A general survey of organic chemistry with emphasis on synthetic     |
|            | methods and the synthesis of natural products. Prereq: CHE 232.      |

| CHE 538    | PRINCIPLES OF ORGANIC CHEMISTRY.                                    |
|            | A general survey of the field of organic chemistry. Topics          |
|            | emphasized are: mechanistic principles relating molecular structure  |
|            | to reaction outcome, stereoisomerism and its effect on chemical     |
|            | reactivity, and simple molecular orbital theory as required to        |
|            | understand aromaticity and to predict the occurrence and stereochemistry of pericyclic reactions. Prereq: CHE 232. |

| CHE 547    | PRINCIPLES OF PHYSICAL CHEMISTRY I.                                  |
|            | An introduction to quantum chemistry and spectroscopy, emphasizing  |
|            | applications to chemical bonding, atomic and molecular spectroscopy,|
|            | and magnetic resonance. Prereq: CHE 442G, MA 214; or equivalent      |
|            | courses; or permission of instructor.                               |

| CHE 548    | PRINCIPLES OF PHYSICAL CHEMISTRY II.                                 |
|            | Fundamental principles of classical physical chemistry, including   |
|            | thermodynamics, statistical thermodynamics, and chemical kinetics.  |
| Prereq:    | Prereq: CHE 440G.                                                   |

| CHE 572    | COMMUNICATION IN CHEMISTRY.                                         |
|            | Reports and discussions on recent research and current chemical     |
|            | literature in seminar format; literature searching methods; *sum*   |
|            | construction; preparation of effective presentations, abstracts, and|
|            | visual aids. May be repeated for a total of two credits.            |

| CHE 580    | TOPICS IN CHEMISTRY.                                                |
|            | A detailed investigation of a topic of current significance in       |
|            | chemistry. May be repeated to a maximum of six credits. Lecture     |
|            | and/or laboratory: variable. Prereq: CHE 232 and 440G or 444G, or   |
|            | consent of instructor.                                              |

| CHE 610    | CHEMISTRY OF THE TRANSITION METALS.                                 |
|            | A detailed treatment of the chemistry of the transition elements,   |
|            | lanthanides and actinides, including the structure of coordination  |
|            | complexes, bonding, reaction mechanisms and preparations. Prereq:   |
|            | CHE 510.                                                           |

| CHE 614    | ORGANOTRANSITION METAL CHEMISTRY.                                  |
|            | A detailed treatment of the organometallic chemistry of the         |
|            | transition metals, including lanthanides and actinides. Topics      |
|            | include synthesis, structure, bonding theories, reactions,          |
|            | characterization by physical methods, and applications in organic   |
|            | chemistry and catalysis. Prereq: CHE 232, CHE 410G or 510, and      |
|            | CHE 442G or 444G; or equivalent courses; or permission of           |
|            | instructor.                                                        |

| CHE 616    | NUCLEAR CHEMISTRY.                                                 |
|            | An advanced study of nuclear chemistry and topics related to nuclear |
|            | and radiochemistry. Prereq: CHE 443G and 520.                      |

| CHE 620    | ELECTROCHEMICAL METHODS OF ANALYSIS.                                |
|            | An intensive study of the fundamental theories and principles of    |
|            | electrochemistry, and their practical applications for physical     |
|            | and quantitative analytical measurements. Topics will include       |
|            | potentiometric, voltammetric, amperometric, and coulometric methods.|
|            | Lecture, two hours; laboratory, three hours per week. Prereq: CHE   |
|            | 442G, 522 or 548.                                                  |

| CHE 625    | OPTICAL METHODS OF ANALYSIS.                                       |
|            | An intensive study of the theory, instrumentation, and analytical    |
|            | applications of modern atomic and molecular spectrometric methods.  |
|            | Lecture, two hours; laboratory, three hours per week. Prereq: CHE   |
|            | 522.                                                              |

| CHE 626    | ADVANCED ANALYTICAL CHEMISTRY.                                    |
|            | An advanced study of the theory and practice of quantitative       |
|            | analysis.                                                         |

| CHE 633    | PHYSICAL ORGANIC CHEMISTRY.                                       |
|            | An advanced presentation of the mechanisms of organic reactions,   |
|            | the experimental methods used to elucidate these mechanisms, and    |
|            | the effect of changing structure and reaction conditions on the    |
|            | reactivity of organic molecules. Prereq: CHE 538.                  |

| CHE 643    | SPECTROSCOPY AND PHOTOPHYSICS.                                    |
|            | An integrated treatment of modern spectroscopy and photophysics.   |
|            | Topics to include atomic spectroscopy, microwave, infrared and UV-  |
|            | visible spectroscopy of diatomic and polyatomic molecules, lasers,|
|            | creation and detection of excited states, fluorescence,           |
|            | phosphorescence, radiationless processes and photochemical         |
|            | transformations. Prereq: CHE 547 or CHE 440G/442G or permission    |
|            | of instructor.                                                    |

| CHE 646    | CHEMICAL KINETICS.                                                |
|            | Studies of chemical reactions from the standpoint of velocity and   |
|            | mechanism. Prereq: CHE 442G.                                      |

| CHE 701    | TOPICS IN INORGANIC CHEMISTRY.                                    |
|            | Discussion of topics of recent interest in inorganic chemistry,    |
|            | including physical methods, syntheses, and structural theories.    |
|            | May be repeated to a maximum of 12 credits. Prereq: CHE 610 or      |
|            | 612.                                                              |

| CHE 746    | TOPICS IN PHYSICAL CHEMISTRY.                                     |
|            | Selected topics which may include photochemistry, structure of     |
|            | crystals, molecular spectra, nature of the chemical bond, and other|
|            | recent advances in the field of physical chemistry. May be         |
|            | repeated to a maximum of 12 credits. Prereq: CHE 442G.             |

| CHE 748    | MASTER’S THESIS RESEARCH.                                        |
|            | Half-time to full-time work on thesis. May be repeated to a       |
|            | maximum of six semesters. Prereq: All course work toward the       |
|            | degree must be completed.                                         |

| CHE 749    | DISSERTATION RESEARCH.                                           |
|            | Half-time to full-time work on dissertation. May be repeated to a  |
|            | maximum of six semesters. Prereq: Registration for two full-time  |
|            | semesters of 769 residence credit following the successful        |
|            | completion of the qualifying exams.                               |

| CHE 768    | RESIDENCE CREDIT FOR DOCTOR’S DEGREE.                             |
|            | May be repeated to a maximum of 12 hours.                         |

| CHE 769    | RESIDENCE CREDIT FOR MASTER’S DEGREE.                             |
|            | May be repeated indefinitely.                                       |

| *CHE 772   | SEMINAR IN CHEMISTRY INSTRUCTION.                                 |
|            | A seminar for teaching assistants on the methods and techniques of  |
|            | effective instruction in laboratory and recitation classes in      |
|            | chemistry. Required of all new graduate teaching assistants.       |
|            | Prereq: Admission to M.S. or Ph.D. program in chemistry.           |

| CHE 776    | GRADUATE SEMINAR.                                                 |
|            | Reports and discussions on recent research and current literature. |
|            | Required of all graduate students. May be repeated for a total of |
|            | eight credits.                                                    |

| CHE 779    | MEMBRANE SCIENCES COLLOQUIUM.                                     |
|            | Outstanding membrane scientists present their current research on  |
|            | biological and/or synthetic membranes. Students read a pertinent  |
|            | paper by the speaker prior to his/her talk and write a short paper |
|            | on the talk, especially important is relevance of the main points |
|            | of the talk to membrane science in general and the student’s own   |
|            | research in particular. May be repeated to a maximum of six credits.|
|            | (Same as BCHE/CME/PHA/PHR 779.)                                   |

| CHE 780    | INDIVIDUAL WORK IN CHEMISTRY.                                     |
|            | Selected library and laboratory problems in conformance with the   |
|            | student’s interest will be attacked and pursued under the direction |
|            | of a suitable staff member who is proficient in the area under     |
|            | investigation.                                                    |
CHE 790 RESEARCH IN CHEMISTRY. (1-12)
Work may be taken in the following fields, subject to the approval of the Departmental Graduate Committee: analytical chemistry, industrial chemistry, inorganic chemistry, organic chemistry, radiochemistry, or physical chemistry. May be repeated indefinitely.

CJT 601 PROSEMINAR IN COMMUNICATION. (3)
Introduction to graduate study; theory and systems, research strategies. Prereq: Graduate standing in communication or consent of instructor.

CJT 607 EVALUATING AND COMMUNICATING INFORMATION. (3)
A study of the communication systems with which students will work, of the effect of the communications systems on public decisions, and of the means by which students work efficiently with communications systems. Prereq: Graduate standing in communications or consent of instructor.

CJT 608 MASS COMMUNICATIONS AND SOCIETY. (3)
A study of the ways in which the communications media play their roles in contemporary society with special attention to the major functions, rights, and responsibilities of media and individuals. Prereq: Graduate standing in communication or consent of instructor.

CJT 615 INFORMATION SYSTEMS DESIGN. (3)
Principles and problems of information systems: systems analysis applied to information systems. Design of information systems with particular attention to equipment, training of personnel, and evaluation. Prereq: CJT 601 and graduate standing in communications or consent of instructor.

CJT 619 PROSEMINAR IN INTERNATIONAL/INTERCULTURAL COMMUNICATION. (3)
Examines important issues in communication from a global perspective. In-depth study of international communications systems, international information flow, problems that occur in communicating with members of different cultures or subcultures, and development of theories and strategies for improving international communications at the mass, organizational, and interpersonal levels. Prereq: CJT 601 and graduate standing in communication or consent of instructor.

CJT 625 PROSEMINAR IN ORGANIZATIONAL COMMUNICATION. (3)
This course is an introductory graduate-level survey of theory and research in the area of organizational communication and related topics. Students will be exposed to a variety of current theoretical perspectives and methodological orientations. Prereq: Graduate standing in communication or consent of instructor.

CJT 630 PROSEMINAR IN MASS MEDIA LAW AND PUBLIC POLICY. (3)
Study of mass communication law and policy-making. Intensive review of court decisions, statutes and administrative rules and regulations regarding libel, privacy, public access to government meetings and documents, intellectual property, broadcast regulation, commercial and corporate speech, obsession and protection of news sources. Prereq: CJT 601 and graduate standing in communication or consent of instructor.

CJT 631 PROSEMINAR IN INTERPERSONAL COMMUNICATION. (3)
An examination of theories, methods of investigation, and current developments in the area of interpersonal communication. Prereq: Graduate standing in communication or consent of instructor.

CJT 645 PROSEMINAR IN MASS COMMUNICATION THEORY. (3)
A broad examination and critical analysis of major mass communication theories and research areas. Prereq: A course in research methods and graduate standing in communication or consent of instructor.

CJT 650 SIGNS AND SIGN BEHAVIOR. (3)
A study of syntactic, semantic and pragmatic aspects of language and their relation to communication. Specific topics are covered by the individual student with an outlook toward the research report-proposal. Prereq: Graduate standing in communications or consent of instructor.

CJT 651 COMMUNICATIONS THEORY. (3)
Major theories of the communications process and review of experiments and field studies on communications. Readings, discussion, and student experiments testing theoretical propositions about communications. Prereq: Graduate standing in communication or consent of instructor.

CJT 665 COMMUNICATIONS RESEARCH METHODS. (3)
The scientific method. Communications research as a part of social science research. Study and practice of advanced behavioral research techniques which apply to communications. Prereq: A behavioral research course and graduate standing in communications or consent of instructor.

CJT 682 COMMUNICATION AND PERSUASION. (3)
An advanced course examining the literature in communication and attitude change. Issues in measurement, theory, and philosophical orientation are central. Covers communication broadly, including interpersonal, mediated, and mass communication. Prereq: Graduate standing in communications or consent of instructor.

CJT 696 INTERNSHIP IN COMMUNICATION. (3)
Field experience for candidates for the M.A. degree in any field of communications through work in industry, government, education, research or business agencies. Laboratory, 12 hours per week. Prereq: Admission to M.A. program and 18 hours of graduate work. Consent of DGS required.

CJT 700 DIRECTED READING IN COMMUNICATION. (1-3)
Individual reading study on some communications aspects not treated in depth in a regular course or of topical interest. Advance consultation regarding reading list and examination procedure required. May be repeated to a maximum of 12 credits. Prereq: Graduate standing in communication or consent of instructor.

CJT 701 ADVANCED TOPICS IN COMMUNICATION THEORY (Subtitle required). (3)
Study of selected topics important to viewing in perspective the development of communication theories and problems. May be repeated to a maximum of six credits. Prereq: Graduate standing in communication or consent of instructor.

CJT 705 SEMINAR: INFORMATION SCIENCES. (3)
An investigation of the parameters of the information sciences from an interdisciplinary approach. Investigation and analysis of the literature of communications, management science, cybernetics, information theory to identify the similarities and differences. From this investigation, both qualitative and quantitative concepts of the directions of information science will be derived. Prereq: CJT 601 and graduate standing in communications or consent of instructor.

CJT 719 SEMINAR IN INTERNATIONAL/INTERCULTURAL COMMUNICATION (Subtitle required). (3)
Special Topics/Issues in International/Intercultural Communication examines the current and the alternative perspectives in the field of study. Topics/Issues such as the New World Information and Communication Order, Information/Communication Technologies, Communication and Development, Transborder Data Flows, etc., are studied. May be repeated to a maximum of six credits. Prereq: CJT 619 and graduate standing in communication or consent of instructor.

CJT 721 SEMINAR IN INTRAPERSONAL COMMUNICATION. (3)
The investigation of a single category of theoretical approaches to communication processing within a single organism. May be repeated. Prereq: Graduate standing in communication or consent of instructor.

CJT 725 SEMINAR IN ORGANIZATIONAL COMMUNICATION: (Subtitle required). (3)
This course is concerned with theory and research relevant to organizational communication and related areas of interest. Special attention is given to various topics relevant to a specific subtitle. May be repeated to a maximum of six credits under a different subtitle. Prereq: Graduate standing in communication or consent of instructor.

CJT 730 SEMINAR IN MASS MEDIA AND PUBLIC POLICY (Subtitle required). (3)
The role of mass communications media in making public policy and the effects of public policies on the mass media. One subject area will be investigated each semester; typical topics are (1) political campaign communications; (2) censorship; (3) controversial public issues; (4) rights; (5) international and world agreements. May be repeated to a maximum of six credits under a different subtitle. Prereq: CJT 630 and graduate standing in communication or consent of instructor.

CJT 731 SEMINAR IN INTERPERSONAL COMMUNICATION (Subtitle required). (3)
Consideration of special problems in interpersonal communication with emphasis on emergence of theory and implications for further research. May be repeated to a maximum of six credits under a different subtitle. Prereq: CJT 631 and graduate standing in communication or consent of instructor.
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<tr>
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<tr>
<td>CJT 745</td>
<td>SEMINAR IN MASS COMMUNICATION</td>
<td>3</td>
<td>Consideration of selected topics in mass communication theory and research. May be repeated under different subtitle to a maximum of six credits. Prereq: Graduate standing in communication or consent of instructor.</td>
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<tr>
<td>CJT 748</td>
<td>MASTER’S THESIS RESEARCH</td>
<td>0</td>
<td>Half-time to full-time work on thesis. May be repeated to a maximum of six semesters. Prereq: All course work toward the degree must be completed.</td>
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<tr>
<td>CJT 749</td>
<td>DISSERTATION RESEARCH</td>
<td>0</td>
<td>Half-time to full-time work on dissertation. May be repeated to a maximum of six semesters. Prereq: Registration for two full-time semesters of 769 residence credit following the successful completion of the qualifying exams.</td>
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<tr>
<td>CJT 765</td>
<td>COMMUNICATION RESEARCH DESIGN</td>
<td>3</td>
<td>An intermediate course in the design of communication studies. May be repeated to a maximum of six credits. Prereq: CJT 665 or the equivalent and graduate standing in communications or consent of instructor.</td>
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<tr>
<td>CJT 767</td>
<td>QUALITATIVE METHODS IN COMMUNICATION RESEARCH</td>
<td>3</td>
<td>This seminar treats the underlying assumptions and methodological techniques of qualitative study in communication research. May be repeated to a maximum of six credits. Prereq: Graduate standing and CJT 665 or equivalent.</td>
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<tr>
<td>CJT 768</td>
<td>RESIDENCE CREDIT FOR THE MASTER’S DEGREE</td>
<td>1-6</td>
<td>May be repeated to a maximum of 12 hours.</td>
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<tr>
<td>CJT 769</td>
<td>RESIDENCE CREDIT FOR DOCTOR’S DEGREE</td>
<td>0-12</td>
<td>May be repeated indefinitely. Prereq: Satisfactory completion of Qualifying Examination (third year).</td>
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<tr>
<td>CJT 771</td>
<td>SEMINAR IN HEALTH COMMUNICATION</td>
<td>3</td>
<td>A topical seminar discussing issues in the field of health communication from a variety of perspectives, e.g., the relevance of interpersonal, international and intercultural and mass communication processes to the quality and availability of health care. May be repeated to a maximum of six credits.</td>
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<tr>
<td>CJT 780</td>
<td>SPECIAL TOPICS IN COMMUNICATION</td>
<td>3</td>
<td>Professors will conduct research seminars in topics or problems in which they have special research interests. May be repeated to a maximum of six credits. Prereq: At least one year of graduate study in communication.</td>
</tr>
<tr>
<td>CJT 781</td>
<td>DIRECTED STUDY IN COMMUNICATION</td>
<td>1-6</td>
<td>To provide advanced students with an opportunity for independent work to be conducted in regular consultation with the instructor. May be repeated to a maximum of six credits. (To be used for independent work.) Prereq: Consent of instructor.</td>
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<tr>
<td>*CJT 782</td>
<td>SEMINAR IN STRATEGIC COMMUNICATION</td>
<td>3</td>
<td>This course is concerned with advanced theory and research in strategic communication and social influence. Special attention may be given to compliance gaining, negotiation, self-presentation, deception or other types of strategic interaction. May be repeated to a maximum of six credits under a different subtitle. Prereq: Graduate standing in communication or consent of instructor.</td>
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<tr>
<td>CJT 790</td>
<td>RESEARCH PROBLEMS IN COMMUNICATION</td>
<td>1-6</td>
<td>Intensive study in communications with qualified staff members. Research paper is required. May be repeated to a maximum of 12 credits. Prereq: Satisfactory completion of Preliminary Examination (second year) and consent of instructor.</td>
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CLA 450G SPECIAL TOPICS IN CLASSICAL LITERATURE IN TRANSLATION (Subtitle required). (3)
Each offering of the course is devoted to advanced study of a particular topic in classical literature not covered in other CLA courses, or to a topic in the history of European and North American Latin-language literature, or the classical literary tradition. Examples of such topics are Greek and Latin historiography, classical rhetoric, Latin satire, classical philosophical prose, classical literature and the modern cinema, Latin literature of the Middle Ages and Renaissance. Lectures and discussions, assigned and supplementary readings, paper writing. May be repeated to a maximum of nine credits with different topics.

CLA 509 ROMAN LAW. (3)
An historical introduction to the development of Roman law, from the Twelve Tables through the Codex Justinianus. (Same as HIS 509.)

COURSES IN LATIN
CLA 101 ELEMENTARY LATIN. (4)
An introduction to the study of classical Latin. Emphasis is placed on learning to read the language. Some attention is given to Latin literature and Roman civilization.

CLA 102 ELEMENTARY LATIN. (4)
A continuation of CLA 101. Prereq: CLA 101 or the equivalent.

CLA 201 INTERMEDIATE LATIN. (3)
Review of grammatical principles together with readings from Latin prose and poetry. Selections from a wide range of authors will be included in order to demonstrate the diversity and appeal of Latin literature. Emphasis is placed on developing reading ability. Prereq: CLA 102 or two years of high school Latin or equivalent.

CLA 202 INTERMEDIATE LATIN. (3)
A continuation of CLA 201. Prereq: CLA 201 or three years of high school Latin or equivalent.

CLA 301 LATIN LITERATURE I (Subtitle required). (3)
An introduction to the literature of Republican Rome with selected readings of complete works from the major Latin authors. Lectures and class discussions on the various genres, styles, and themes of Latin literature. Topics vary every time the course is offered. May be repeated once under a different subtitle. Prereq: CLA 202 or equivalent.

CLA 302 LATIN LITERATURE II (Subtitle required). (3)
An introduction to the literature of Imperial Rome with selected readings of complete works from the major Latin authors. Lectures and class discussions on the various genres, styles, and themes of Latin literature. Topics vary every time the course is offered. May be repeated once under a different subtitle. Prereq: CLA 202 or equivalent.

CLA 522 ROMAN REPUBLICAN PROSE (Subtitle required). (3)
A study of one or more works selected from prose writings from the beginnings of Roman literary history to 31 B.C. Authors include Cicero, Caesar, Sallust, and others; genres include history, philosophy, rhetoric and oratory, letters, and others. Textual analysis is emphasized, with lectures and class discussion on the literary milieu. Topics vary every time the course is offered. May be repeated once under a different subtitle. Prereq: CLA 301 or equivalent.

CLA 523 ROMAN REPUBLICAN POETRY (Subtitle required). (3)
A study of one or more works selected from poetry from the beginnings of Roman literary history to 31 B.C. Authors include Plautus, Terence, Lucretius, Catullus, and others; genres include drama, lyric poetry, didactic poetry, satire, and others. Textual analysis is emphasized, with lectures and class discussion on the literary milieu. Topics vary every time the course is offered. May be repeated once under a different subtitle. Prereq: CLA 301 or equivalent.

CLA 526 ROMAN IMPERIAL PROSE (Subtitle required). (3)
A study of one or more works selected from prose writings from approximately 31 B.C. to the end of the Western Empire. Authors include Livy, Petronius, Tacitus, Pliny, Suetonius, Seneca, Quintilian, Augustine, and others; genres include history, philosophy, biography, letters, fiction, and others. Textual analysis is emphasized, with lectures and class discussion on the literary milieu. Topics vary every time the course is offered. May be repeated to a maximum of nine credits under a different subtitle. Prereq: CLA 301 or equivalent.

CLA 527 ROMAN IMPERIAL POETRY (Subtitle required). (3)
A study of one or more works selected from poetry from approximately 31 B.C. to the end of the Western Empire. Authors include Virgil, Horace, Propertius, Tibullus, Ovid, Juvenal, Martial, and others; genres include epic, lyric, elegiac, satire, pastoral, and others. Textual analysis is emphasized, with lectures and class discussion on the literary milieu. Topics vary every time the course is offered. May be repeated to a maximum of nine credits under a different subtitle. Prereq: CLA 301 or equivalent.

CLA 603 STUDIES IN LATIN LITERATURE OF THE REPUBLIC (Subtitle required). (3)
Intensive study of an author, a literary form, or a problem in the period of the Roman Republic. Considerable attention to secondary sources; students will write papers and present oral reports in class. May be repeated to a maximum of nine hours.

CLA 604 STUDIES IN LATIN LITERATURE OF THE EMPIRE (Subtitle required). (3)
Intensive study of an author, a literary form, or a problem in the period of the Roman Empire. Considerable attention to secondary sources; students will write papers and present oral reports in class. May be repeated to a maximum of nine hours.

COURSES IN GREEK
CLA 151 ELEMENTARY GREEK. (4)
An introduction to the study of Classical Greek. Emphasis is placed on learning to read the language. Some attention is given to Greek literature and civilization.

CLA 152 ELEMENTARY GREEK. (4)
A continuation of CLA 151. Prereq: CLA 151 or equivalent.

CLA 251 INTERMEDIATE GREEK. (3)
Review of grammatical principles together with readings from Greek prose and poetry. Selections from a wide range of authors will be included in order to demonstrate the diversity and appeal of Greek literature. Emphasis is placed on developing reading ability. Prereq: CLA 152 or equivalent.

CLA 252 INTERMEDIATE GREEK. (3)
The reading of Greek prose and poetry. Textual and literary analysis of selections from classical authors and the New Testament. Prereq: CLA 251 or equivalent.

CLA 395 INDEPENDENT STUDY IN GREEK. (1-3)
Study of an author (e.g. Plato), a work (e.g. the liad), or a topic (e.g. prose syntax and style). All readings are in Greek. May be repeated to a maximum of 12 credits with different topics. Prereq: CLA 252 or equivalent, and consent of director of undergraduate studies and instructor.

CLA 552 GREEK EPIC AND LYRIC POETRY. (3)
A study of the two genres as exemplified in Homer, Hesiod, the Homeric Hymns and the early Greek Lyricists. Emphasis on textual analysis with lectures and class discussions on the authors’ literary milieu. Prereq: CLA 252 or equivalent.

CLA 553 GREEK PHILOSOPHICAL LITERATURE. (3)
A study of Greek philosophical literature as exemplified in Plato, Aristotle and other philosophical writers. Emphasis on textual analysis with lectures and class discussions on the authors’ literary milieu. Prereq: CLA 252 or equivalent.

CLA 556 GREEK DRAMATIC LITERATURE. (3)
A study of the Greek drama through selected plays of the major tragic and comic writers. Emphasis on textual analysis with lectures and class discussions on the authors’ literary milieu. Prereq: CLA 252 or equivalent.

CLA 557 GREEK HISTORICAL LITERATURE. (3)
A study of the Greek historiographical tradition as exemplified in Herodotus, Thucydides and other Greek historians. Emphasis on textual analysis with lectures and class discussions on the authors’ literary milieu. Prereq: CLA 252 or equivalent.

CLA 601 STUDIES IN GREEK LITERATURE I (Subtitle required). (3)
Intensive study of an author, a literary form or a problem in the period from Homer through the Fifth Century, B.C. Considerable attention will be focused on secondary sources; students will write papers and present oral reports in class. May be repeated to a maximum of nine hours.

CLA 602 STUDIES IN GREEK LITERATURE II (Subtitle required). (3)
Intensive study of an author, a literary form or a problem in the period from the Fourth Century, B.C. through the Third Century, A.D. Considerable attention will be focused on secondary sources; students will write papers and present oral reports in class. May be repeated to a maximum of nine hours.

CLASSICS IN GENERAL
CLA 511, 512 STUDIES IN ROMAN PHILOLOGY. (3 ea.)
Courses to meet the needs of students in various areas of Roman philology, e.g., in Latin literature, in Roman civilization, in Latin linguistics, etc. May be repeated to a maximum of nine hours. Prereq: Consent of instructor.

CLA 561, 562 STUDIES IN GREEK PHILOLOGY. (3 ea.)

Courses to meet the needs of students in various areas of Greek philology, e.g., in Greek literature, in Greek civilization, in Greek linguistics, etc. May be repeated to a maximum of nine hours. Prereq: Consent of instructor.

CLA 580 INDEPENDENT WORK IN CLASSICS. (3)

Courses to meet the needs of the student, including those who wish to study Medieval and/or Renaissance Latin, will be arranged in various areas. May be repeated to a maximum of 12 credits. Prereq: Major standing of 3.0 in the department or consent of instructor.

CLA 748 MASTER’S THESIS RESEARCH. (0)

Half-time to full-time work on thesis. May be repeated to a maximum of six semesters. Prereq: All course work toward the degree must be completed.

CLA 768 RESIDENCE CREDIT FOR MASTER’S DEGREE. (1-6)

May be repeated to a maximum of 12 hours.

CLA 790 RESEARCH IN THE TEACHING OF CLASSICAL LANGUAGES. (3)

Problems in the teaching of Latin and/or Greek in secondary and/or higher education. Objectives, methods, preparation of materials, development of curricula, or the history of the field. Prereq: CLA 530 or the equivalent.

### Clinical Laboratory Sciences

**CLS 120 CLINICAL LABORATORY SCIENCES AS A CAREER.** (1)

Presentation of information about the various careers in clinical laboratory science via lectures, demonstrations and field trips. Open to students wishing to explore the field of clinical laboratory sciences.

**CLS 130 INTRODUCTION TO CLINICAL LABORATORY SCIENCES.** (1)

Through lectures, demonstrations and audiovisuals, students are introduced to disease processes, their manifestations, and laboratory studies used for diagnoses and prognosis. Open to students wishing to explore the field of clinical laboratory sciences.

**CLS 501 SEMINAR IN ADVANCED HEMATOLOGY.** (2)

Study of the biochemical aspects of blood cell physiology and kinetics as applied to practice in the clinical hematology laboratory and a review of current related literature. This course is designed for practicing clinical laboratory physicians or medical technologists who are pursuing a graduate degree. Prereq: BCH 401G or equivalent and consent of instructor.

**CLS 610 ETHICS IN CLINICAL SCIENCES RESEARCH.** (1)

Students will examine ethical issues in biomedical research using a case-study approach. Representative issues addressed may include data selection and retention, plagiarism, scientific review of grants and manuscripts, scientific misconduct, and informed consent. Prereq: Graduate student status. (Same as CD/CNU/PT/RAS 610.)

**CLS 801 INTRODUCTION TO LABORATORY METHODOLOGY.** (1)

This course is designed to develop basic laboratory skills needed for the clinical laboratory sciences curriculum. Required for new junior students. Lecture, one hour; laboratory, four hours for four weeks. Prereq: Admission to the clinical laboratory sciences professional program.

**CLS 802 CLINICAL LABORATORY METHODS.** (1)

This is a four-week course designed to develop skills and didactic content related to laboratory techniques and procedures common to all areas of the clinical laboratory. Required for second-semester juniors in the CLS professional curriculum. There will be a total of eight lectures and eight laboratory periods in the course. Lecture, two hours; laboratory, six hours per week. Prereq: Admission to the professional curriculum or consent of instructor.

**CLS 809 FUNDAMENTALS OF CLINICAL LABORATORY SCIENCE I.** (4)

This course is presented only within the four-week intersession. The course will be presented in modular form and will: 1) develop basic laboratory skills in clinical laboratory sciences; 2) study the qualitative and quantitative chemical and microscopic constituents of urine, cerebrospinal fluid and other body fluids; and 3) study cellular and humoral immunity with emphasis on the laboratory procedures used to evaluate the immune status. Lecture, eight hours; laboratory, twenty-four hours per week. Prereq: B.S. degree in a related science; one course each in biochemistry and microbiology, or their equivalents.

**CLS 810 FUNDAMENTALS OF CLINICAL LABORATORY SCIENCE II.** (8)

This course is a continuation of CLS 809. The course will be presented in modular form and will cover: 1) basic methodologies and instrumentation principle of Clinical Chemistry; 2) introduction to hematologic methods and procedures; and 3) application of serologic laboratory methods and principles. Lecture, eight hours; laboratory, twenty-four hours per week. Prereq: Completion of CLS 809.

**CLS 815 HISTOTECHNOLOGY I.** (3)

The study of basic principles of fixation, processing, infiltration, and embedding techniques and their application for human and animal tissues. Lecture, two hours; laboratory, two hours per week. Prereq: High school science courses.

**CLS 816 HISTOTECHNOLOGY II.** (3)

The study of principles and applications of microtomy, frozen sectioning and some special staining techniques.

**CLS 817 HISTOTECHNOLOGY III.** (3)

A study of the histologic technique and microscopic anatomy of human tissues using routine hematoxylin and eosin, immunoperoxidase and special stains. Emphasis will be placed on proper preparation of stains and their uses, as well as on microscopic examination for interpretation of properly prepared slides. Demonstration slides will be studied in the laboratory. Lecture, two hours; laboratory, two hours per week. Prereq: CLS 815 and CLS 816.

**CLS 822 BIOCHEMISTRY FOR CLINICAL SCIENCES.** (3)

A presentation of the biochemistry of carbohydrates, lipids, proteins, amino acids and nucleic acids and exploration of major metabolic pathways as the basis of clinical chemistry. Case studies will be used to emphasize the role of biochemistry in the understanding of clinical science. Prereq: CHE 105, 107 and 115, CHE 230 or CHE 236 or equivalent and consent of instructor.

**CLS 825 BASIC PHYSIOLOGY FOR THE HEALTH SCIENCES.**

**CLS 832 GENERAL CLINICAL CHEMISTRY AND INSTRUMENTATION.** (4)

A course covering the theory and practice of general clinical chemistry laboratory testing. Emphasis is on laboratory testing, quality control, introduction of instrumentation principles, troubleshooting potential laboratory problems and concern for the accuracy of patient results and their confidentiality. Lecture, four hours per week; laboratory, 12 hours per week for seven weeks. Prereq: Admission to the clinical laboratory sciences professional program. Biochemistry (CLS 822 or equivalent) may be taken concurrently.

**CLS 833 CLINICAL HEMATOLOGY AND BODY FLUID ANALYSIS.** (4)

This course will cover the basic theory and practice of clinical hematology, hemostasis and body fluids. Both manual and automated techniques in blood cell and body fluid analysis will be covered. Laboratory reporting, quality control and concern for the patient will be emphasized throughout the course. Lecture, four hours per week; laboratory, 12 hours per week for seven weeks. Prereq: Admission to the Clinical Laboratory Sciences professional program.

**CLS 835 CLINICAL IMMUNOLOGY.** (4)

An overview of an immunology with a molecular biological basis for the immune responses and the role of genetics in immunological disorders. Molecular biological techniques in the modern clinical laboratory will be emphasized. Prereq: MLT/CLT certification or consent of the instructor.

**CLS 836 LABORATORY ORGANIZATION AND MANAGEMENT.** (3)

An overview of management with an emphasis on problem solving in the clinical laboratory setting. Content will include the management process, managing change, motivation, personnel issues, regulatory issues, delegation, problem solving, leadership, quality improvement strategies and techniques and other relevant topics. Prereq: Admission to the Clinical Laboratory Sciences professional program.
†CLS 837 COMPUTER APPLICATIONS IN CLINICAL SCIENCES.

#CLS 838 INTRODUCTION TO IMMUNOHEMATOLOGY. (4)
Introduction to the principles and practice of blood banking including blood group systems, routine serologic testing, blood collection and processing and component therapy. Lecture, four hours; laboratory 12 hours per week for six weeks. Prereq: CLS 835 or consent of instructor.

#CLS 839 SCIENTIFIC WRITING AND PRESENTATIONS. (2)
An introduction to basic research skills including computer assisted search of professional literature, critical analysis of journal reports, design of a simple research study and the necessary skills for both oral and poster presentations of research findings. Two lectures/discussion per week. Prereq: Admission to the Clinical Laboratory Science professional program or consent of instructor.

*CLS 843 ADVANCED CLINICAL HEMATOLOGY. (3)
A study of the principles of hematologic disease processes with emphasis on correlation of laboratory data with disease quality control and problem solving. The lectures will cover the major hematologic disorders as well as advanced techniques for evaluation of blood cells such as cytochemistry, cytoflow and molecular biological methods. The laboratories will be devoted to practice in blood cell identification and problem solving using case studies and problem based learning techniques. Lecture, four hours per week; laboratory 12 hours per week for five weeks. Prereq: CLS 833 or MLT/CLT certification or consent of instructor.

*CLS 844 ADVANCED CLINICAL CHEMISTRY. (3)
A study of specialized clinical chemistry testing which will include toxicology, therapeutic drug monitoring, endocrine function and testing as well as quality assurance issues. The theory and evaluation of methodologies involved in the quantitation of these substances and compounds will be discussed in lecture and demonstrated in laboratory. Lecture, four hours per week; laboratory, 12 hours per week for six weeks. Prereq: Admission to the Clinical Laboratory Sciences professional curriculum, CLS 832 or CLS 872; biochemistry and immunology courses, or consent of instructor.

#CLS 845 CLINICAL IMMUNOLOGY AND SEROLOGY I. (3)
An overview and introduction to the field of immunology will be presented with a focus on the clinical application of the subject matter. Emphasis will concentrate on the molecular and genetic aspects as they relate to disorders of the immune system. Wherever possible, modern advances such as molecular biological techniques will be emphasized. Prereq: Admission to the Clinical Laboratory Sciences professional program or consent of instructor.

†CLS 846 BODY FLUID ANALYSIS.

#CLS 848 ADVANCED IMMUNOHEMATOLOGY. (4)
This course emphasizes clinical interpretation and problem solving. Antibody identification, selection of blood components, transfusion complications, hemolytic disease of the newborn, autoimmune hemolytic anemias and quality assurance are included. Lecture, four hours; laboratory, 12 hours per week for six weeks. Prereq: CLS 838 or MLT/CLT certification or consent of instructor.

*CLS 851 INTRODUCTION OF CLINICAL BACTERIOLOGY. (4)
This course will cover medically significant bacteria, including commensals and normal flora, as well as pathogens. Also covered will be microbial physiology, interactions between host and pathogenic bacteria, and the clinical and epidemiological consequences of these interactions. The laboratory will cover conventional microscopic, cultural and immunological techniques used for the recovery, isolation and identification of clinically significant bacteria. Lecture, four hours per week; laboratory, 12 hours per week. Prereq: Admission to the Clinical Laboratory Sciences program or consent of instructor.

†CLS 852 BASICS OF CLINICAL MICROBIOLOGY LAB.

†CLS 854 MEDICAL PARASITOLOGY.

*CLS 855 CLINICAL IMMUNOLOGY AND SEROLOGY II. (4)
An overview and introduction to the field of immunology will be presented with a focus as to the clinical application of the subject matter. Emphasis will concentrate on the molecular and genetic aspects as they relate to disorders of the immune system. Wherever possible, modern advances such as molecular biological techniques will be emphasized. Lecture, three hours per week; laboratory, three hours per week. Prereq: CLS 845 or consent of instructor.

*CLS 856 ADVANCED MICROBIOLOGY. (3)
Course content will cover medically important bacteria, with an emphasis on anaerobes and mycobacteria, and clinically significant fungi, parasites and viruses. The laboratory will focus on the isolation and identification of pathogenic and opportunistic fungi, viruses, parasites, and difficult-to-isolate bacteria from clinical specimens. Knowledge from Clinical Bacteriology will be applied, and theories and advanced techniques used for the diagnosis of bacterial, fungal, viral and parasitic human disease will be presented. Lecture, four hours per week; laboratory, eight hours per week. Prereq: Admission to the Clinical Laboratory Sciences professional program, completion of CLS 851 or equivalent or consent of instructor.

†CLS 857 MEDICAL MYCOLOGY.

#CLS 858 IMMUNOHEMATOLOGY LECTURES. (3)
Study of immunohematology and blood banking applications in transfusion medicine. This course includes collection and processing of blood, blood group systems, and the handling of special problems in blood banking, such as transplantation. Prereq: Admission to the clinical laboratory sciences professional program and CLS 435 or equivalent.

*CLS 860 BLOOD COLLECTION I. (1)
Experience collecting venous blood specimens for laboratory testing. Students will receive instructions on proper procedures for phlebotomy and will practice on mannequin arms and each other prior to collecting blood from adult ambulatory and bed patients. Offered on a Pass/Fail basis only. Prereq: Admission to the Clinical Laboratory Sciences program or consent of instructor.

#CLS 861 BLOOD COLLECTION II. (1)
Advanced experience in collecting venous blood and capillary blood specimens for many types of studies. This will include collection from pediatric and nursery patients. Offered on a Pass/Fail basis only. Prereq: Admission to Clinical Laboratory Sciences professional program or consent of instructor.

CLS 863 CLINICAL HEMATOLOGY LABORATORY. (3)
Practice and mastery of the basic skills required in a clinical hematology laboratory to include particle counting, cellular morphology and coagulation with an introduction to special methodologies used in clinical hematology for the diagnosis of diseases. Laboratory, six hours. Prereq: Concurrent registration in CLS 843.

†CLS 864 CLINICAL CHEMISTRY LABORATORY.

†CLS 866 CLINICAL BACTERIOLOGY LABORATORY.

#CLS 867 EDUCATIONAL PRINCIPLES IN CLS. (1)
This course provides the skills necessary to prepare, present and evaluate educational presentations and student supervision in the clinical laboratory and continuing education environments. Students develop a presentation which includes topic selection, writing educational objectives, selecting audiovisual equipment, preparing audiovisual and handout materials, writing evaluation questions and an oral presentation. The principles of clinical education supervision are also provided. Prereq: Admission to the Clinical Laboratory Sciences professional program or consent of instructor.

CLS 868 IMMUNOHEMATOLOGY AND BLOOD BANKING LABORATORY. (2)
Practice and mastery of the basic skills required in blood banking, including: determination of blood type, detection and identification of antibodies, compatibility testing and special techniques needed in diagnosis of immunohematologic disorders. Laboratory, four hours per week. Concur: CLS 858.

†CLS 870 CLINICAL LABORATORY SCIENCES SEMINAR.

CLS 871 SURVEY OF HEMATOLOGY AND LABORATORY MATH. (2)
An overview of basic mathematical computations used in common laboratory procedures. A review of structure, function and identification of abnormal blood cells. Prereq: Associate degree in Medical Laboratory Technology.

*CLS 872 CLINICAL CHEMISTRY SURVEY. (1)
An overview of the theory and practice of clinical chemistry, including instrumentation and calculations. Prereq: Admission to the Clinical Laboratory Sciences program or consent of instructor.

*CLS 880 CLINICAL PRACTICUM IN CLINICAL LABORATORY SCIENCES. (8)
A supervised clinical practicum which integrates theory and practice in routine clinical chemistry, hematology, blood bank and microbiology. In addition, students will present 1-2 case studies that address the role of the clinical laboratory in diagnosis and treatment of disease. Offered on a Pass/Fail basis only. Laboratory, 30-40 hours per week for eight weeks. Prereq: Completion of junior year clinical laboratory science courses.
CME 006 THE ENGINEERING PROFESSION (JUNIOR AND SENIOR). (0)
Activities of the Student Chapter of the American Institute of Chemical Engineers (for junior and senior year chemical engineering students). Lecture: one hour per week. May be repeated three times. Prereq: Chemical engineering major.

CME 101 INTRODUCTION TO CHEMICAL ENGINEERING. (1)
An introduction to the chemical engineering profession including: problem-solving techniques, use of computers, computer problems and lectures by practitioners.

CME 200 PROCESS PRINCIPLES. (3)
A course in material and energy balances, units, conversions, tie elements, recycle, bypass, equations of state, heat effects, phase transitions, and the first and second laws of thermodynamics applications in separation processes involving equilibrium reactions and energy exchange. Prereq: CHE 115, CS 221; “C” grade or better in MA 113; “C” average or better in CHE 105 and CHE 107; prereq or concur: MA 114, PHY 231.

CME 320 ENGINEERING THERMODYNAMICS. (4)

* CME 330 FLUID MECHANICS. (3)
Introduction to the physical properties of fluids, fluid statics. Equations of conservation of mass, momentum and energy for systems and control volumes. Dimensional analysis and similarity. Principles of inviscid and real fluid flows; flow through pipes and around bodies. Application and design of fluid handling systems. Prereq: Engineering standing, ME 220 or CME 200, CS 221 and MA 214. (Same as ME 330.)

CME 395 SPECIAL PROBLEMS IN CHEMICAL ENGINEERING. (1-3)
Individual work on some selected problems in the field of chemical engineering. May be repeated one time. Prereq: Engineering standing and approval of the chairperson of the department.

CME 415 SEPARATION PROCESSES. (3)
Separations based on both equilibrium stage concepts and mass transfer rate control are addressed for a range of chemical process operations, including distillation, gas absorption, extraction, adsorption, and membrane-based processes. Design problems are conceived to require computer-aided modeling and analysis. Prereq: CME 320, engineering standing.

CME 420 PROCESS MODELING IN CHEMICAL ENGINEERING. (3)
Applications of principles of material and energy balances, thermodynamics, heat and mass transfer, physical chemistry and numerical methods to problems in separation and transport processes and reactive systems. Prereq: CS 221, MA 214; prereq or concur: CME 320, ME 330, engineering standing.

CME 425 HEAT AND MASS TRANSFER. (4)
Fundamental principles of conduction and convection heat transfer, and diffusion and convective mass transfer. Design applications to heat exchangers and packed bed absorbers. Prereq: CME 320, ME 330, engineering standing.

CME 433 CHEMICAL ENGINEERING LABORATORY. (3)
A laboratory course emphasizing experimental work in the areas of fluid flow, heat transfer, mass transfer, and chemical reaction kinetics. Special consideration is given to the development of experimental acumen, mathematical and statistical data handling, report writing, and oral presentation. Lecture, one hour; laboratory, six hours per week. Prereq: CME 415, 420, 425; concur: CME 550, engineering standing.

CME 455 CHEMICAL ENGINEERING PROCESS DESIGN I. (3)
A lecture and problem-solving course devoted to the study of chemical engineering economics as it applies to the design of chemical process units and systems. Prereq: CME 415, 420, CME 425, ME 330, CS 221, and engineering standing.

CME 456 CHEMICAL ENGINEERING PROCESS DESIGN II. (4)
A lecture and problem-solving course intended to combine the principles of chemical engineering with optimization as they apply to the design of chemical processes. Results of each design case studied will be presented by both oral and written reports. Prereq: COM 199, CME 455, CME 550 and engineering standing.

CME 462 PROCESS CONTROL. (3)
Basic theory of automatic control devices and their application in industrial chemical plants is emphasized. Identification of control objectives, appropriate measurements and manipulations, and possible loops between these, requires integration of the control system with the original process design. Interactions between process units are analyzed using well-known analytical tools and design strategies. Prereq: Consent of instructor.

CME 470 PROFESSIONALISM, ETHICS AND SAFETY. (1)
Detailed lectures and supervised discussions on standards of ethics and safety as they relate to the engineering profession. Emphasis will be on safety in plant design and safety practice in the laboratory and plant. Sociologic problems inherent with air, water and waste management and professional ethics will be addressed. Prereq: Engineering standing.

CME 471 SEMINAR. (1)
Students carry out literature searches on assigned topics in engineering, prepare for and deliver formal and informal talks at least every two weeks, and submit written summaries of these presentations. Lecture, two hours per week. Prereq: COM 199 and engineering standing.

CME 505 ANALYSIS OF CHEMICAL ENGINEERING PROBLEMS. (3)
The application of differential and integral equations to traditional and non-traditional chemical engineering problems. Prereq: CME 425, CME 550 concurrent or consent of instructor.

CME 515 AIR POLLUTION CONTROL. (3)
CME 550 CHEMICAL REACTOR DESIGN. (3)
A lecture and problem course dealing with interpretation of rate data and development of performance equations for single and multiple reactor systems. A design problem will be selected for an industrially important chemical reaction system requiring computer solution. Prereq: CS 221, CME 420, CME 425, and engineering standing, or consent of instructor.

CME 552 POLYMERIC MATERIALS. (3)
Relating properties to structure; properties of polymer materials, mechanical, electrical and thermal properties of amorphous and crystalline polymers, molding and fabrication, polymers as additives, biomedical application, selection of polymers, design. Prereq: CME 230 or CME 236, or consent of instructor. (Same as MSE 552.)

CME 554 CHEMICAL AND PHYSICAL PROCESSING OF POLYMER SYSTEMS. (3)
Theory related to the chemical and physical processing of polymer systems, polymer chemistry, non-Newtonian flow behavior, stress and strain tensors, polymer processing operations and technology. Prereq: CME 232 and CME 425, or consent of instructor. (Same as MSE 554.)

CME 558 PRINCIPLES OF POLYMER CHARACTERIZATION AND ANALYSIS. (3)
A lecture course exploring the fundamental chemical and physical aspects of a range of characterization methods as applied to polymeric systems; the primary objective will be the development of a broad understanding of the various tools available for polymer characterization both on the molecular level and as bulk materials. Prereq: CME 320, ME 330, or consent of instructor. (Same as MSE 558.)

†CME 570 CHEMICAL SEPARATION AND MEASUREMENT FOR CHEMICAL ENGINEERS. (3)
CME 580 DESIGN OF RATE AND EQUILIBRIUM PROCESSES FOR WATER POLLUTION CONTROL. (3)
The design of chemical and physical processes for the removal and concentration of organic, inorganic, and particulate pollutants from aqueous solution/suspension: adsorption, destabilization, disinfection, membrane processes, thermal processes, flow through beds of solids, etc. Prereq: CHE 440G, CME 425 and prerequisite or concurrent: CME 550 or consent of instructor.

CME 583 FUEL SCIENCE. (3)
This course is concerned with the structure, chemistry, processing, utilization, environmental aspects, and conversion of hydrocarbon resources: petroleum, natural gas, coal, oil shale, and heavy oil. The laboratory component, which is taught off-campus at the Center for Applied Energy Research, covers characterization methods for fossil fuels. Prereq: CME 230, CME 232, and CHE 440G.

CME 599 TOPICS IN CHEMICAL ENGINEERING. (3)
A detailed investigation of a topic of current significance in chemical engineering such as: contemporary energy topics, fuels development, membrane science, computer control of chemical processing. A particular topic may be offered twice under the CME 599 number. May be repeated to a maximum of six credits. Prereq: Engineering standing.

PREREQUISITE FOR GRADUATE WORK: Students desiring to take any of the following courses should have a thorough working knowledge of chemistry, physics, and mathematics. For major work, a candidate must hold a bachelor’s degree in chemical engineering or its equivalent.

CME 620 EQUILIBRIUM THERMODYNAMICS. (3)
The criteria for physical and chemical equilibrium, including: predictive equations, solution theory, chemical activity, coupled chemical equilibrium, and external constraints. Emphasis may be on vapor-liquid equilibrium, chemical reaction equilibrium, or complex ionic equilibria in dilute aqueous solutions and suspensions. Prereq: CHE 440G and CME 320 or consent of instructor.

CME 621 NONEQUILIBRIUM THERMODYNAMICS. (3)
An introductory course in the thermodynamics of irreversible processes, including: phenomenological equations relating flows and forces, Onsager’s law, and entropy production in continuous processes. Prereq: CME 620, or ME 620, or consent of instructor.

CME 625 PROPERTIES OF GASES AND LIQUIDS. (3)
Development, discussion and application of intermolecular force laws as they apply to gases, liquids and mixtures: Chapman-Enskog kinetic theory, virial theorem, Buckingham (6-exp) potential, and theoretical and semiempirical predictive equations. Estimation of thermodynamic and transport properties. Prereq: CME 620, CME 630, or consent of instructor.

CME 630 TRANSPORT I. (3)
A unified study of physical rate processes in liquids and vapors, including: mass, energy, and momentum transport, transport in chemically reacting systems, similarities, turbulence modeling, buoyance-induced transport and multicomponent diffusion. Prereq: ME 330, CME 425, CME 505 concurrent or consent of instructor.

CME 631 TRANSPORT II. (3)
A continuation of Transport I. Interphase transport of mass, energy, and momentum is discussed. Boundary Layer theory is applied to combined transport and chemical reaction. Theories of turbulent transport are examined. Prereq: CME 630 or consent of instructor.

CME 635 STAGED MASS TRANSFER OPERATIONS. (3)

CME 637 BIOLOGICAL TRANSPORT PHENOMENA. (3)
Selected topics concerning momentum and mass transfer in the cardiopulmonary system. Prereq: CME 630 or consent of instructor.

CME 650 ADVANCED CHEMICAL REACTOR DESIGN. (3)
Rate expressions for heterogeneous reaction kinetics; energy and mass transport within and external to reacting porous catalysts; design equations for multiphase fixed and moving bed reactors. Prereq: CME 550, CME 630, CME 505, or instructor consent.

CME 671 BASIC ELECTRODE PROCESSES IN ELECTROCHEMICAL ENGINEERING. (3)
Provides engineers with an introduction to electrochemical theory and measurement techniques, including relaxation methods. Selected topics in equilibrium electrochemistry, generalized theory of reversibility, double layer structural effects on charge transfer rates, organic redox reactions, chemical power systems, and biomedical engineering. Prereq: CME 620 or consent of instructor.

CME 680 BIOCHEMICAL ENGINEERING. (3)
Principles and design of processes involving biochemical reactions, including aerobic and anaerobic respirations and fermentations, and involving pure and mixed cultures. Energy considerations, heat and mass transfer, biochemical kinetics, and application to biological waste treatment. Prereq: CME 550, CME 630, CHE 440G or consent of instructor.

CME 748 MASTER’S THESIS RESEARCH. (0)
Half-time to full-time work on thesis. May be repeated to a maximum of six semesters. Prereq: All course work toward the degree must be completed.

CME 749 DISSERTATION RESEARCH. (0)
Half-time to full-time work on dissertation. May be repeated to a maximum of six semesters. Prereq: Registration for two full-time semesters of 769 residence credit following the successful completion of the qualifying exams.

CME 768 RESIDENCE CREDIT FOR THE MASTER’S DEGREE. (1-6)
May be repeated to a maximum of 12 hours.

CME 769 RESIDENCE CREDIT FOR THE DOCTOR’S DEGREE. (0-12)
CME 771 SEMINAR. (0)
Review of current literature in the field of chemical engineering, general discussion and presentation of papers on departmental research. Lecture, one hour per week. Required for all graduate students in chemical engineering.

CME 779 MEMBRANE SCIENCES COLLOQUIUM. (1)
Outstanding membrane scientists present their current research on biological and/or synthetic membranes. Students read a pertinent paper by the speaker prior to his/her talk and write a short paper on the talk, especially important is relevance of the main points of the talk to membrane science in general and the student’s own research in particular. May be repeated to a maximum of six credits. (Same as BCH/CHE/PHA/PHR 779.)

CME 780 SPECIAL PROBLEMS IN CHEMICAL ENGINEERING. (1-3)
Independent study, design, or research in chemical engineering topics. May be repeated to a maximum of 12 credits. Prereq: Approval of the departmental director of Graduate Studies.
CNU

Clinical Nutrition

CNU 601 CLINICAL NUTRITION. (4)
An analysis of the process by which man ingests, assimilates and utilizes all of the constituents of food in health and disease. Relationship of biochemical and physiological factors to the nutrient requirements of the human body. Evaluation of dietary status and rationale of dietary management. Course to be taught by lectures, clinical rounds, case conferences and written and oral case studies. Prereq: PGY 502, 503; consent of instructor. BCH 501 to be taken concurrently.

CNU 602 CURRENT TOPICS IN CLINICAL NUTRITION. (1)
This course is designed to develop in students independent thinking and critical analysis related to various clinical nutrition issues. These skills will be developed through reading assignments related to clinical nutrition. Prereq: CNU 601.

CNU 603 NUTRITIONAL IMMUNOLOGY. (3)
Theories and mechanisms of immunity will be introduced. The effects of nutrition on immunity will be discussed from experimental and clinical perspectives. A lecture and problem-based learning approach with incorporation of student presentations, three hours per week. Prereq: PGY 412G and CNU 601, or consent of instructor.

CNU 604 LIPID METABOLISM. (3)
Emphasis on factors influencing the absorption of fats and fatty acids, distribution and incorporation of fatty acids into body tissues, the biosynthesis of and catabolism of fatty acids, as well as cholesterol, bioactive eicosanoid production and the involvement of fats in the disease process. Lecture and problem-based learning approach with incorporation of student presentations, three hours per week. Prereq: BCH 401G and PGY 412G or consent of instructor.

CNU 605 WELLNESS AND SPORTS NUTRITION. (3)
Emphasis is directed toward nutrition as applied to prevention of disease through lifestyle management and the application of nutrition in exercise and sport. Targeted focus areas are: body composition and energy expenditure, the metabolic basis of weight management, nutrient needs throughout the lifecycle, the metabolic changes associated with obesity, behavioral management of obesity, nutrient metabolism and exercise, water and electrolyte balance during exercise, nutritional ergogenic aids, nutrition-strength and performance enhancement. Prereq: PGY 412G, and BCH 401G or equivalent or consent of instructor. (Same as PT 605.)

CNU 606 MOLECULAR BIOLOGY APPLICATIONS IN NUTRITION. (2)
Focus will be on the use of the most recently developed techniques and model systems in molecular biology for studying nutrient regulation of gene expression. Examples include current problems in nutrition such as models for engineering plants containing more desirable nutrient sources (fats); for studying effects of various nutrients in transgenic mice on tumor suppressor genes and oncogene expression, that are important in cancer prevention; and for studying nutrient effects on genes that modulate obesity. Prereq: BCH 501 and 502 or equivalent; or BCH 401G and consent of instructor.

CNU 610 ETHICS IN CLINICAL SCIENCES RESEARCH. (1)
Students will examine ethical issues in biomedical research using a case-study approach. Representative issues addressed may include data selection and retention, plagiarism, scientific review of grants and manuscripts, scientific misconduct, and informed consent. Prereq: Graduate student status. (Same as CD/CLS/PT/RAS 610.)

CNU 701 ADVANCED CLINICAL NUTRITION. (4)
A course dealing primarily with the clinical application of the principles of nutrition, e.g., gastrointestinal disease and nutrition, nutrition and cancer, electrolytes and acid-base balances, drug-nutrient interactions, nutrition in the burn patient and pediatric nutrition. Prereq or concur: CNU 601.

CNU 702 CLINICAL NUTRITION PROBLEM-BASED CASE STUDIES. (1-5)
A problem-based learning approach to case studies is integrated with a traditional didactic approach to offer options in therapeutic nutrition, health promotion and/or management. Efforts are directed toward patient, worksite and laboratory data interpretation as well as patient education. Students are directed to develop independent critical thinking related to case presentations regarding rotations through various medical or health services e.g. surgery, pediatrics, nutrition consultation, health promotion and wellness, hospital administration. Prereq: CNU 601, CNU 701, admission to CNU graduate program.

CNU 780 CLINICAL NUTRITION RESEARCH. (1-5)
This course is designed to expose students to scientific research methods, including library research, laboratory experience, data preparation and analysis, etc., utilizing a project of mutual interest to the student and instructor. One semester required, credits to be arranged. May be repeated to a maximum of five credits.

CNU 781 CLINICAL NUTRITION SEMINAR. (1)
Seminars on current topics of interest in clinical nutrition.

CNU 782 INDEPENDENT STUDY. (1)
Student will investigate a particular aspect of clinical nutrition with appropriate presentation.

CNU 800 APPLIED NUTRITION FOR THE HEALTH PROFESSIONS: FUNDAMENTALS OF NUTRITION SCIENCE IN NORMAL LIFE CYCLES. (1)
An interdisciplinary approach to applied nutrition and its role in primary, secondary, and tertiary health care delivery. Covers the fundamental principles and concepts of nutrition science as applied to the human life cycle. Prereq: Currently enrolled in the College of Medicine, Nursing, Dentistry, Pharmacy, or Allied Health Professions. Completion of at least one semester of physiology; one semester of organic chemistry or biochemistry, and preferred, clinical exposure. Special examination credit is possible for this course.

COM

Communication

COM 101 INTRODUCTION TO COMMUNICATIONS. (3)
An introduction to the process of communication as a critical element in human interaction and society. Designed to enhance effective communication and informed use of the mass media.

COM 181 BASIC PUBLIC SPEAKING. (3)
A course designed to give the student platform experience in the fundamentals of effective speaking.

COM 184 INTERCOLLEGIATE DEBATING. (1)
Preparation for and participation in intercollegiate debating. May be repeated to a maximum of two credits.

COM 199 PRESENTATIONAL COMMUNICATION SKILLS. (1)
Introduces students to fundamental oral communication skills needed to prepare and present messages effectively. Note: This course will not substitute for the three-credit course COM 181, Basic Public Speaking. It will count toward partial completion of the oral communication skills component of the University Studies Program.

COM 249 MASS MEDIA AND MASS CULTURE. (3)
An examination of the interplay between the technology and content of the mass communications media and culture. Prereq: COM 101 or SOC 101 or its equivalent. (Same as SOC 249.)

COM 252 INTRODUCTION TO INTERPERSONAL COMMUNICATION. (3)
Examines basic verbal and nonverbal elements affecting communication between individuals in family, peer group, and work contexts. Course requires participation in activities designed to develop interpersonal communication skills. Topics include: strategy development, relationship and conversation management, effective listening, conflict management, defensive communication, communication anxiety, cultural/sex differences in communication style.

COM 281 COMMUNICATION IN SMALL GROUPS. (3)
A study of communication processes in small group situations. Topics include conflict, leadership, and decision-making. Students will participate in group discussion and develop skills in analyzing group performance.

COM 283 ARGUMENTATION AND DEBATE. (3)
A course in the theory of argument, with practice in the several forms of debate.

COM 284 INTERCOLLEGIATE DEBATING. (1)
Preparation for and participation in intercollegiate debating. May be repeated to a maximum of four credits.
COM 285 APPLIED PHONETICS. (3) Study of the phonetic structure of English language with requirement of mastery of international Phonetic Alphabet. Emphasis will be placed on phonetic transcription, and application will be made for students interested in general speech, speech correction, radio, television, and theatre. (Same as EDS 285.)

COM 287 PERSUASIVE SPEAKING. (3) A study of the processes involved in attitude change, with emphasis on the preparation and delivery of persuasive messages.

COM 288 ORAL INTERPRETATION. (3) An analysis of prose and poetry for oral interpretation. Helpful to those who plan to teach literature.

COM 319 WORLD MEDIA SYSTEMS. (3) A comparison of the communications media in different countries of the world and how the media affect society in which they exist. Prereq: COM 319 or consent of instructor. (Same as TEL 319.)

COM 325 BUSINESS AND INDUSTRIAL COMMUNICATION. (3) Reviews the principles of communication in organizations. The most common organizational communication variables are reviewed, e.g., communication distortion, conflict, power, managerial leadership style, roles, interviewing, information overload and underload. Emphasis is on application of the principles reviewed to the organizational setting. Simulations, exercises, case studies, and visits to organizations are used to accomplish this goal. Enrollment priority given to College of Communications majors.

COM 350 LANGUAGE AND COMMUNICATION. (3) An introductory survey course covering syntactic, semantic and pragmatic aspects of language as they relate to communication. Language learning, sign typologies, psycholinguistics, and the nature of meaning are selected topic areas. Emphasis is on behavioral, communication approach. Not open to students who have completed a 300-level (or above) linguistic class.

COM 351 INTRODUCTION TO COMMUNICATION THEORY. (3) Considers various theoretical perspectives which lead to a more thorough understanding of communication processes. Begins with discussion of the development of theory and inquiry. Includes perspectives of systems, cognitive, behavioral, affective, symbolic interactionist, dramatic, cultural and social reality, interpretive and critical theories.

COM 355 INTRODUCTION TO COMMUNICATION RESEARCH METHODS. (3) An introduction to the methods of philosophy of scientific research into the origins, nature, and effects of communication processes. Provides skills necessary for designing research projects and for interpreting and critically evaluating research results. Prereq: One course in statistics.

COM 381 MANAGING COMMUNICATION IN LARGER GROUPS: THE PARLIAMENTARY PROCESS. (3) A study of the principles and history governing decision-making in voluntary organizations and deliberative assemblies. Social and political rationales for group activity, as well as principles of decision making in small groups and larger assemblies. Emphasis is on both traditional and newer forms of parliamentary practice.

COM 395 INDEPENDENT WORK. (1-3) Research and study of special topics in communication. The student proposes the specific study to be undertaken and formally contracts with a faculty supervisor for guidance and evaluation. Ordinarily, projects will require the production of written materials as a basis for the evaluation. May be repeated to a maximum of six credits. Prereq: Either a major and a standing of 3.6 in COM courses or consent of instructor.

COM 399 INTERNSHIP IN COMMUNICATION. (1-6) Provides field-based experience in communication through work in industry, government, education, etc. Pass-fail only. May be repeated to a maximum of six credits. A maximum of three credit hours may be counted toward the communication major. Prereq: 2.6 GPA (with 3.0 GPA in major courses), junior/senior Communication majors only, consent of Department Internship Director prior to registration, and completion of departmental learning contract.

COM 419 INTERNATIONAL AND INTERCULTURAL COMMUNICATION. (3) Studies interpersonal and media communication systems and policies of various cultures within and across nations. Considers the social, economic, and political implications of advances in communication technology. Prereq: COM 319.

COM 449 SOCIAL PROCESSES AND EFFECTS OF MASS COMMUNICATION. (3) The relationship between the organization of modern society and its communication media. Special emphasis is given to the study of social processes and social change. The impact of modern society upon the mass media and upon the mass media influence cultural processes and social change. The social-psychological bases of communication are studied within a context of theory and research. Prereq: SOC/COM 249 or its equivalent. (Same as SOC/EDC 449.)

COM 452 STUDIES IN INTERPERSONAL COMMUNICATION. (3) Examines current theory and research on the nature and development of interpersonal communication ability. Topics include: foundations of communicative development, development of strategic communicative skills, relational communications, conversational analysis, cultural and institutional influences on the development of interpersonal communication ability. Prereq: COM 252.

COM 453 MASS COMMUNICATION AND SOCIAL ISSUES. (3) A course devoted to the examination of criticism of the mass media and an evaluation of the relationship of mass communication to contemporary social issues. Prereq: COM 249.

COM 454 HONORS SEMINAR IN COMMUNICATION. (3) Intensive study of a communication topic in professional, theoretical, and research methodology areas of communication. This seminar will not count toward a communication major; it will count toward credits for graduation. Prereq: 3.3 GPA in communication major.

COM 482 PERSUASION. (3) The principles and methods of persuasion. Of particular benefit to teachers, lawyers, business majors, and other persons whose work is concerned with motivating human conduct.

COM 483 STUDIES IN ARGUMENTATION. (3) A study of the theories of argumentation and debate as derived from rhetorical, philosophical and psychological sources; critical examination of representative examples of oral argument.

COM 525 ORGANIZATIONAL COMMUNICATION. (3) This course reviews theories and research relevant to an understanding of the organizational communication process. Emphasis is on communication in an organizational setting at the interpersonal, small group and whole organizational level. Prereq: COM 325 or consent of the instructor.

COM 571 HEALTH COMMUNICATION. (3) This course offers a broad introduction to communication in health care delivery from a variety of perspectives, combining interpersonal, organizational, and semiotic approaches. Prereq: Consent of instructor.

COM 581 STUDIES IN SMALL GROUP COMMUNICATION CONTEXTS. (3) Examines current theory and research on the nature and development of small group discussion. Includes topics of leadership, interpersonal relations and roles, group goals vs. individual goals, and networks. Prereq: COM 281.

COM 584 TEACHING OF SPEECH COMMUNICATION. (3) An analysis of the field of speech education as related to the teacher of speech.

COM 591 SPECIAL TOPICS IN COMMUNICATION (Subtitle required). (1) Intensive study of a specialized topic area in communication. May be repeated to a maximum of six credits under different subtitles. A maximum of three credits can be counted toward a Communication major. Lecture, three hours per week for five weeks. Prereq: Consent of instructor.
CON  Conjoint (College of Medicine)

CON 841 AMBULATORY MEDICINE. (2)
This course is offered for senior medical students who are enrolled in the Accelerated Internal Medicine Residency Program. The course is designed to provide the student/resident with a broad survey of outpatient medical care in the primary disciplines that relate to internal medicine. The focus of these rotations will be on the development of clinical skills in interviewing and patient examination, on the use of a comprehensive approach to outpatient diagnosis and management and on the integration of the pathophysiologic problems with the psychosocial and economic problems that the patient presents. Each student will be assigned to a single faculty member in the Division of General Internal Medicine who will act as his/her preceptor. The student will work in that faculty member's clinic one half day to two half days a week depending on the other clinic rotations. In addition to the Medicine experience the student/resident will be assigned one half day per week for the eight-week period to Neurology, office otolaryngology, Gynecology, orthopedics or Sports Medicine, General Surgery, Dermatology and Psychiatry. In each of the clinics, the student/resident will be expected to perform at the level of a house officer under the close supervision of the clinic attending. At the end of each week, the General Internal Medicine course preceptor will review the entire week's experience with the student/resident for the purpose of identifying an appropriate reading program to amplify the patient experience. These reading programs will particularly emphasize interviewing techniques, decision analysis, screening methodologies and preventive medicine. Prereq: Required first three years of Medical School.

CPC  Clinical Pastoral Counseling

CPC 501 PERSPECTIVES IN RELIGION AND HEALTH. (3)
An interdisciplinary study of significant religious components in health. Prereq: Consent of instructor.

CPC 899 CLINICAL PASTORAL PRACTICUM. (1-2)
Students participate in a program of supervised learning consistent with one unit of CPE, according to Standards of the Association for Clinical Pastoral Education, Inc. Each student is assigned to at least one area of the University Hospital for clinical pastoral work. Evening, weekend, and/or overnight assignments may be expected. The course work consists of instruction, group interaction, and experience with patients in the University Hospital. An individualized learning contract is required for each student. May be repeated to a maximum of 18 credits. Offered on a pass/fail basis only. Prereq: Baccalaureate degree, consent of instructor.

CS  Computer Science

CS 101 INTRODUCTION TO COMPUTING I. (3)
An introduction to computing and its impact on society from a user's perspective. Topics include computation using spreadsheets, beautification using text formatters and word processors, information management with database managers, and problem solving through program design and implementation using a simple programming language. Not open to students who have received credit for higher level computer science courses.

CS 121 COMPUTER SCIENCE I. (4)
Fundamentals of computer science including algorithm design and testing, specification, control structures, lists, simple searching and sorting algorithms, recursion, record and file structures, and simple applications. A high-level procedural language is presented. This is the usual first course for students wishing to study computer science above the freshman level.

CS 122 COMPUTER SCIENCE II. (4)
A continuation of CS 121 which presents basic machine organization, representations of elementary data types, external file processing, and list processing. Simple data structures are presented for trees, queues, and lists. This course is a prerequisite for most upper level computer science courses. Prereq: CS 121.

CS 221 FIRST COURSE IN COMPUTER SCIENCE FOR ENGINEERS. (2)
Characteristics of a procedure-oriented language; description of a computer as to internal structure and the representation of information; introduction to algorithms. Emphasis will be placed on the solution of characteristic problems arising in engineering. Prereq: MA 113. Not open to students who have received credit for CS 150.

CS 222 COMPUTER SCIENCE FOR ELECTRICAL ENGINEERS. (3)
Characteristics of a procedure-oriented language; high-level description of computer structure and information representation schemes; introduction to algorithm development and design. Emphasis will be placed on the programming tools used in software engineering. Tools suitable for programming development on microcomputers will be emphasized. Not open to students who have received credit for CS 121 or CS 221.

CS 223 COMPUTER SCIENCE FOR CIVIL ENGINEERS. (2)
An introduction to computer-assisted problem solving for civil engineering students using a microcomputer based procedure-oriented language; a description of internal structure and representation of information; an introduction to algorithms. Emphasis will be placed on the solution of characteristic problems arising in civil engineering. Prereq: MA 113, CE 121.

CS 245 INTRODUCTION TO LOGIC AND DISCRETE COMPUTER MATHEMATICS. (3)
Introduction to basic mathematical and logical concepts which form the foundation of computer science. Main topics of the course include: propositional and predicate calculi, set theory (including the theory of relations and functions), Boolean algebra, introduction to the logic programming, and introduction to combinators. Prereq: CS 121.

CS 250 COMPUTER ORGANIZATION. (3)
Number systems, memory organizations, addressing schemes. Representation of data and instructions. Machine language, assembler languages, macros and basic input/output. Prereq: CS 121 or CS 221.

CS 270 FILE PROCESSING. (3)
Data management techniques for sequential, direct, and linked access; file structures; list structures; design of large programming systems. Prereq: CS 122.

CS 321 INTRODUCTION TO NUMERICAL METHODS. (3)

CS 340 DISCRETE STRUCTURES IN COMPUTER SCIENCE. (3)
Topics include permutations, combinations and partitions; inclusion-exclusion principle; generating functions and recurrence relations; elementary algorithms concerning graphs and trees; generation of random combinatorial and graphical examples; Boolean algebra, Boolean functions, switching circuits and mathematical logic; introduction to algebraic coding theory. Prereq: CS 245 and CS 270. Restricted to computer science, electrical engineering, mathematics and mathematical sciences majors. Others by permission. (Same as MA 340.)

CS 370 DATA STRUCTURES. (3)
Basic data structures and associated algorithms. Arrays, stacks and queues, linked lists, trees, graphs, and sorting algorithms. Prereq: CS 250 and CS 270. Restricted to computer science and electrical engineering majors. Others by permission.

CS 380 MICROCOMPUTER ORGANIZATION. (3)
Hardware and software organization of a typical computer; machine language and assembler language programming, interfacing peripheral devices, and input-output programming; real-time computer applications, laboratory included. Prereq: EE 280 or CS 245. (Same as EE 380.)

CS 395 INDEPENDENT WORK IN COMPUTER SCIENCE. (2)
A course for computer science majors only. A problem, approved by the chairperson of the department, provides an opportunity for individual research and study. May be repeated to a maximum of six credits. Prereq: Major and a standing of 3.0 in the department and consent of instructor.

CS 415G GRAPH THEORY. (3)
Theory of linear undirected graphs, including definitions and basic concepts, trees, connectivity, traversability, factorization, planarity and matrices. In addition, algorithms for finding spanning trees, testing connectivity, finding Euler trails, finding a maximum matching in a bipartite graph, and testing planarity will be presented at appropriate times. Applications of algorithms to operations research, genetics and other areas. About 55 percent of the course will be on general theory of graphs, 30 percent on algorithms and 15 percent on applications of these algorithms. Prereq: Consent of instructor. (Same as MA 415G.)

CS 416G PRINCIPLES OF OPERATIONS RESEARCH I. (3)
The course is an introduction to modern operations research and includes discussion of modeling, linear programming, dynamic programming, integer programming, scheduling and inventory problems and network algorithms. Prereq: MA 213 or equivalent. (Same as MA 416G.)
CS 420G COMPILERS FOR ALGORITHMIC LANGUAGES. (3)
The techniques of processing, specifying, and translating high level computer languages are studied. Topics include finite state machines and lexical analysis, context-free grammars for language specification, attributed translation grammars, language parsing, and automatic generation of compilers by SLR, LALR, and other methods of analyzing context-free grammars. Other topics may include code optimization, semantics of programming languages and top-down parsing. Prereq: CS 370. Restricted to computer science and electrical engineering majors. Others by permission.

CS 422 NUMERICAL SOLUTIONS OF EQUATIONS. (3)
Linear equations: Gaussian elimination, special linear systems, orthogonalization, eigenproblem, iterative methods. Nonlinear equations: solutions of equations in one variable, solutions of systems of nonlinear equations. Optimization. Prereq: CS/MA 321 and MA 322; or consent of instructor. (Same as MA 538.)

CS 440 FOUNDATIONS OF COMPUTING. (3)
An introduction to theoretical foundations of computing via automata and formal language models of computation such as Turing machines, finite automata, push down machines, regular sets, and context free grammars. Applications to programming, compiling, and computing systems. Prereq: CS 340. Restricted to computer science and electrical engineering majors. Others by permission.

CS 450G FUNDAMENTALS OF PROGRAMMING LANGUAGES. (3)
An intensive study of fundamental programming concepts exhibited in current high level languages. Concepts include recursion, iteration, coroutines, multiprocessing, backtracking, pattern-matching, parameter passing methods, data structures, and storage management. Typical languages studied are SNOBOL, LISP, PASCAL, and APL. Prereq: CS 370. Restricted to computer science and electrical engineering majors. Others by permission.

CS 470G SYSTEMS SOFTWARE. (3)
A study of the use and construction of system software, including assemblers, macro-processors, linkers, loaders, interrupt handlers, and elementary operating systems. Software appropriate for use on small mini/micro computer systems will be emphasized. Prereq: CS 370 or CS 250 and EE 280. Restricted to computer science and electrical engineering majors. Others by permission.

CS 485G TOPICS IN COMPUTER SCIENCE
(Subtitle required. (2-4)
Studies of emerging research methods and computers in science. A review and extension of selected topics in the current literature. When the course is offered, a specific title with specific credits, the number of hours in lecture-discussion and laboratory will be announced. Lecture/discussion, two-four hours; laboratory, zero-four hours per week. May be repeated to a maximum of eight credits under different subtitles. Prereq: Variable, given when topic is identified; or consent of instructor.

CS 505 DATABASE MANAGEMENT SYSTEMS. (3)
This course is primarily concerned with the definition, organization, and manipulation of a database. An overview of the goals and database management systems is examined. The database management process is broken down into its four constituent parts: data definition, data manipulation, data retrieval, and report generation. Attempts toward standardization in database management are presented with emphasis on the CODASYL activities. The concept of shared files and the deadlock problem are presented. A number of general database management systems are surveyed, and at least one case study is examined in detail. Prereq: CS 370. Restricted to computer science and electrical engineering majors. Others by permission.

CS 522 MATRIX THEORY AND NUMERICAL LINEAR ALGEBRA I. (3)

CS 537 NUMERICAL ANALYSIS. (3)
Floating point arithmetic. Direct methods for the solution of systems of linear algebraic equations. Polynomial and piecewise polynomial approximation, orthogonal polynomials. Numerical integration; Newton Cotes formulas and Gaussian quadrature. Basic methods for initial value problems for ordinary differential equations. The emphasis throughout is on the understanding and use of software packages for the solution of commonly occurring problems in science and engineering. Prereq: CS/MA 321 or equivalent or graduate standing or consent of instructor. Knowledge of a procedural computer language is required. (Same as EGR/MA 537.)

CS 538 NUMERICAL ANALYSIS II. (3)
A continuation of CS/EGR/MA 537. Roots of a nonlinear equation and minimization of a function of a single variable. Linear difference equations. Numerical methods for ordinary differential equations: initial value problems, and elementary techniques for two-point boundary value problems. Prereq: A grade of B or better in CS/MA 521 or CS/EGR/MA 537 or equivalent. (Same as MA 538.)

CS 540 SYSTEMS SIMULATION. (3)
Computer simulation techniques including building and utilizing deterministic and stochastic models for digital computers, Monte Carlo. Prereq: CS 121 and a course in statistics or probability.

CS 541 ADVANCED COMPILER DESIGN I. (3)
A study of the theory and practice of implementing compilers for high-level languages with emphasis on the use of compiler-compilers for automatic generation of compiler systems. Topics include specification of languages by grammars, LR, SLR, LALR, and LL parsing algorithms, lexical analysis, syntax directed translation, code optimization and generation, and data flow analysis. Prereq: CS 420G or CS 580 or CS 575. Restricted to computer science and electrical engineering majors. Others by permission.

CS 545 COMPUTER GRAPHICS. (3)
The problems of representing and manipulating graphical information in computers are discussed. An overview of the hardware and software techniques is presented for using refresh, storage, and raster scanning devices. Two-dimensional transformations, clipping, and windowing algorithms are developed. The use of display files, graphical databases, and input devices is covered. Three-dimensional graphics is included to present viewing algorithms, solid models, and shading. Prereq: MA 213 and CS 370, or consent of instructor. Restricted to Computer Science and Electrical Engineering majors. Others by permission.

CS 555 LOGIC FOR COMPUTER SCIENCE. (3)
The course exposes students to intermediate areas of logic, model theory, recursion theory and set theory (basic undergraduate logic is covered by CS 245). It creates foundations for Theory (CS 575 and subsequent courses), Artificial Intelligence (CS 560, CS 660), Expert Systems, and Natural Language Processing areas. Prereq: CS 245.

CS 560 ARTIFICIAL INTELLIGENCE. (3)
This course is primarily concerned with current problem-solving methods: production systems, searching of graphs, and automated theorem-proving methods, in particular the resolution method and its variants. Topics include methods of heuristics, games on trees, and minimax methods, as well as a study of various knowledge-representation schemes such as frames, prototypes, predicate logic and basic methodology of expert systems. Prereq: CS 245, CS 340, and CS 370.

CS 570 OPERATING SYSTEMS DESIGN. (3)
Concurrent processes, resource management, protection, file management, deadlocks, and memory management. Prereq: CS 470. Restricted to computer science and electrical engineering majors. Others by permission.

CS 575 THEORETICAL ASPECTS OF COMPUTING. (3)
Theoretical considerations in computer science. Topics include computability, unsolvability, automata and formal language theory, verification, and computational complexity. Prereq: CS 340. Restricted to computer science and electrical engineering majors. Others by permission.

CS 580 ALGORITHM DESIGN. (3)
The design of efficient algorithms on data structures such as lists, trees, sets and graphs. Topics include: sorting, searching and pathfinding by techniques such as divide-and-conquer, back tracking and the greedy method. Prereq: CS 370 and 440. Restricted to computer science and electrical engineering majors. Others by permission.

CS 585 INTERMEDIATE TOPICS IN COMPUTER SCIENCE (Subtitle required. (3)
Topics to be selected by staff. May be repeated to a maximum of six credits, but only three credits may be earned by a student under the same topic. Prereq: Restricted to computer science and electrical engineering majors. Others by permission.

CS 587 MICROCOMPUTER SYSTEMS DESIGN. (3)
A course in the design of microcomputer systems for hardware engineers which includes the following topics: use of uncommitted logic arrays in instruction set design; hardware support for operating systems and programming languages; customizing microcomputer systems for specific execution environments; and control of concurrency. Prereq: EE 581 and EE 583, or consent of instructor, engineering standing or upper division computer science standing. (Same as EE 587.)
CS 610 MASTER’S PROJECT. (3)
Design and implementation of a large computing project under the supervision of a member of the graduate faculty. Prereq: Satisfactory completion of the departmental foundational examinations.

CS 612 INDEPENDENT WORK IN COMPUTER SCIENCE. (1-3)
Reading course for graduate students in computer science. May be repeated to a maximum of nine credits. Prereq: Overall standing of 3.0, and consent of instructor.

CS 622 MATRIX THEORY AND NUMERICAL LINEAR ALGEBRA II. (3)

CS 630 GEOMETRIC MODELING. (3)
This course discusses methods for design, modeling, representation, and generation of solids. Topics of curve design, surface design, solid modeling, shapes, and inter-section methods will be covered. Prereq: CS 545, CS 321.

CS 635 IMAGE PROCESSING. (3)
The course outlines applications of image processing and addresses basic operations involved. Topics covered include image perception, transforms, compression enhancement, restoration, segmentation, and matching. Prereq: CS 542 and consent of instructor. (Same as EE 635.)

CS 636 COMPUTER VISION. (3)
Topics of human visual system will be discussed first. Then approaches to implementation of visual processes by computers will be described. Prereq: CS/EE 635.

CS 641 ADVANCED COMPILER DESIGN II. (3)
Optimization, special purpose languages, compiler-compiler, industrial compiler practice. Prereq: CS 541 or consent of instructor.

CS 642 DISCRETE EVENT SYSTEMS. (3)
The objective of the course is to prepare students for research in the field of supervisory control of discrete event systems (DES’s). Logical models, supervisory control. Stability and optimal control of DES, complexity analysis and other related research areas will be covered. Prereq: CS 641 and consent of instructor. (Same as EE 642.)

CS 645 COMPUTER NETWORKS. (3)
The focus of the course will be on learning various principles and techniques employed in the development of computer communication networks. A study of International Standards Organization’s (ISO) seven-layer Open Systems Interconnections (OSI) model and the U.S. Department of Defense’s ARPANET Internet model will be covered. The course will cover details of link and network layer under the OSI model, and will examine the model of internetworking with particular emphasis on DARPA Internet. Prereq: CS/EE 570.

CS 650 PROBLEM SEMINAR. (3)
A seminar on the identification, analysis, formulation and solution of problems amenable to computer solution. Presupposes knowledge of calculus and programming. Prereq: Consent of instructor.

CS 655 DESIGN OF PROGRAMMING LANGUAGES. (3)
A study of techniques for designing programming languages and implementing processors for them. Emphasis is placed on programming languages exhibiting powerful and high level features such as nondeterminism and pattern-directed procedure invocation. The course includes the writing of actual processors. Prereq: CS 575 or CS 580.

CS 660 TOPICS IN ARTIFICIAL INTELLIGENCE (Subtitle required). (3)
Advanced topics chosen from the following: knowledge representation, knowledge acquisition, problem solving, very high-level programming languages, expert systems, intelligent and deductive databases, automated theorem proving. May be repeated to a maximum of six credits, but only three credits may be earned under the same topic. Prereq: CS 505 and CS 560 or consent of instructor.

CS 674 HEURISTIC ALGORITHMS. (3)
Advanced topics in algorithm design emphasizing the application of various heuristics. The course will treat active research topics. These topics include graph algorithms, parallel algorithms, randomization, linear and integer programming, VLSI and geometry problems. Prereq: CS 575 and CS 580.

CS 675 THEORY OF COMPUTATION. (3)
Computability by Turing Machines and algorithms. The predicate calculus, syntax, semantics, natural deduction, and the resolution method. Program verification and flowchart schemes. The fixpoint theory of programs. Prereq: CS 575.

CS 676 PARALLEL ALGORITHMS. (3)
The study of intrinsic parallelism in computational problems and the design of fast and efficient parallel algorithms. Parallel algorithms for prefix computation, selection, merging, sorting, routing, arithmetic, graph, and systolic algorithms. Prereq: CS 580.

CS 677 COMPUTATIONAL GEOMETRY. (3)
Design and analysis of algorithms and data structures for geometric problems. The particular groups of problems addressed include convex hull construction, proximity, Voronoi Diagrams, geometric search, intersection. Prereq: CS 580.

CS 679 ADVANCED GRAPH ALGORITHMS. (3)
The design of algorithms for graph problems. In particular, the design of efficient algorithms for optimization problems on graphs, such as minimum spanning tree, shortest paths, maximum matching and maximum flow problems. Design of heuristic (approximation) algorithms. Search trees, heaps, and their self-adjusting variants. Methods of estimating algorithm performance: worst-case analysis, average-case analysis, amortization. Prereq: CS 580 or consent of instructor.

CS 680 SEMINAR IN COMPUTER SCIENCE. (2)
May be repeated to a maximum of four credits. Prereq: Consent of instructor, or two 500-level computer science courses.

CS 682 SWITCHING THEORY. (3)
Application of the symbolic logic of Boole and Schroeder to the design of switching systems. Topics include Boolean algebra, Boolean analysis, the solution of logic equations, the minimization of Boolean formulas, and the diagnosis of failures in digital systems. Prereq: EE 280 or consent of instructor. (Same as EE 682.)

CS 683 FINITE-STATE MACHINES. (3)

CS 685 SPECIAL TOPICS IN COMPUTER SCIENCE (Subtitle required). (3)
Topics to be selected by staff. May be repeated to a maximum of six credits but only three credits may be earned under the same topic. Prereq: Consent of instructor or two 500-level computer science courses.

CS 686 SPECIAL TOPICS IN THE THEORY OF COMPUTATION (Subtitle required). (3)
Advanced topics in the theory of computation and the design and analysis of algorithms, including heuristic approaches for algorithm design, parallel computation, flow problems, parallel and concurrent processes and other areas of current research interest. May be repeated to a maximum of six credits but only three credits may be earned under the same topic. Prereq: Consent of instructor or CS 575 and 580.

CS 687 SPECIAL TOPICS IN SOFTWARE (Subtitle required). (3)
Topics to be selected by staff. May be repeated to a maximum of six credits but only three credits may be earned under the same topic. Prereq: Consent of instructor or two 500-level computer science courses.

CS 688 NEURAL NETWORKS. (3)
The purpose of this course is to introduce various aspects of the neural networks and neurocomputing. The course starts with an introduction to Learning Machines and analyzes various learning algorithms such as Hebbian, Grossberg’s and Kohonen’s learning algorithms. Some of the neural networks that will be studied in detail are: Backpropagation nets, Hopfield nets, Adaptive Resonance Theory, Adaline and Madalines, Kohonen’s Self learning nets, BAMs, Neocognition, etc. Students will implement a minimum of three learning algorithms. Prereq: CS 675. (Same as EE 688.)

CS 689 ADVANCED TOPICS IN NUMERICAL COMPUTING (Subtitle required). (3)
Prereq: Consent of instructor or two 500-level computer science courses.

CS 690 OPERATING SYSTEMS THEORY. (3)
An advanced study of operating systems theory including cooperating sequential processes, processor scheduling, paging systems, and memory management. Prereq: CS 570.
CS 748 MASTER'S THESIS RESEARCH.  (0)
Half-time to full-time work on thesis. May be repeated to a maximum of six semesters.
Prereq: All course work toward the degree must be completed.

CS 749 DISSERTATION RESEARCH.  (0)
Half-time to full-time work on dissertation. May be repeated to a maximum of six
semesters. Prereq: Registration for two full-time semesters of 769 residence credit
following the successful completion of the qualifying exams.

CS 768 RESIDENCE CREDIT FOR MASTER'S DEGREE.  (1-6)
May be repeated to a maximum of 12 hours.

CS 769 RESIDENCE CREDIT FOR DOCTOR'S DEGREE.  (0-12)
May be repeated indefinitely.