871. **Advanced Construction Practice**
Winter. 3 credits. Approval of department.
Advanced problems involved in construction. Theoretical analysis and practical solutions commonly employed. Emphasis on heavy construction including caissons, piles, foundations, tunnels, dams, and bridge structure.

880. **Special Problems in Civil Engineering**
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
Research problems of limited scope not pertaining to thesis accomplished under 899 or 999.

899. **Research**
(EGR 899.) Fall, Winter, Spring, Summer. Variable credit. Approval of department.

904. **Advanced Structural Theory II**
Spring. 4(4-0) 804; MTH 422 or concurrently.
Energy (variational) approach to deriving and solving equations governing advanced problems in beam-columns, rings, buckling, plates, load diffusions, etc. Approximate solutions by Rayleigh-Ritz and related methods.

905. **Advanced Theory and Design of Reinforced Concrete II**
Spring. 3(2-3) 805.
Continuation of 805 with application of theory to analysis and design of tanks, rigid frames, and shells.

906. **Advanced Structural Steel Design**
Spring. 3(2-3) 406.
Analysis and design of multiple-story building frames, continuous trusses and rigid-frame girder bridges in structural steel. Plastic design.

908. **Numerical Methods in Structural Engineering**
Winter. 3(2-3) 406.
Solution of mathematical equations by means of successive numerical approximations and the application of these numerical methods to structural problems.

909. **Elastic Thin Shells**
Spring. 4(4-0) 804 or MMM 815 or approval of department; MTH 421. Interdepartmental with the Metallurgy, Mechanics and Materials Science Department.
Elements of differential geometry, membrane theory of shells, Pucher's stress function, deformation and bending of shells of revolution and shallow shells.

912. **Theory of Plates**
Winter. 4(4-0) 804 or MMM 815 or approval of department; MTH 422. Interdepartmental with and administered by the Metallurgy, Mechanics and Materials Science Department.
Bending of thin elastic plates with various shapes and boundary conditions; application of energy principles and approximate methods of solution; thick plates; large deflection theory; sandwich plates.

915. **Advanced Soil Mechanics II**
Spring. 3(3-0) 817.
Earth structures including natural and cut slopes, embankments and earth dams; mechanisms of flow slides, slope stability analysis and design problems, seepage applications including confined and unconfined flow of water through soils.

916. **Advanced Soil Mechanics III**
Summer. 3(3-0) 817.
Soil dynamics including design of foundations for machinery; effects of ground motion on earth slopes and earth dams; stress-strain behavior of soil during transient and repeated loadings; and relation of soil properties to wave velocity.

999. **Research**
(EGR 999.) Fall, Winter, Spring, Summer. Variable credit. Approval of department.

Sanitary Engineering   S E

803. **Treatment of Industrial Wastes**
Spring. 3(3-0) C E 483.
Physical, chemical and biological treatment methods for industrial wastes.

805. **Water Treatment Principles**
Winter. 3(3-0) C E 483.
Chemical and physical principles of water treatment.

806. **Sewage Collection and Treatment**
Spring. 3(3-0) C E 483.
Chemical, physical and biological principles of sewage collection and treatment.

899. **Research**
(EGR 899.) Fall, Winter, Spring, Summer. Variable credit. Approval of department.

905. **Biological Principles of Sanitary Engineering I**
Fall. 3(2-3) C E 483.
Fundamental physical, chemical, and biological principles relating to the field of sanitary engineering.

906. **Biological Principles of Sanitary Engineering II**
Winter. 3(2-3) 905.
Fundamental physical, chemical, and biological principles relating to the field of sanitary engineering.

999. **Research**
(EGR 999.) Fall, Winter, Spring, Summer. Variable credit. Approval of department.

COMMUNICATION   COM

College of Communication Arts

100. **Human Communication I**
Fall, Winter, Spring, Summer. 3(3-0)
Process and functions of communication. Principles underlying communication behavior. Practice in analyzing communication situations and in speaking and writing.

101. **Human Communication II**
(S T 101.) Fall, Winter, Spring, Summer. 3(3-0) 100.
Continuation of 100, with greater emphasis on speaking and writing, and on analyzing increasingly complex communication situations.

199. **Methods of Inquiry**
Fall, Winter, Spring, Summer. 3(3-0)
Majors and minors only. 101.
Major theoretic orientations toward communication. Primary tools of scholarly inquiry.

205. **Persuasion**
(305., S T 305.) Fall, Winter, Spring. 4(4-0) 101.
Process of influencing human behavior through persuasive communication. Experience in creating persuasive messages and in evaluating the acceptability of persuasive attempts.

210. **Leadership**
(116., S T 116.) Fall, Winter. 4(4-0) 100.
Principles and practice in the utilization of communication for effective leadership.

299. **Individual Projects**
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 15 credits. 199, approval of project proposal by department.
Independent research, experience in communication laboratories, or tutorial work in communication skills.

300. **Effects of Communication I**
Fall, Winter, Spring, Summer. 4(4-0) 100; majors must enroll in 300R concurrently.
Examination of the dimensions of communication effects.

300R. **Effects of Communication II**
Fall, Winter, Spring, Summer. 1 credit. Majors. 300 concurrently.
In-depth consideration of effects of communication.

315. **Organizational Communication**
(311., S T 311.) Spring. 4(4-0) 101.
Principles and practice in the management of communication systems, with emphases on conflict resolution, information exchange, innovativeness, and information management.

350. **Signs and Sign-Behavior I**
Fall, Winter, Spring, Summer. 4(4-0) 100; majors must enroll in 350R concurrently.
Theories of man's symbolic behaviors. Semiotics and general semantics.

350R. **Signs and Sign-Behavior II**
Fall, Winter, Spring, Summer. 1 credit. Majors. 350 concurrently.
In-depth consideration of signs and sign behavior.

351. **Message Analysis I**
(440.) Winter. 4(4-0) 350.
Methods of describing messages and message codes, with emphasis on the concept of information.

352. **Message Analysis II**
(320.) Spring. 4(4-0) 351.
Continuation of 351, with emphasis on nonverbal codes: gesture, expression, time and space, light.

360. **Critical Perspectives on Communication**
Fall, Winter, Spring. 4(3-0) 100.
Interdependence of communication and other societal factors, emphasizing criteria for ethical and social appropriateness.

399. **Seminar**
(400.) Fall, Winter, Spring, Summer. 4(4-0) Majors only. 360.
Contemporary issues in communication.

405. **Research in Communication Strategies and Styles**
(S T 405.) Fall, Spring, Summer. 5(5-0) Seniors. 300.
Research literature in communication strategies and styles.

413. Seminar in Communication Education
(S T 413.) *Fall, Winter, Spring, Summer. 4(4-0) ED 436.*
Philosophies of curricular and co-curricular programs in communication education. Internship experience in those programs.

420. Message Design
Winter. 4(4-0) 101.
Principles and practice in message-media construction and selection.

499. Special Projects
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 15 credits. Approval of project proposal by department.
Independent research, group research, student-directed group projects.

805. Communication Research
Fall. 5(4-2) Majors.
Communication research strategy and methodology. Scientific process, bases for derivation and verification of hypotheses, and basic methods of designing research in communication.

806. Communication Research
Winter. 5(4-0) 805.
Continuation of 805.

815. Organizational Communication
Winter, Spring. 4(4-0)
Structure and function of communication in organizations, with emphasis on concepts and principles needed for effective management of organizational communication processes.

820. Communication Theory and Process
Fall, Summer. 3(3-0)
Theoretic models of communication, with emphasis on the applications of communication theory to various professional communication areas.

821. Mass Communication Theory and Research
(921.) Fall, Spring. 4(3-0)
Current theories and research in mass communication.

822. Interpersonal Communication
(920.) Winter, Summer. 4(3-0)
Current theories and research in interpersonal communication, with emphasis on persuasion.

828. Cross-Cultural Communication
(428.) Winter, Summer. 4(4-0)
Role of communication in the economic, social and political development of less developed countries. Problems in communicating across cultural boundaries.

850. Seminar in Research Utilization
(950.) Winter, Summer. 4(3-0) May re-enroll for a maximum of 8 credits. Approval of department.
Applications of communication research to professional practice in such areas as teaching, change agencies, information system management, etc.

870. Communication and Change: The Diffusion of Ideas and Information
(470.) Fall, Spring. 4(4-0)
Research traditions underlying the diffusion of ideas and information, and acceptance of innovation and change. Strategic principles for introduction of change through the use of communication.

890. Special Problems
Fall, Winter, Spring, Summer. 1 to 6 credits. Approval of department.
Special problems as arranged with instructor.

899. Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

905. Communication Research Design
Fall, Winter, Spring. 4(4-0) May re-enroll for a maximum of 12 credits. 806.
Methods of data collection and analysis in communication research. Designing exploratory studies of the communication process. Interviewer training and bias. Content analysis of the mass media. Writing and critiquing research reports.

940. Seminar in Communication Theory and Research
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 45 credits. Approval of department.
Theoretic and research issues in communication.

990. Special Problems
Fall, Winter, Spring, Summer. 1 to 6 credits. Approval of department.

999. Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

COMPUTER SCIENCE　　　CPS

College of Engineering

110. Introduction to Computer Programming
Fall, Winter, Spring, Summer. 3(3-0) Students may not receive credit in both 110 and 120.
FORTRAN programming, number systems and basic computer structure. Applications from various areas including business and social science.

120. Computer Programming for Engineers and Scientists
Fall, Winter, Spring, Summer. 3(3-0) MTH 111 concurrently. Students may not receive credit in both 110 and 120.
FORTRAN programming, number systems and basic computer structure. Applications from engineering, mathematics and physical science.

255. Computer Models in Science and Engineering
Spring. 3(3-0) 110 or 120 or equivalent FORTRAN. Interdepartmental with and administered by the Mechanical Engineering Department.
Problem-solving; development of student's ability to formulate computable models based on finite physical elements, examples from statics, dynamics, electrical resistance, and conduction heat transfer.

300. Computer Programming
Fall, Winter, Spring, Summer. 3(2-1) 110 or 120; MTH 108 or 111.
Development and implementation of numeric and non-numeric algorithms using FORTRAN. Number systems and representations of data. Concepts of storage, processors and compilers.

305. List Processing Languages
Winter. 3(3-0) 300 or approval of department.
Development and implementation of computer programs in string and list processing languages.

Emphasis upon non-numeric applications. Structure of a simple list processing language. Comparison of list processing languages.

306. COBOL Programming
Spring. 3(3-0) 110 or 120.
The mechanics of COBOL, a business data processing language; presented with illustrative problems.

311. Assembly Language and Machine Organization
(301.) Fall, Winter. 4(3-1) 300.
Machine structure, registers and operations. Programming in assembly language. Discrimination of assembler, loader and execution tasks. Comparison with interpretive processing. Introduction to program and data structures. Subprogram linkage.

312. Generative Coding and Information Structures
(302.) Winter, Spring. 4(3-1) 311.
Macro facilities, conditional assembly, interaction with monitor, assembly language I/O. Use of buffer, stack, queque, deque, tree and list data structures. Interpreters, recursive routines.

313. Introduction to System Programming
(303.) Fall, Spring, Summer. 4(3-1) 312.
Loaders and operating systems. Study of existing batch and time-sharing systems. Design and implementation of part of an operating system. Segments, overlays, multi-processing and multi-programming.

321. Introduction to Discrete Structures
Fall, Winter. 3(3-0) 300, MTH 113.
Set operations, relations and functions. Deductive and mathematical proofs. Algebraic systems. Applications to computer science.

322. Introduction to Theory of Computing
Winter, Spring. 3(3-0) 321.
Finite-state machines, Turing machines. Effective procedures and algorithms. Symbol manipulation systems.

411. Information Theory
Winter. 3(3-0) 110 or 120; 322 recommended; STT 351 or 441.
Measures of information content and flow. Channel capacity and theoretical limits on information transmission. Applications to coding and computer related studies.

421. Combinational Circuits
Fall. 3(3-0) 300, 321; 322 desirable; MTH 215.
Combinational circuits. Minimization, multiple output, NAND-NOR implementation and iterative circuits.

422. Sequential Circuits
Winter. 3(3-0) 311, 421.
Synchronous and asynchronous machines. State minimization, flip-flops, Boolean equations, races and hazards.

423. Computer Architecture
Spring. 3(3-0) 422.
Computer arithmetic algorithms, memory systems, computer design, input-output system design, digital system simulation.

451. Mechanical Language I
Fall. 3(3-0) 311; MTH 215; 321 or PHL 337 and MTH 324; 322 recommended.
Classification of grammars and their properties. BNF, trees, relations, top-down parsing. Simple precedence grammars using matrix techniques.