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 (vibration) 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(3-0) 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 multi-story building frames, continuous trusses and rigid-frame girders 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, Pocher's stress function, deformation and bending of shells of revolution and shallow shells.

911. 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 unconfinned 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

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

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

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

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

Communication

100. Human Communication I
Fall, Winter, Spring, Summer. 3(2-0)
Process and function 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(2-0) 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. 3(3-0)
Majors and minors only. 101.
Major theoretical orientations toward communication. Primary tools of scholarly inquiry.

205. Persuasion
(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
(S16., 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. 109, approval of project proposal by department.
Independent research, experience in communication laboratory, or tutorial work in communication skills.

300. Effects of Communication I
Fall, Winter, 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, Summer. 1 credit. Majors. 300 concurrently.
In-depth consideration of effects of communication.

315. Organizational Communication
(S11., S T 311.) Spring. 4(4-0) 101.
Principles and practice in the management of communication systems, with emphasis 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
(490.) 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 non-verbal codes: gesture, expression, time and space, light.

360. Critical Perspectives on Communication
Fall, Winter, Spring. 4(4-0) 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 these programs.

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

490. 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.

505. Communication Research
Fall, 3(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.

506. Communication Research
Winter. 3(4-4) 805.
Continuation of 850. Seminar and political development of less developed countries. Problems in communicating across cultures.

511. Communication Theory and Research
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 15 credits. Approval of department.
Theoretical and research issues in communication.

540. Seminar in Communication Theory and Research
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 15 credits. Approval of department.

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

599. 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. 906.
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. 4(4-0) 945 credits. Approval of department.

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

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.
FORTAN programming, number systems and basic computer structure. Applications from various areas including business and social sciences.

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.
FORTAN programming, number systems and basic computer structure. Applications from engineering, mathematics and physical sciences.

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 statistics, dynamics, electrical resistance, and construction heat transfer.

300. Computer Programming
Fall, Winter, Spring, Summer. 3(2-1) 110 or 120; MTH 105 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 struct 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) Winter, Spring. 4(3-1) 300.

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

313. Introduction to System Programming
(303) Fall, Spring, Summer. 4(3-3) 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, Spring. 3(3-0) 309, 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.

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 1
Fall, 3(3-0) 311; MTH 215; 321 or PHL 337 and MTH 354; 322 recommended.
Classification of grammars and their properties. BNF, trees, relations, top-down parsing, simple precedence grammars using matrix techniques.