92. Interpersonal Communication
Fall, 3(3-0) Theory and research in interpersonal communication. Role of communication in processes such as interpersonal influence and relationship development.

990. Independent Study
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to graduate students in Communication. Approval of department. Individualized study under faculty direction.

999. Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to Ph.D. students in Communication.

COMMUNICATION ARTS AND SCIENCES CAS

College of Communication Arts and Sciences

922. Interpersonal Communication
Fall, Spring, Summer. 3-0

923. Special Topics
Fall, Spring, Summ. 1 to 6 credits. A student may earn a maximum of 18 credits in all enrollments for this course. R: Open only to graduate students in Communication. Approval of department. Individualized study under faculty direction.

924. Communication Research
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 18 credits in all enrollments for this course. R: Open only to Ph.D. students in Communication. Participation in faculty research projects.

925. Communication Theory
Fall, Spring, Summ. 3-0

926. Communication Process
Fall, Spring, Summer. 3-0

927. Communication and Society
Fall, Spring, Summer. 3-0

928. Communication and Technology
Fall, Spring, Summer. 3-0

929. Communication and Public Opinion
Fall, Spring, Summer. 3-0

930. Communication and Social Change
Fall, Spring, Summer. 3-0

931. Communication and Political Behavior
Fall, Spring, Summer. 3-0

932. Communication and Law
Fall, Spring, Summer. 3-0

933. Communication and Health
Fall, Spring, Summer. 3-0

934. Communication and Business
Fall, Spring, Summer. 3-0

935. Communication and the Environment
Fall, Spring, Summer. 3-0

936. Communication and the Media
Fall, Spring, Summer. 3-0

937. Communication and the Law
Fall, Spring, Summer. 3-0

938. Communication and the Economy
Fall, Spring, Summer. 3-0

939. Communication and the State
Fall, Spring, Summer. 3-0

940. Communication and the Individual
Fall, Spring, Summer. 3-0

941. Communication and the Group
Fall, Spring, Summer. 3-0

942. Communication and the Organization
Fall, Spring, Summer. 3-0

943. Communication and the Global Society
Fall, Spring, Summer. 3-0

944. Communication and the Human Experience
Fall, Spring, Summer. 3-0

945. Communication and the Human Condition
Fall, Spring, Summer. 3-0

946. Communication and the Human Experience
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990. Independent Study
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to graduate students in Communication. Approval of department. Individualized study under faculty direction.

999. Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to Ph.D. students in Communication.

COMPUTER SCIENCE AND ENGINEERING CSE

Department of Computer Science and Engineering
College of Engineering

101. Computing Concepts and Competencies
Fall, Spring, Summer. 3(2-2) Core concepts in computing including information storage, retrieval, management, and representation. Applications from specific disciplines. Applying core concepts to design and implement solutions to various focal problems, using hardware, multimedia software, communication and networks.

131. Introduction to Technical Computing
Fall, Spring. 3(2-2) Use of computing systems for technical communications and problem solving in engineering, mathematics, and science. Development and use of mathematical models suitable for computer representation, solution, graphical display, and animation.

231. Introduction to Programming I
Fall, Spring. 4(3-2) P: (CSE 131) R: Open only to students in the Department of Computer Science and Engineering or Computer Engineering majors or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.

232. Introduction to Programming II
Fall, Spring. 4(3-2) P: (CSE 231) Continuation of object-centered programming using C++, development of classes and reliable software. Data structures and their encapsulation; stacks, queues, lists, trees, and hash tables. Algorithms operating on data structures. Object-oriented design and programming.

260. Discrete Structures in Computer Science

290. Independent Study in Computer Science
Fall, Spring. 1 credit. A student may earn a maximum of 3 credits in all enrollments for this course. R: Approval of department; application required. Supervised individual study in an area of computer science.

301. Algorithms and Data Structures
Fall, Spring. 4(3-2) P: (CSE 232 and CSE 260) R: Open only to students in the Department of Computer Science and Engineering or Computer Engineering majors or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.

410. Operating Systems
Fall, Spring. 4(3-2) P: (CSE 232 and CSE 260) and (CSE 320 or ECE 331) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.

415. Computer Organization and Assembly Language Programming
Fall, Spring. 4(3-2) P: (CSE 232 and CSE 260) R: Open only to students in the Department of Computer Science and Engineering or Computer Engineering majors or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.

Computer Science and Engineering—Descriptions of Courses
Descriptions—Computer Science and Engineering of Courses

420. **Computer Architecture**
Fall, Spring. 4(3-2) P: (CSE 332 and CSE 260) and (CSE 331 and CSE 333) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.
Digital logic and sequential machine design. Computer organization, control unit and arithmetic logic unit implementation. Input-output, memory organization, parallel operations. Digital system simulation.
SA: CPS 420

422. **Computer Networks**
Fall, Spring. 4(2-2) P: (STT 351) and (CSE 320 or ECE 331) and (CSE 410 or concurrently) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.
Computer network architectures and models. Medium access control. Physical, data link, network, transport, and session layers. Local-area and wide-area networks.
SA: CPS 422

440. **Artificial Intelligence and Symbolic Programming**
Fall. 4(3-2) P: (CSE 331) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.
SA: CPS 440

450. **Translation of Programming Languages**
Spring. 4(3-2) P: (CSE 331) and (CSE 320 or ECE 331) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.
SA: CPS 450

452. **Organization of Programming Languages**
Fall. 4(3-2) P: (CSE 331) and (CSE 320 or ECE 331) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science coordinate major or the LBS Computer Science field of concentration or the Computer Science disciplinary minor.
Organization of programming languages including language processors, syntax, data types, sequence control, storage management. Comparison of language features from the functional, imperative, logical and object-oriented paradigms.
SA: CPS 452

460. **Computability and Formal Language Theory**
Fall, Spring. 4(3-2) P: (CSE 331) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.
Formal models of computation such as finite state automata, pushdown automata and Turing machines. Formal definitions of languages, problems, and language classes including recursive, recursively enumerable, regular, and context free languages. The relationships among various models of computation, language classes, and problems. Church's thesis and the limits of computability. Proofs of program properties including correctness.
SA: CSE 360

470. **Software Engineering**
Fall, Spring. 4(2-2) P: (CSE 331) and (CSE 320 or ECE 331) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.
Software life cycle including specification, design, coding, testing, and verification of a software product. Stepwise refinement and rapid prototyping. Software portability, reusability and maintenance.
SA: CPS 470

471. **Media Processing and Multimedia Computing**
Fall. 4(3-2) P: (CSE 320 and CSE 331) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.
Basic operations for processing images, video, and audio; devices for input and output; data formats and compression; tools for processing images and sound; multimedia authoring tools; applications.

472. **Computer Graphics**
Spring. 4(3-2) P: (MTH 314 and CSE 331) R: Open only to juniors or seniors or graduate students in the Department of Computer Science and Engineering or to juniors or seniors in the Computer Engineering major or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.
Graphics hardware. Fundamental algorithms. Two- and three-dimensional imaging geometry and transformations. Curve and surface design, rendering, shading, color, and animation.
SA: CPS 472

480. **Database Systems**
Spring. 4(3-2) P: (CSE 331) and (CSE 320 or ECE 331) R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary minor.
Storage of and access to physical databases including indexing, hashing, and range accesses. Data models, query languages, transaction processing, recovery techniques. Object-oriented and distributed database systems. Database design.
SA: CPS 480

490. **Independent Study in Computer Science**
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 3 credits in all enrollments for this course. R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major. Approval of department, application required. Supervised individual study in an area of computer science.
SA: CPS 490

491. **Selected Topics in Computer Science**
Fall, Spring. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open only to students in the Department of Computer Science and Engineering or the Computer Engineering major. Approval of department. Topics selected to supplement and enrich existing courses and lead to the development of new courses.
SA: CPS 491

498. **Collaborative Design (W)**
Fall, Spring. 4(2-4) P: (CSE 470) and two additional CSE 400-level courses.
Development of a comprehensive software and/or hardware solution to a problem in a team setting with emphasis on working with a client. Participation in a design cycle including specification, design, implementation, testing, maintenance, and documentation. Issues of professionalism, ethics, and communication.
SA: CSE 449, CSE 475, CSE 479

802. **Pattern Recognition and Analysis**
Spring. 4(4-0) P: CSE 330, MTH 314, STT 441. R: Open only to Computer Science or Electrical Engineering majors.
SA: CPS 802

803. **Computer Vision**
Fall. 3(3-0) P: (CSE 330 and MTH 314 and STT 351) R: Open only to Computer Science or Electrical Engineering majors.
SA: CPS 803

807. **Computer System Performance and Measurement**
Spring of odd years. 3(3-0) Interdepartmental with Electrical and Computer Engineering. P: CSE 410, STT 441. R: Open only to Computer Science or Electrical Engineering majors.
SA: CPS 807
808. Modelling and Discrete Simulation
Fall of even years. 3(3-0) Interdepartmental with Electrical and Computer Engineering. P: CSE 330, STT 441. R: Open only to Computer Science or Electrical Engineering majors.
SA: CPS 808

809. Algorithms and Their Hardware Implementation
Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering.
Arithmetic, signal processing, and image processing algorithms. Array structures: systolic architecture, data flow structure, neural network architecture. Performance analysis.
SA: CPS 809

812. Advanced Operating Systems
Spring. 3(3-0) P: (CSE 410 and CSE 420) R: Open only to Computer Science or Electrical Engineering majors.
Parallel and distributed operating systems. Load sharing, scheduling, reliability, recovery, memory management. Distributed file systems, distributed agreement, and object-oriented operating systems.
SA: CPS 812

813. Logic Design Principles
Fall. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering.
SA: CPS 813

814. Formal Methods in Software Development
Fall of odd years. 3(3-0) P: MTH 472. R: Open only to Computer Science or Electrical Engineering majors.
Formal specification languages, integrating verification with development. Design and the implementation of term project.
SA: CPS 814

820. Advanced Computer Architecture
Fall, Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. P: CSE 410, CSE 420. R: Open only to Computer Science or Electrical Engineering majors.
Instruction set architecture. Pipelining, vector processors, cache memory, high bandwidth memory design, virtual memory, input and output. Benchmarking techniques. New developments related to single CPU systems.
SA: CPS 820

822. Parallel Processing Computer Systems
Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. P: CSE 820. R: Open only to Computer Science or Electrical Engineering majors.
Massively parallel SIMD processors, multiprocessor architectures, interconnection networks, synchronization and communication. Memory and address space management, process management and scheduling. Parallel compilers, languages, performance evaluation.
SA: CPS 822

824. Advanced Computer Networks and Communications
Fall. 3(3-0) P: CSE 422 R: Open only to graduate students in the Department of Computer Science and Engineering.
Advanced topics in emerging computer networking technologies, including high-speed wide area networks and local area networks, wireless and mobile computing networks, optical networks, and multimedia networking.
SA: CPS 824

830. Design and Theory of Algorithms
Fall, Spring. 3(3-0) P: CSE 330, CSE 360. R: Open only to Computer Science or Electrical Engineering majors.
Analysis of algorithms. Algorithm design techniques. Efficient algorithms for classical problems. Intractable problems and techniques to handle them.
SA: CPS 830

835. Algorithmic Graph Theory
Fall. 3(3-0) P: CSE 330, CSE 360, MTH 314. R: Open only to Computer Science or Electrical Engineering majors.
Classical concepts in Graph Theory. Algorithmic aspects of graphs such as finding paths, network flow, spanning trees and matching.
SA: CPS 835

838. Design of Parallel Algorithms
Spring. 3(3-0) P: CSE 420, CSE 830. R: Open only to Computer Science or Electrical Engineering majors.
Current research topics and issues. Models of parallel computation. Implementation of algorithms on SIMD and MIMD machines. Relationship to VLSI.
SA: CPS 838

841. Artificial Intelligence
Fall. 3(3-0) P: CSE 440. R: Open only to Computer Science or Electrical Engineering majors.
types of intelligence, knowledge representation, cognitive models, goal-based systems, heuristic search and games, expert systems. Language understanding, robotics and computer vision, theorem proving and deductive systems, and learning.
SA: CPS 841

845. Knowledge-Based Systems (MTC)
Spring. 2 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. P: CSE 841. R: Open only to Computer Science or Electrical Engineering majors.
Research literature examining model-based reasoning, design, or diagnosis. Effectiveness and potential for future developments.
SA: CPS 845

846. Laboratory in Knowledge-Based Systems (MTC)
Summer. 3(1-1) A student may earn a maximum of 6 credits in all enrollments for this course. P: CSE 845. R: Open only to Computer Science or Electrical Engineering majors.
Development of a working model-based reasoning, design, diagnostic system. Design, implementation, and testing.
SA: CPS 846

860. Foundations of Computing
Fall. 3(3-0) P: CSE 360. R: Open only to Computer Science or Electrical Engineering majors.
SA: CPS 860

880. Advanced Database Systems
Fall. 3(3-0) P: CSE 480. R: Open only to Computer Science or Electrical Engineering majors.
Distributed and object-oriented databases and knowledgebase systems. Design theory, query optimization, and transaction processing.
SA: CPS 880

885. Artificial Neural Networks
Fall. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Electrical and Computer Engineering.
SA: CPS 885

890. Independent Study
Fall, Spring. Summer. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to Computer Science or Electrical Engineering majors. Approval of department.
Independent study of some topic, system, or language not covered in a regular course.
SA: CPS 890

891. Selected Topics
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to Computer Science or Electrical Engineering majors.
Selected topics in computer science of current interest and importance but not covered in a regular course.
SA: CPS 891

898. Master's Project
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to Computer Science majors. Approval of department.
Master's degree Plan B individual student project: original research, research replication, or survey and reporting on a topic such as system design and development, or system conversion or installation.
SA: CPS 898
999. Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 72 credits in all enrollments for this course. P: Open only to Computer Science majors.
Approval of department.
SA: CPS 999

902. Selected Topics in Recognition by Machine
Spring, 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. P: CSE 802, CSE 803. R: Open only to Computer Science or Electrical Engineering majors.
Advanced topics in pattern recognition and computer vision such as Markov random fields, modeling and recognition of three dimensional objects, and integration of visual modules.
SA: CPS 902

910. Selected Topics in Computer Networks and Distributed Systems
Spring of even years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. P: CSE 422, CSE 812. R: Open only to Computer Science or Electrical Engineering majors.
Advanced topics and developments in high-bandwidth computer networks, protocol engineering, and distributed computer systems.
SA: CPS 910

COUNSELING, EDUCATIONAL PSYCHOLOGY AND SPECIAL EDUCATION CEP

Department of Counseling, Educational Psychology and Special Education College of Education

150. Reflections on Learning
Fall, Spring, Summer. 3(3-0) Interdepartmental with Teacher Education. Administered by Teacher Education. Students' experiences as learners in comparison to psychological, sociological, and anthropological theories and assumptions about learning and teaching in and out of school.

SA: CEP 890

240. Diverse Learners in Multicultural Perspective
Fall, Spring, Summer. 3(2-2) Interdepartmental with Teacher Education. Not open to students with credit in TE 250.
Communicative, linguistic, physical, sensory, behavioral, affective, and cognitive differences in learning in multicultural classrooms. Factors that mediate access to knowledge.

260. Dynamics of Personal Adjustment
Fall, Spring, Summer. 3(3-0) Psychological theories of human adjustment. Implications for effective learning, self-development, and adaptation.

261. Substance Abuse
Summer. 3(3-0) Effects of mood-altering chemicals. Treatment approaches and resources. Special emphasis on adolescent users.

301. Introduction to Students With Mild Impairments (W)
Fall, Spring, Summer. 3(2-2) P: Completion of Tier I writing requirement. R: Open only to students admitted to the teacher certification program in emotional impairment or learning disabilities. Learning and emotional impairments. Characteristics, causes, educational approaches, theories, and issues pertaining to students with mild impairments.

341. American Sign Language and the Deaf Community
Fall, Spring. Orientation to deaf culture. Essential signing for those expecting to have intermittent contact with deaf adults.

440. Introduction to Educating Deaf Children (W)
Fall. 3(2-2) P: Completion of Tier I writing requirement. (CEP 442B) R: Open only to students admitted to the teacher certification program in deaf education or to master's students in the special education major. Political, social, methodological, historical, philosophical, and legal issues in educating deaf children and youth.
SA: CEP 840

441A. American Sign Language I
Fall, Spring. Summer. 3(3-0) P: (CEP 441) R: Not open to freshmen. Production, conversation, and grammatical analysis of American Sign Language.

441B. American Sign Language II
Fall, Spring. Summer. 3(3-0) P: (CEP 441A) More advanced lexical and syntactic structures of American Sign Language. Sentence types, verb inflections, aspect marking, and story telling. Translations between American Sign Language and English.