802   Survey of Research Methods
Spring. 3(3-0) R: Open only to graduate students in the Department of Community, Agriculture, Recreation and Resource Studies.

Methodological approaches and research techniques applied in multidisciplinary research in community, agriculture, recreation, and resources studies. Concepts and skills needed to interpret and evaluate published research.

895   Case Studies in Community, Agriculture, Recreation and Resource Studies
Spring. 3(3-0) P:M: (ACR 800 and ACR 802) R: Open only to graduate students in the Department of Community, Agriculture, Recreation and Resource Studies.

Case studies in community, agriculture, recreation and tourism, natural resources and environmental systems. Use of multi-disciplinary teams in addressing complex policy, planning, development, and management issues.

898   Master's Professional Project
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 master's students in the Department of Community, Agriculture, Recreation and Resource Studies.
Master's project, non-thesis research, practicum or other professional development capstone experiences.

899   Master's Thesis Research
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to master's students in the Department of Community, Agriculture, Recreation and Resource Studies.
Master's thesis research.

999   Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to doctoral students in the Department of Community, Agriculture, Recreation and Resource Studies.
Doctoral dissertation research.

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) SA: CPS 100, CPS 130
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.

103   Introduction to Databases in Information Technology
Fall, Spring, Summer. 3(2-2) P: (CSE101)
Core concepts in database organization and use. Information storage, retrieval, management, and representation. Application of database concepts to develop and implement solutions to various problems. Web-to-database issues inherent in e-commerce.

131   Technical Computing and Problem Solving
Fall, Spring. 3(1-3) P: (MTH 124 or concurrently or MTH 132 or concurrently or LBS 118 or concurrently) or (MTH 152H or concurrently) SA: CPS 131
Use of computing systems for technical problem solving in engineering and science.

231   Introduction to Programming I
Fall, Spring. 4(3-2) P: (LBS 118 or concurrently or MTH 124 or concurrently or MTH 132 or concurrently or MTH 152H or concurrently) RB: (CSE 131) SA: CSE 230
Introduction to object-centered programming using C++. Design, implementation and testing of programs to solve problems in engineering, mathematics and science. Programming fundamentals, functions, classes, arrays, and pointers.

232   Introduction to Programming II
Fall, Spring. 4(3-2) P: (CSE231) and (LBS118 or MTH124 or MTH132 or MTH152H) SA: CSE 330
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.

240   Informatics
Fall, Spring, Summer. 3(3-0) P: (CSE 103 or CSE 131 or CSE 231) and (MTH 103 or MTH 116 or MTH 124 or MTH 132 or LBS 117) or designated score on Mathematics placement test. R: Approval of department.
Digital representation of objects such as numbers, signals, and 3D shapes. Algorithms that operate on digital objects. Storage devices and network distribution of digital objects. How information systems support various applications.

260   Discrete Structures in Computer Science
Fall, Spring. 4(4-0) P: (MTH 133 or MTH 126 or MTH 153H or LBS 119) SA: CPS 260
Propositional and first order logic. Equivalence and methods of proof. Basics of counting. Set operations, relations, functions. Grammars and finite state automata. Discrete probability. Applications to computer science and engineering.

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. SA: CPS 290
Supervised individual study in an area of computer science.

291   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: Approval of department. SA: CPS 291
Topics selected to supplement and enrich existing courses and lead to the development of new courses.

320   Computer Organization and Architecture
Fall, Spring. 3(3-0) P: (CSE 232 and CSE 260) SA: CPS 320 Not open to students with credit in ECE 331.
Boolean algebra and digital logic. Combinational and sequential circuits. Representations of data and instructions. Architecture and major components of computer systems. Assembly language programming and interfacing to high level languages. Assembler and linker processing.

331   Algorithms and Data Structures
Fall, Spring. 3(3-0) 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.
Linear data structures, trees, graphs and algorithms which operate on them. Fundamental algorithms for searching, sorting, string matching, graph problems. Design and analysis of algorithms.

335   Object-oriented Software Design
Fall, Spring. 3(3-0) P: (CSE 232 and CSE 260) R: Open only to students in Computer Science or Computer Engineering or the LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary minor. SA: CSE 370
Development of large software products, libraries, and product families. Object-oriented programming using inheritance and polymorphism. Design methods. Specification and the use of contracts to design reliable software. Configuration management and life-cycle issues.

410   Operating Systems
Fall, Spring. 3(3-0) 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. SA: CPS 410
Principles and evolution of operating systems. Process and processor management. Concurrent processes and threads. Primary and secondary storage management. Case studies of modern operating systems.

420   Computer Architecture
Fall, Spring. 3(3-0) 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. SA: CPS 420
Organization and architecture of computer systems. Arithmetic Logic Unit and control unit implementations. Hardwired and microprogrammed control. Pipelined processors; data and branch hazards. Memory hierarchy and storage devices. Input-output and peripheral devices. Advanced architectures.

422   Computer Networks
Fall, Spring. 3(3-0) P: (STT 351 or ECE 280) and (CSE 320 or ECE 331) and (CSE 410 or concurrently) R: Open only to students in the Department of Computer Science or the Computer Engineering or LBS Computer Science major or the LBS Computer Science coordinate major or the Computer Science disciplinary minor. SA: CPS 422

Computer network architectures and models. Physical media and signaling. Data link protocols. Medium access control. Routing and IP. Transport services including TCP/UDP. Network applications. Local-area and wide-area networks.

435   Software Engineering
Fall. 3(3-0) P: (CSE 320 and CSE 331 and CSE 335) R: Open only to students in the Department of Computer Science or the Computer Engineering or LBS Computer Science major or the LBS Computer Science coordinate major or the Computer Science disciplinary minor. SA: CSE 470

Software lifecycle including specification, design, coding, testing, and verification of a software product. Stepwise refinement and traceability. Software maintenance and documentation.

440   Introduction to Artificial Intelligence
Fall. 3(3-0) P: (CSE 331 or CSE 335) 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

Fundamental issues in intelligent systems. Knowledge representation and mechanisms of reasoning. Search and constraint satisfaction. Agents. Application areas of AI and current topics.

444   Information Technology Project Management
Spring. 3(3-0) Interdepartmental with Information Technology Management; Telecommunication. Administered by The Eli Broad College of Business. P: (ITM 311) R: Open only to seniors in the Specialization in Information Technology.

Practical training and experiences in design, testing, and launch of new information technologies and systems.

450   Translation of Programming Languages
Spring. 3(3-0) P: (CSE 331 or CSE 335) 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 LBS Computer Science field of concentration or the LBS Computer Science coordinate major or the Computer Science disciplinary minor. SA: CPS 450

Theory and practice of programming language translation. Languages, grammars and parsing. Lexical, syntactic and semantic analysis. Compile-time error handling. Code optimization and code generation.

452   Organization of Programming Languages
Fall, Spring. 3(3-0) P: (CSE 331 or CSE 335) and (CSE 320 or ECE 331) R: Open only to students in the Department of Computer Science and Engineering or Computer Engineering major or the LBS Computer Science coordinate major or the LBS Computer Science field of concentration or the Computer Science disciplinary minor. SA: CPS 452

Organization of programming languages. Type systems. Alternative execution models. Comparison of language features: functional, imperative, logical and object-oriented.

460   Computability and Formal Language Theory
Fall, Spring. 3(3-0) P: (CSE 331) R: Open only to students in the Department of Computer Science and Engineering or Computer Engineering major or LBS Computer Science coordinate major or the LBS Computer Science field of concentration or the Computer Science disciplinary minor. SA: CSE 360

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.

471   Media Processing and Multimedia Computing
Fall. 3(3-0) P: (CSE 320) and (CSE 331 or CSE 335) R: Open only to students in the Department of Computer Science and Engineering or 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. 3(3-0) P: (MTH 314) and (CSE 331 or CSE 335) 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. SA: CPS 472

Graphics systems. Two- and three-dimensional imaging geometry and transformations. Curve and surface design. Rendering, shading, color, and animation. Graphics programming.

475   Introduction to Computational Linguistics
Fall. 3(3-0) Interdepartmental with Linguistics. Administered by Department of Linguistics and Germanic, Slavic, Asian and African Languages. P: (CSE 232 and LIN 401)

Computer science of linguistic theories and their application in natural language processing systems. Stochastic and categorical automata for morphological analysis. Rule systems for grammars. Parsing algorithms for syntactic and semantic analysis, with implications for cognitive models of human sentence processing. Probabilistic models of linguistic events.

480   Database Systems
Spring. 3(3-0) 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 480

Storage of and access to physical databases including indexing, hashing, and range accesses. Relational data models, database design principles, query languages, query optimization, transaction processing and recovery techniques. Object-oriented and distributed databases.

490   Independent Study in Computer Science
Fall, Spring. 1 to 3 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 or the Computer Engineering major. Approval of department; application required. SA: CPS 490

Supervised individual study in an area of computer science.

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 or the Computer Engineering major. Approval of department. SA: CPS 491

Topics selected to supplement and enrich existing courses and lead to the development of new courses.

498   Collaborative Design (W)
Fall, Spring. 4(2-4) P: (CSE 335 and CSE 410) and (CSE 420 or CSE 422 or CSE 435 or CSE 440 or CSE 450 or CSE 452 or CSE 460 or CSE 471 or CSE 472 or CSE480) and completion of Tier I writing requirement. R: Open only to majors in the Department of Computer Science and Engineering. SA: CSE 449, CSE 478, CSE 479

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.

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

Algorithms for classifying and understanding data. Statistical and syntactic methods, supervised and unsupervised machine learning. Cluster analysis and ordination. Exploratory data analysis. Methodology for design of classifiers.

803   Computer Vision
Fall. 3(3-0) RB: (CSE 331 and MTH 314 and STT 351) R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 803

Visual information processing problems. Human and machine vision systems. Image formation and transforms. Encoding, enhancement, edge detection, segmentation. 2D and 3D object description and recognition. Scene analysis. Applications.

Computer Science and Engineering—CSE

807   Computer System Performance and Measurement
Spring of odd years. 3(3-0) Interdepartmental with Electrical and Computer Engineering. RB: (CSE 410 and STT 441) R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 807

Queueing network modelling, general analytic techniques, workload characterization, representing specific subsystems, parameterization. Software and hardware monitors, performance measures. Case studies, software packages.

808   Modelling and Discrete Simulation
Spring of even years. 3(3-0) Interdepartmental with Electrical and Computer Engineering. RB: (CSE 232 and STT 441) R: Open only to majors in Computer Science and Engineering or approval of department. SA: CPS 808

Simulation examples and languages. Mathematical models, petri nets, model validation, random variate generation. Analysis of simulation data. Case studies.

809   Algorithms and Hardware Implementation
Fall. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Department of Electrical and Computer Engineering. SA: EE 809

Arithmetic, signal processing, and image processing algorithms. Array structures: systolic architecture, data flow structure, neural network architecture. Performance analysis.

812   Advanced Operating Systems
Spring. 3(3-0) RB: (CSE 410 and CSE 420) R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 812

Parallel and distributed operating systems. Load sharing, scheduling, reliability, recovery, memory management. Distributed file systems, distributed agreement, and object-oriented operating systems.

813   Advanced VLSI Design
Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Department of Electrical and Computer Engineering. P:M: (ECE 410) SA: EE 813

Advanced topics in digital integrated circuit design. Design specifications: functionality, performance, reliability, manufacturability, testability, cost. Standard cells. Design-rule checking. Circuit extraction, simulation, verification. Team-based design.

814   Formal Methods in Software Development
Fall of odd years. 3(3-0) RB: (MTH 472) R: Open only to majors in the Department of Computer Science and Engineering or approval of department. SA: CPS 814

Formal specification languages, integrating verification with development. Design and the implementation of term project.

820   Advanced Computer Architecture
Fall, Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. RB: (CSE 410 and CSE 420) R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 820

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.

822   Parallel Processing Computer Systems
Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. RB: (CSE 820) R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 822

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.

824   Advanced Computer Networks and Communications
Fall. 3(3-0) RB: (CSE 422) R: Open only to graduate students in the Department of Computer Science. SA: CPS 824

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.

825   Computer and Network Security
Spring. 3(3-0) RB: (CSE 410 and CSE 422)

Threat assessments, secure software, intrusions and intrusion detection.

830   Design and Theory of Algorithms
Fall, Spring. 3(3-0) RB: (CSE 232 and CSE 460) R: Open only to majors in the Department of Computer Science and Engineering or approval of department. SA: CPS 830

Analysis of algorithms. Algorithm design techniques. Efficient algorithms for classical problems. Intractable problems and techniques to handle them.

835   Algorithmic Graph Theory
Fall. 3(3-0) RB: (CSE 232 and CSE 460 and MTH 314) R: Open only to majors in the Department of Computer Science and Engineering or approval of department SA: CPS 835

Classical concepts in Graph Theory. Algorithmic aspects of graphs such as finding paths, network flow, spanning trees and matching.

838   Design of Parallel Algorithms
Spring. 3(3-0) RB: (CSE 420 and CSE 830) R: Open only to majors in the Department of Computer Science and Engineering or approval of department. SA: CPS 838

Current research topics and issues. Models of parallel computation. Implementation of algorithms on SIMD and MIMD machines. Relationship to VLSI.

841   Artificial Intelligence
Fall. 3(3-0) RB: (CSE 440) R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 841

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.

847   Machine Learning
Spring. 3(3-0) P:M: (CSE 841) RB: Algorithms, programming in C or equivalent, probability and statistics, artificial intelligence. R: Open only to students in the Department of Computer Science and Engineering or approval of department.

Computational study of learning and data mining. Strengths and limitations of various learning paradigms, including supervised learning, learning from scalar reward, unsupervised learning, and learning with domain knowledge.

848   Evolutionary Computation
Fall of even years. 3(3-0) RB: (CSE 841 and CSE 440) R: Open only to students in the Department of Computer Science and Engineering or approval of department.

Investigation of evolutionary computation from a historical, theoretical and application viewpoint. Readings from the present literature, experiments with provided software on the application of evolutionary computation principles.

860   Foundations of Computing
Spring of even years. 3(3-0) RB: (CSE 460) R: Open only to majors in the Department of Computer Science and Engineering or approval of department. SA: CPS 860

Models of computation: partial recursive functions, Turing machines, alternative models of computing. Basic theory and limitations of computability. Undecidability. Resource-bounded computational complexity, non-determinism, NP-completeness.

867   Nature and Practice of Cognitive Science
Spring. 3(3-0) Interdepartmental with Zoology; Psychology; Linguistics; Philosophy. Administered by Department of Zoology. RB: Undergraduate course work in behavioral biology, cognitive psychology, philosophy, linguistics, or artificial intelligence.

Survey of how different disciplines explore the cognitive processes underlying intelligent behavior.

870   Advanced Software Engineering
Spring. 3(3-0) RB: (CSE 470) Undergraduate software engineering course R: Open only to students in the Department of Computer Science and Engineering.

Methods and techniques supporting later lifecycle activities, including software testing and maintenance, reuse, and reverse engineering. Domain-specific software engineering methods. Human-computer interfaces, distributed systems, and visualization techniques.

875   Advanced Computational Linguistics
Spring. 3(3-0) Interdepartmental with Linguistics. Administered by Department of Linguistics and Germanic, Slavic, Asian and African Languages. P:M: (LIN 475)

Cutting-edge research in computational linguistics. Expressive formalisms such as tree-adjoining, type-logical and multi-component string grammars, and their associated parsing and learning problems. Robustness for spoken language understanding. Mathematical theories of language learnability. Logic and probability of finite state techniques.

880   Advanced Database Systems
Fall. 3(3-0) RB: (CSE 480) R: Open only to majors in the Department of Computer Science and Engineering or approval of department. SA: CPS 880

Distributed and object-oriented databases and knowledgebase systems. Design theory, query optimization, and transaction processing.

881   Data Mining
Fall. 3(3-0) RB: Programming skills in C, C++, Java and Matlab. Basic knowledge in calculus, probability and statistics.

Techniques and algorithms for knowledge discovery in databases, from data preprocessing and transformation to model validation and post-processing. Core concepts include association analysis, sequential pattern discovery, anomaly detection, predictive modeling, and cluster analysis. Application of data mining to various application domains.

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

Overview of neuro-engineering technology. Basic neural network architectures. Feedforward and feedback networks. Temporal modeling. Supervised and unsupervised learning. Implementation. Basic applications to pattern recognition.

890   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 Computer Science or Electrical Engineering majors. Approval of department. SA: CPS 890

Independent study of some topic, system, or language not covered in a regular course.

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. SA: CPS 891

Selected topics in computer science of current interest and importance but not covered in a regular course.

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. SA: CPS 898

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.

899   Master's Thesis Research
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 24 credits in all enrollments for this course. R: Open only to Computer Science majors. Approval of department. SA: CPS 899

Master's thesis research.

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. RB: (CSE 802 and CSE 803) R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 902

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.

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. RB: (CSE 422 and CSE 812) R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 910

Advanced topics and developments in high-bandwidth computer networks, protocol engineering, and distributed computer systems.

914   Formal Methods in Software Development
Fall. 3(3-0) P:M: (CSE 814) RB: Undergraduate courses in software engineering and in logic. R: Open only to students in the Department of Computer Science and Engineering. SA: CPS 914

Current research in selected areas of software engineering such as: approaches for the incorporation of formal methods in software development; current projects using formal methods in software engineering; object-oriented analysis and development techniques; and approaches for the incorporation of user-interface analysis and design in software development.

920   Selected Topics in High Performance Computer Systems
Spring of odd years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. P:M: (CSE 822) R: Open only to Computer Science and Engineering majors or approval of Department. SA: CPS 920

Design of high performance computer systems. Seminar format.

921   Advanced Topics in Digital Circuits and Systems
Fall, Spring. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. Interdepartmental with Electrical and Computer Engineering. Administered by Department of Electrical and Computer Engineering. SA: EE 921

Topics vary each semester.

921A   Testable and Fault-tolerant Digital Systems
Fall of odd years. Spring of odd years. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Department of Electrical and Computer Engineering. RB: (ECE 809 and ECE 813) SA: EE 921A

Reliability evaluation. Fault models and test pattern generation. Design for testability. Fault-tolerant design techniques, self-checking circuits and systems, system diagnosis and reconfiguration.

921B   Embedded Architectures
Fall of odd years. Spring of odd years. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Department of Electrical and Computer Engineering. RB: (ECE 809 and ECE 813) SA: EE 921B

Embedded computers and architectures for real-time computation and/or robust control. ASICs. Bit-slice architectures. Systolic arrays. Neural networks. Genetic algorithms. Implementation technologies and design issues.

921C   Electronic Systems Packaging
Fall of odd years. Spring of odd years. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Department of Electrical and Computer Engineering. RB: A basic background in electronics and electromagnetics.

VLSI packaging technology, thermal management, electrical design, switching noise, multi-chip packaging, materials, device assembly, RF device packaging, and electrical testing.

941   Selected Topics in Artificial Intelligence
Fall. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. RB: (CSE 841) R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 941

Topic such as second generation expert systems, human factors, natural language processing, speech understanding, neural networks, genetic algorithms and opportunistic planning.

960   Selected Topics in Algorithms and Complexity
Spring of odd years. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. RB: (CSE 830 and CSE 860) R: Open only to graduate students in the Department of Computer Science and Engineering. Approval of department. SA: CPS 960

Current research in the general theory of algorithms and computational complexity.

980   Selected Topics in Database Systems
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. RB: (CSE 880) R: Open only to Computer Science or Electrical Engineering majors. SA: CPS 980

Recent developments in areas such as distributed and parallel database systems, object oriented database systems, knowledgebase and expert database systems.

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 Computer Science majors. Approval of department. SA: CPS 999

Doctoral dissertation research.

COUNSELING, CEP EDUCATIONAL PSYCHOLOGY AND SPECIAL EDUCATION

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 Department of 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.

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.