

# Computer Engineering (CPE)

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## CPE 512 - INTRO PARALLEL PROGRAMMING

Semester Hours: 3

Introduction to processing in parallel and distributed computing environments. General concepts of parallel machine models, processes, mutual exclusion, process synchronization, message passing, and programming languages for parallel computing and scheduling. Design and analysis of parallel algorithms. Parallel programming environments: Pthreads for shared memory multiprocessor systems and PVM/MPI for distributed networked computers.

## CPE 523 - HARDWARE/SOFTWARE CO-DESIGN

Semester Hours: 3

Study and design of Systems On a Chip (SOC). Emphasis on Field Programmable realizations of SOC systems. Prerequisite: CPE 522 or CPE 526.

## CPE 526 - VLSI HARDWARE DESC LANG/MODL/S

Semester Hours: 3

Modern VLSI design techniques and tools, such as silicon compilers, (V)HDL modeling languages, placement and routing tools, synthesis tools, and simulators. Students will design, simulate, and layout using both programmable logic families and ASIC libraries.

## CPE 527 - VLSI DESIGN I

Semester Hours: 3

Introduction to VLSI design using CAD tools, CMOS logic, switch level modeling, circuit characterization, logic design in CMOS, systems design methods, test subsystem design, design examples, student design project. Design project to be fabricated and tested in CPE 528. Students enrolling in CPE 527 must enroll concurrently in CPE 527L.

## CPE 527L - LABORATORY

Semester Hours: 0

Students enrolling in CPE 527L must enroll concurrently in CPE 527.

## CPE 528 - VLSI DESIGN II

Semester Hours: 3

Advanced experience with CAD tools for VLSI design, IC testing. Design project from CPE 527 will be fabricated and tested. Implementation and verification of test programs, IC testing and troubleshooting, legal, economic, and ethical design issues. Oral presentations and written reports are required. Students enrolling in CPE 528 must enroll concurrently in CPE 528L.

## CPE 528L - LABORATORY

Semester Hours: 0

Students enrolling in CPE 528L must enroll concurrently in CPE 528.

## CPE 531 - INTRO COMPUTER ARCHITECTURE

Semester Hours: 3

Existing computer structures. Computer organization with emphasis on busing systems, storage systems, and instruction sets. Special purpose architecture, performance models and measures, VLSI influence on architecture.

## CPE 534 - OPERATING SYSTEMS

Semester Hours: 3

Study of the fundamentals of operating systems. Emphasis on processes, file management, interprocess communication, input-output, virtual memory, networking and security.

## CPE 536 - INTERNALS OF MODERN OPER SYS

Semester Hours: 3

In depth study of the design of modern operating systems such as Unix, NT, and Linux. Emphasis on the internals and implementation details of interrupt processing, real-time clocks, device independent I/O, process management, memory management, file management.

## CPE 538 - REAL TIME & EMBEDDED SYSTEMS

Semester Hours: 3

Study of design methodologies for reliable real time systems.

CPE 549 - INTRO TO CYBERSECURITY ENGINRG

Semester Hours: 3

Introduction to cryptography and computer security through hardware and physical security to a knowledge of audit methods, security management, and public law. The course will introduce security engineering skills such as business process analysis, software security, IAE evaluation, and IAE testing.

Prerequisite: CPE 548.

CPE 549L - INTRO CYBERSECURITY ENG LAB

Semester Hours: 0

Students enrolling in CPE 549 must enroll concurrently in CPE 549L.

CPE 561 - TRANSLATION SYSTEMS

Semester Hours: 3

Grammars, parsers, and lexical analyzers; implementation of translators via top-down and bottom up techniques; grammar analysis to identify ambiguities. Practical applications of translators including conversion of file formats and compilation of traditional computer languages.

CPE 590 - SPECIAL TOPICS IN COMP ENGR

Semester Hours: 1-3

CPE 590L - SELECTED TOPICS LABORATORY

Semester Hours: 0

CPE 601 - SURVEY INFORMATION ASSURANCE

Semester Hour: 1

CPE 610 - SELECTED TOPICS IN COMPUTER EN

Semester Hours: 1-6

CPE 612 - PARALLEL ALGORITHMS

Semester Hours: 3

Introduction to metrics describing the performance and scalability of parallel algorithms. Performance analysis of parallel algorithms for performing sorting, matrix multiplication, solving linear equations, and FFT.

CPE 613 - GEN PURPOSE GPU COMPUTING

Semester Hours: 3

The focus of this course is to introduce emerging techniques and programming paradigms that can be used to accelerate the processing speed of scientific and other high performance applications using Graphics Processing Units, GPUs. GPUs represent low-cost highly parallel video processing hardware that can be programmed for general purpose applications using UDA/OpenCL software architecture. The course will survey the current state of research and industrial activity and will give student's hands-on experience implementing designapplications on real-world GPU facilities for a wide range of scientific applications. Prerequisite: CPE 512.

CPE 619 - MODELING & ANAL COMPU/COMMUN S

Semester Hours: 3

Modeling of single and multiprocessor systems, single and multi-stage interconnection networks, Computer Networks. Analysis using Stochastic processes, Markov and Queuing techniques. Modeling using Petri Nets and Finite State models. Prerequisite: EE 500 or MA 585.

CPE 621 - ADVANCED EMBEDDED SYSTEMS

Semester Hours: 3

Deeply embedded low-power wireless sensors. Low-power microcontroller architectures, sensor platform architecture, wireless intelligent sensors, low power wireless communication standards, battery powered systems, resource constrained operating systems, data aggregation/sensor synergy, and collaborative signal processing.

CPE 625 - CMOS ANALOG CIRCUIT DESIGN

Semester Hours: 3

Analog circuit design in CMOS technology. CMOS processing technology. MOS transistor modeling. Basic current mirrors and single-stage amplifiers. Noise analysis and modeling. Basic OPAMP design and compensation. Advanced current mirrors and OPAMPS. Bandgap references. Oscillators. CMOS technology characterization for radio-frequency (RF) design.

CPE 626 - ADVANCED VLSI DESIGN

Semester Hours: 3

Advanced VLSI Design. Case study of the VLSI design of a modern RISC processor using a Hardware Description Language. Prerequisite: CPE 526.

**CPE 628 - TESTING OF HARDWARE SYSTEMS**

Semester Hours: 3

Introduction to testing of digital electronic circuits and systems. Topics include: fault modeling, testing problems, testing schemes, test generation for combinational and sequential circuits, the complexity of testing, design for testability, built-in self-testing and boundary scan.

**CPE 631 - ADV COMP SYSTEMS ARCHITECTURE**

Semester Hours: 3

Study of architectural features of modern processors, including cache memories and memory systems, pipeline designs, branch prediction techniques. Design of superscalar, multithreaded VLIW processors, code optimization for such systems will be studied. Quantitative evaluation of architectural features are emphasized throughout the course. Prerequisite: CPE 512 and CPE 531.

**CPE 633 - FULT-TOLERANT COMPUTING SYSTEM**

Semester Hours: 3

Analysis and design of very high reliability and availability systems. Fault types, reliability techniques, and maintenance techniques. Case studies of high-availability long-life, life-critical systems. Both hardware and software techniques for achieving fault-tolerance will be studied.

**CPE 635 - SYSTOLIC ARRAY PROCESSING**

Semester Hours: 3

Systolic structure of fast algorithms and switchable array realizations.

**CPE 641 - DATA & DIGITAL COMMUNICATIONS**

Semester Hours: 3

Introduction to digital and data communications; transmission channels; modulation and coding; telephone networks; data communication standards; noise and distortion; computer interfacing; protocols.

**CPE 643 - OPTICAL COMMUNICATIONS**

Semester Hours: 3

**CPE 645 - COMPUTER NETWORK SECURITY**

Semester Hours: 3

Principles and concepts of computer network security. Introduction to cryptography, confidentiality, authentication, digital signatures, E-mail security, IP security, web security, intruders, malicious software, firewall, and other network security-related issues. Prerequisite: CPE 548.

**CPE 646 - MOBILE & WIRELESS NETWORKS**

Semester Hours: 3

High-level issues in mobile and wireless networks. The main topics are mobile IP, mobile Ad hoc NETWORKS (MANETS) wireless sensor networks, wireless LAN, Bluetooth, cellular networks, satellite systems and security issues in mobiles and wireless networks. Prerequisite: CPE 548.

**CPE 647 - UBIQUITOUS COMPUTING**

Semester Hours: 3

The course is based on the new "anytime, anywhere" computing paradigm, also known as ubiquitous computing. This course is project oriented, and explores issues of mobile, wireless, and distributed computing in Internet environment, advanced human-computer interfaces, and power efficient computing.

**CPE 648 - ADVANCED COMPUTER NETWORKS**

Semester Hours: 3

Advanced principles and concepts of general-purpose computer networks, with a special emphasis to internetworking and Internet. Transport and higher level protocols emphasis. Programming issues. High-speed networking, congestion control, data compression, security and distributed processing will be covered. Prerequisite: CPE 548.

**CPE 649 - ADV CYBERSECURITY ENGINEERING**

Semester Hours: 3

Introduction to topics ranging from how to attack computer systems and networks to how to protect and recover from attacks on computer systems and networks. Basic process utilized by computer attackers in order to develop a complete understanding and appreciation of the threat to information assurance. Process of detecting, preventing, and recovering from information assurance attacks. Intrusion Detection and Prevention Systems, Auditing, Security Vulnerability Assessments, and the Incident Response process. Prerequisite: CPE 549.

**CPE 649L - ADV CYBERSECURITY ENG LAB**

Semester Hours: 0

Students enrolling CPE 649 must enroll concurrently in CPE 649L.

CPE 656 - SOFTWARE ENGRG STUDIO I

Semester Hours: 3

This is the first course in a two course studio series required for the MSSE degree in the College of Engineering. Students will work in small design teams on medium sized software projects. Activities include developing requirements, designing and constructing system prototypes, developing and implementing test and verification plans, and presenting the project for evaluation. The practice of software design and evaluation will be conducted in an iterative cycle using best software engineering practices, so that design and execution can be refined over the lifecycle of the project. Prerequisite: CS 650.

CPE 658 - SOFTWARE ENGRG STUDIO II

Semester Hours: 3

This is the second course in a two course studio series required for the MSSE degree in the College of Engineering. Students will work in small design teams on medium sized software projects. Activities include developing requirements, designing and constructing system prototypes, developing and implementing test and verification plans, and presenting the project for evaluation. The practice of software design and evaluation will be conducted in an iterative cycle using best software engineering practices, so that design and execution can be refined over the lifecycle of the project. Prerequisite: CPE 656.

CPE 690 - SELECTED TOPICS COMPUTER ENGRG

Semester Hours: 1-6

CPE 692 - CYBERSECURITY CAPSTONE

Semester Hours: 3

A capstone course emphasizing the intergration of various principles, theories, and techniques for developing, implementing and using cybersecurity strategies and applications in organizations. Includes readings, lectures, tours, situation analysis, cases, and the completion of a major practical project. Normally taken in the last semester of a student's program. Minimum grade B required. Prerequisites: CS, 585, CPE 549, IS 660, IS 663.

CPE 695 - PROJECTS IN COMPUTER ENGRG

Semester Hours: 3

CPE 699 - MASTER'S THESIS

Semester Hours: 1-9

Required each semester student is working and receiving direction on a master's thesis. Minimum of two semesters and 6 hours required for M.S.E. students. A maximum of 9 hours credit is awarded upon successful completion of master's thesis. The 1 hour option is only available to students who have successfully defended their thesis and submitted it for approval, but do not meet the deadlines for graduation in the semester submitted. Students may only use the 1 hour option once in their career.

CPE 710 - SEL TOPICS IN PARALLEL PROC

Semester Hours: 3

CPE 715 - SELECTED TOPICS IN COMPUTAT TH

Semester Hours: 3

CPE 720 - SELECTED TOPICS IN VLSI DESIGN

Semester Hours: 3

Prerequisite: CPE 626.

CPE 726 - ALGORITHMS FOR VLSI DESIGN TOO

Semester Hours: 3

Tools for VLSI Design. This course is concerned with the algorithms found in VLSI design tools.

CPE 730 - SELECTED TOPICS IN COMPUTER SY

Semester Hours: 3

Prerequisite: CPE 631.

CPE 731 - DISTRIBUTED SHARED MEMORY SYS

Semester Hours: 3

Study issues related to performance, granularity of sharing, multithreading, cache coherence, memory consistency models, pull vs push cacheing, false sharing, thread migration. Case studies systems, including DASH, FLASH ThreadMarks, SHRIMP, Calypso, Alewife to understand these issues.

CPE 735 - SELECTED TOPICS IN OPERATING S

Semester Hours: 3

**CPE 740 - SPEC TOPICS COMPUTER NETWORKS**

Semester Hours: 3

Prerequisite: CPE 648.

**CPE 742 - PARALLEL PROCESS DESIGN**

Semester Hours: 3

**CPE 748 - MOBILE & WIRELESS NETWORKS**

Semester Hours: 3

High-level issues in mobile and wireless networks. The main topics are mobile IP, Mobile Ad hoc NETWORKS (MANETs), wireless sensor networks, wireless LAN, Bluetooth, cellular networks, satellite systems, and security issues in mobiles and wireless networks. Prerequisite: CPE 648 or CS 670.

**CPE 760 - SEL TOPICS COMPILER/TRANSLATORS**

Semester Hours: 3

**CPE 790 - SEL TOPICS COMPUTER ENGRG**

Semester Hours: 1-6

**CPE 795 - RESEARCH IN COMPUTER ENGRG**

Semester Hours: 1-6

**CPE 799 - DOCTORAL DISSERTATION**

Semester Hours: 3-9

Required each semester student is enrolled and receiving direction on doctoral dissertation.