CMPE 261
Digital Logic Design
Credit Hours: 3

Introduction to digital logic circuit design, combinational and sequential circuits. TTL logic family; combinational logic design; logic minimization techniques; logic implementation techniques for ROM, RAM, EPROM, and PLDs, flip flops; sequential logic design, state diagrams, logic minimization; registers and counters; synthesis and analysis of sequential machines.

Prerequisite:
CMPS 205 AND CMPE 262 Concur.

CMPE 262
Digital Logic Design Laboratory
Credit Hours: 1

Selected experiments examining logic devices and circuits, a final design project to accompany and complement the lecture course.

Prerequisite:
CMPE 261 Concur.

CMPE 263
Computer Architecture & Organization I
Credit Hours: 3

Higher-level concepts in computer architecture. Data representation; classic components of a computer; performance measures for computers; CPU types, design, organization, instruction-level description; processor programming, register transfer languages, addressing modes, assembly language; main and cache memory, caching techniques.

Prerequisite:
CMPS 205 AND CMPS 151

CMPE 363
Computer Architecture & Organization II
Credit Hours: 3

Fundamentals of computer organization. Central processing unit organization; hardwired control; arithmetic logic unit design and implementation; micro- programmed control, interrupts; instruction cycle and format, addressing modes; buses, pipelining, instruction-level parallelism; input/output system design; external storage.

Prerequisite:
CMPE 263 AND CMPE 261

CMPE 364
Microprocessor Based Design
Credit Hours: 3

Fundamentals and evolution of microprocessors. Architecture of a 16-bit microprocessor, assembly language and its development tools; data transfer; arithmetic logic, program control instructions; interrupt organization; memory interface and address decoding; input/output, programmable peripheral, serial input/output interfacing; universal synchronous and asynchronous receivers and transmitters; hardware interrupts, basic interrupt interface, programmable interrupt controllers; analog-digital converters; 32-bit programming.

Prerequisite:
CMPE 363 AND CMPE 365 Concur.

CMPE 365
Microprocessor Based Design Laboratory
Credit Hours: 1

Experiments to emphasize the practice of assembly language programming, data acquisition software techniques, and hardware for data acquisition systems.

Prerequisite:
CMPE 364 Concur.

CMPE 370
Computer Engineering Practicum
Credit Hours: 1

Introduction to hands-on broad hardware techniques and specific hardware skills useful for computer engineers. Circuit construction through soldering; personal computer hardware troubleshooting; project implementation using digital signal processing kits or advanced controller kits; embedded reverse engineering approaches; discrete component-based analog/digital circuits; programmable hardware designs.

Prerequisite:
CMPE 261 AND ELEC 231 AND ELEC 201 AND CMPE 262

CMPE 399
Practical Training
Credit Hours: 3

Supervised eight week training period at an institution (Business, industrial, government), intended to provide students with hands-on experience at the workplace. Evaluation is based on: Daily performance, supervisor's input, student's report, and a short presentation.

CMPE 455
Data Communication & Computer Networks I
Credit Hours: 3

Fundamental concepts of communication systems such as the Internet, local area, metropolitan and wide area networks. Layered network architecture; transmission technology; data link layer protocols, broadcast networks and their protocols, flow and error control; concepts of the network layer and routing algorithms; services and protocols of the transport layer; examples of application layer protocols.

Prerequisite:
CMPS 303 AND CMPE 456 Concur. AND CMPE 263

CMPE 456
Data Communication & Computer Networks I Lab
Credit Hours: 1

Practical skills and hands-on experience needed to build small-to-medium size networks. Network simulation tools, installing, configuring, troubleshooting and monitoring computer networks and their components, protocols and services.

Prerequisite:
CMPE 455 Concur.

CMPE 457
Data Communication & Computer Networks II
Credit Hours: 3

Builds upon fundamental knowledge and concepts addressed in the "Data Communications and Computer Networks I" course. Signal modulation, coding techniques; wireless transmission; radio frequency, multiplexing, circuit and packet switching, medium access control; interior and exterior routing protocols, autonomous systems, link state routing; IPv6 address space, transmission methods from IPv4 to IPv6; network and internet security, VPN, cryptography, encryption schemes, firewalls, intrusion detection; congestion control, quality of service; protocols

for network management; network socket programming.

Prerequisite:
CMPE 455

CMPE 462
Computer Interfacing
Credit Hours: 3

Review of basic components in computer interfacing with real-world applications in graphical programming environments representing complete dataflow logic. Sensors; signal conditioning circuits; analog-digital converters; actuators; serial and parallel data interfacing with personal computers.

Prerequisite:
CMPE 364

CMPE 470
Modern Computer Organization
Credit Hours: 3

Discussion of current trends and future directions in computer organization highlighting various hardware and software techniques designed to maximize parallelism and improve performance within technological constraints. Non-von Neumann architectures; performance/cost enhancement techniques; cache memory, bus architecture, memory interleaving, pipelining, super-pipelining, super-scaling, vector computing, parallel organization; discussion of current research and publications in computer organization.

Prerequisite:
CMPE 363

CMPE 471
Selected Topics in Computer Engineering
Credit Hours: 3

Selected topics in the field of computer engineering addressing new trends and practical issues.

CMPE 472
Performance Evaluation
Credit Hours: 3

Introduction to performance analysis and evaluation. Modeling and evaluation of computer systems; Markov processes and chains; single and network queues; concurrent process modeling.

Prerequisite:
GENG 200

CMPE 474
Artificial Neural Networks

Credit Hours: 3

Introduction to theory, architecture, and applications of artificial neural systems; Supervised, unsupervised, and reinforcement learning in single and multiple layer neural networks; Associative neural memory recording and retrieval dynamics; Self-organizing maps; Learning capacity and generalization; Hardware implementations.

Prerequisite:
MATH 217

CMPE 475
Artificial Intelligence
Credit Hours: 3

Fundamental concepts of artificial intelligence, logic, and knowledge representation with associated algorithms and techniques supported by logic programming applications. Motivation for logic and knowledge representation by horn clauses; logic and propositional equivalencies; predicates and quantifiers; matching, backtracking, forward and backward chaining; logic programming applications.

Prerequisite:
CMPS 303

CMPE 476
Digital Signal Processing
Credit Hours: 3

Overview of continuous and discrete signal processing with hands-on algorithmic implementation of various signal transforms and other operators for generalized applications. Analog to digital conversion methods; sampling theory, discrete Fourier transform, fast Fourier transform, z-transforms; signal sampling and reconstruction; digital filters, correlation, spectral estimation.

Prerequisite:
ELEC 351 AND CMPE 478 Concur.

CMPE 478
Digital Signal Processing Lab
Credit Hours: 1

Practical implementation of digital signal processing algorithms using standard kits. Audio signal filtering; spectral analysis of signals, de-convolution of composite signals, spectral shifting of audio signals; channel equalization for communication signals.

Prerequisite:
CMPE 476 Concur.

CMPE 480
Computer Vision

Credit Hours: 3

Introduction to the basic concepts and techniques of computer vision focusing on reconstruction of 3D models from 2D still images and video. Image formation, segmentation; camera calibration, motion and object recognition; use of image processing tools.

Prerequisite:
CMPS 251

CMPE 481
Modeling and Simulation of Digital Sys
Credit Hours: 3

Advanced concepts in digital logic design using language tools to describe digital logic systems at different levels of abstraction and simulation. Programmable logic devices; designing with field programmable gate arrays; synchronous and asynchronous sequential logic circuits.

Prerequisite:
CMPE 261

CMPE 482
Multimedia Networks
Credit Hours: 3

Analysis of main characteristics and challenges of multimedia delivery over IP networks with the analysis of main quality of service mechanisms used at each layer to allow for differentiated services with the ability to explain the main characteristics of IEEE standards for LANs and MANs. Multimedia applications; video and audio streaming; quality of service fundamentals and mechanisms; IEEE standards for wireless local, metropolitan, personal, and 3G area networks.

Prerequisite:
CMPE 455

CMPE 483
Introduction to Robotics
Credit Hours: 3

Use of robotics kits, robot assembly, familiarization with the basic concepts of sensing, actuation, and robotic intelligence. Basic robotic sensors; actuation functions; embedded robotic task-related intelligence levels; capstone project and report presentation.

Prerequisite:
CMPE 261 AND CMPS 151

CMPE 485
Fundamentals of Digital Image processing
Credit Hours: 3

Introduction to various mathematical and algorithmic concepts in digital image processing and hands-on implementation using simulated environments. Hands-on approach to image operations; filtering, de-convolution, edge detection, geometric transformations, compression, conversions.

CMPE 487
Hardware Software Co-Design
Credit Hours: 3

A knowledge of how to design reliable and real-time embedded systems is a very important asset of today's computer engineer, particularly for the design of heterogeneous and SoC embedded platforms using hardware (HW) software (SW) co-design approaches. This course will emphasize on the integration of custom hardware components with software. Topics to be covered are: Embedded systems design, reconfigurable computing, heterogeneous SoC platforms (FPGA, ARM), HW/SW co-design techniques, hardware compilation, Tools for HW/SW co-design.

Prerequisite:
ELEC 351

CMPE 495
Independent Study
Credit Hours: 3

Guided reading of selected topics exploring advanced topics in computer engineering. Topics and credit hours vary.

CMPE 498
Design Project I
Credit Hours: 2

The first phase of the capstone design project involving number of students tackling different aspects of a hardware and/or software project. It includes problem definition, requirements gathering and analysis, identification of appropriate engineering standards and real-life design constraints (e.g., economic, environmental, social, ethical, health and safety, manufacturability, and sustainability), defining an architecture of the proposed solution, preparing an implementation project plan, and compiling all in a well-formulated interim report and orally presenting it to the examining committee.

Prerequisite:
CMPE 370 Concur.

CMPE 499
Design Project II
Credit Hours: 4

The implementation phase of the capstone design project. It includes the design, implementation and testing of the solution that was selected in CMPE498. This culminates in producing a working prototype, documenting the design solution and process, and presenting the project achievements. The primary objective of this course is to apply a systematic design process while incorporating appropriate engineering standards and addressing multiple realistic design constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability.

Prerequisite:
CMPE 498

CMPS 101
Introduction to Computer Science
Credit Hours: 3

Fundamental concepts of computer systems organization, logic, and algorithmic problem solving. Lab session: problem solving with fundamental components of a modern programming language.

CMPS 151
Programming Concepts
Credit Hours: 3

Exposure to problem solving techniques and operations on data using the fundamental components of a programming language. Problem solving techniques and presentations; motivations to programming languages and program execution; fundamental components of a programming language including simple and structured data representation; mathematical and logical operations; input/output, control and loop structures; functions; recursion; memory referencing; and simple file processing.

Prerequisite:
CMPS 152 Concur.

CMPS 152
Programming Concepts - Lab
Credit Hours: 1

Practical experience with programming using fundamental components of a programming language and exploring additional features illustrated by solving problems of various types and requirements. Purpose of programming environments; coding quality and professionalism; coding solutions to problems using fundamental programming language features; explorations of additional language features; debugging, testing and program evaluation.

Prerequisite:
CMPS 151 Concur.

CMPS 200
Computer Ethics

Credit Hours: 1
Overview of computing ethics and practice. Philosophical ethical theory and morality; codes ethics and professional practice; cyber and computer crimes; whistle blowing; privacy and freedom of expression; legal and ethical issues; intellectual property and rights; safety-critical program development; ethics and the market place.

CMPS 205
Discrete Structures for Computing
Credit Hours: 3
Introduction to the elements of mathematics applicable to the computing field. Logic and methods of proof; logic gates and simple sequential circuits; Boolean algebra and minimization; set theory; relations and functions; sequences and sums; induction and recursion; numbering systems, combinatorics; discrete probability; graphs and trees.

CMPS 251
Objec-Oriented Programming
Credit Hours: 3
Fundamentals of object-oriented programming paradigm illustrated with an object-oriented programming language. Object-oriented design; encapsulation and information hiding; coherence, inheritance, abstraction, polymorphism, coupling; graphical user interface programming; additional features of the language.

Prerequisite:
CMPS 151 AND CMPS 252 Concur.

CMPS 252
Object-Oriented Programming lab
Credit Hours: 1
Practical experience with object-oriented programming, covering object-oriented features illustrated by various types of problem-solving techniques. Motivations to the programming environment; coding quality and professionalism; using object-oriented features of a programming language to code solutions to various problems; exploring additional language features; debugging, testing and evaluation of programs.

Prerequisite:
CMPS 251 Concur.

CMPS 303
Data Structures
Credit Hours: 3
Static and dynamic presentation, implementation, analysis, and applications of abstract data types (ADT) for linear and non-linear data structures and fundamental algorithms for software system development. ADTs; algorithm efficiency;

CMPS 405
Operating Systems
Credit Hours: 3
Fundamental concepts of operating system design and implementation. Overview of operating system components; concurrency; mutual exclusion and synchronization; implementation of processes; deadlock; scheduling algorithms; memory management; input/output and file systems; protection and security.

Prerequisite:
CMPS 303 AND CMPS 406 Concur. AND CMPE 263

CMPS 406
Operating Systems Laboratory
Credit Hours: 1
Practical experience with an operating system's components, associated services, and implementations. Operating system structure, components, services, shell commands; process management, inter-process communications; problem solving with concurrency, mutual exclusion, synchronization; implementations of CPU scheduling algorithms, memory placement algorithms; protection and security.

Prerequisite:
CMPS 405 Concur.

CMPS 411
Software Engineering
Credit Hours: 3
Fundamental principles of classical and modern software engineering theory and practice. Taxonomy of software systems; software project management, process models; requirements engineering, design, architectures, user interface design; software development methods; verification, validation, testing; software management (people, cost, quality, process improvement, configuration); emerging technologies.

Prerequisite:
CMPS 303