Department of Computer Engineering
Course Description

0907231 Digital Logic (3 Credit Hours)

Prerequisite: (1900100)

Number Systems and digital waveforms. Basic gates and logic functions. Boolean algebra, Boolean expressions. Logic minimization techniques. VHDL basics. Design, simulation and synthesis tools for programmable logic devices. Combinational logic building blocks including decoders, encoders, multiplexers, demultiplexers, magnitude comparators. VHDL for combinational circuits. Digital arithmetic, adders, subtractors. VHDL for arithmetic circuits. Basics of sequential circuits. Basic latches and flip-flops. Timing parameters and diagrams. Counters, shift registers. Basic PLDs, CPLDs and FPGAs architectures. VHDL for binary counters and shift registers. State machines. System design with state machines using VHDL. Memory devices and systems including RAM, ROM, FIFO, LIFO and dynamic RAM.

0907234 Logic Lab (1 Credit Hour)

Co requisite: (0907231)

Experiments on basic TTL and CMOS logic gates, including simulations to explore functionality and timing parameters. Experiments using both simulation and practical hardware implementation on CPLDs or FPGAs, using VHDL for combinational and sequential circuits including multiplexers, demultiplexers, decoders, encoders counters, shift registers, latches and memory. Experiments in logic design using state machines. Design project using CPLDs or FPGAs.

0907235 Assembly Language and Microprocessors (3 Credit Hours)
Prerequisite: (0907231)
Introduction to microprocessors and microcomputers. Evolution, architecture, and software model. Introduction to Real-mode and protected-mode memory addressing. Addressing modes. The PC and its DEBUG program. Move, stack, load-effective address, and string instructions. Arithmetic instructions. Addition, subtraction and comparison. Multiplication and division. Logic instructions. Shifts and rotates. Counters and time delays. String comparisons. Jump instructions. Code conversion. Stacks and subroutines. Program and machine control instructions. Software interrupts. Program development. The microprocessor and its bus architecture. Introduction to memory and I/O interface. Discussion, one hour weekly.

0907311 Computer Applications Lab (1 Credit Hour)
Prerequisite: (1901102)
Computer packages for mathematical and symbolic manipulations (Matlab, Mathematica). Graphics packages. The internet and its use in literature survey and information acquisition. Library search via computer. Data processing and statistical packages. Computer Engineering packages for digital design.

0907332 Microprocessor System Design (3 Credit Hours)
Prerequisite: (0907235)
Introduction to x86 microprocessor systems. Memory devices, circuits, and subsystem design. Memory addressing and data formats. Memory-mapped and isolated I/O techniques. Basic and programmable parallel I/O interface. Keyboard and display interface. ADC and DAC interface. Timer interfacing and programming. Serial communications interfacing and programming. Hardware and software interrupts. Interrupt controller interfacing and programming. Real-time clock. DMA operation, controller interfacing and programming. Math coprocessors and MMX technology. Bus interface: ISA (EISA), VESA, PCI, and USB. Term project on microcomputer hardware design. Discussion, one hour weekly.

0907333 Embedded Systems (3 Credit Hour)
Prerequisite: (0907261 and 0907231)
Embedded systems characteristics. Microprocessors versus micro controllers. Micro controller characteristics. General-purpose micro controllers. Examples of micro controller architectures. Interrupts, counters/timers, Input/output ports. Micro controller programming. Instruction set. Program development and use of assemblers. Memory maps and addressing modes. Digital to analogue and analogue to digital conversion in micro controllers. Data acquisition and distribution. Serial and parallel communications. Real-time system and its constraints. Interfacing to external devices. Power consumption consideration. Applications. Discussion, one hour weekly.

0907334 Embedded Systems Lab (1 Credit Hour)
Co requisite: (0907333)
Introduction to embedded systems design tools and hardware programmers. Experiments using both simulation and practical implementation of the basic building blocks of a microcontroller including timers, counters, PWM generation, I/O techniques and requirements, A/D conversion, serial communications. Experiments to explore the system design process using hardware-software co design process. Design project.

0907335 Computer Organization (3 Credit Hours)
Prerequisite: (0907231 and 1901102)
Introduction to computer organization. Computer instruction set. Machine language. Data processing. Arithmetic unit: Carry look-ahead adders, subtractors, and shifters. Logic unit. Combinational and sequential multipliers and dividers. Floating-point number representation and arithmetic. Data path design. Control unit design. Microprogramming. Pipelining. Discussion, one hour weekly.

0907337 Microprocessor Lab (1 Credit Hour)
Prerequisite: (0907235)
Writing, assembling, executing, and debugging various x86 programs to cover the basic concepts of microprocessor usage. Designing, implementing and troubleshooting various microprocessor-based applications.
Experiments in building and programming microprocessor-based systems. Microcomputer interfacing experiments.

0907342 Object-Oriented Problem Solving (3 Credit Hours)
Prerequisite: (1901102)
Problem solving techniques for engineering problems, primarily from the fields of electrical and computer engineering; object-oriented programming concepts; object-oriented program development, editing, compiling, linking, and debugging using the Object Oriented Programming languages. Introduction to Object-oriented analysis and design (concepts, methodologies and UML).

0907422 Computer Networks (3 Credit Hours)
Prerequisite: (0903321)
Introduction to computer networks. Network topologies. Network architecture and the OSI reference model. Circuit switching and packet switching. Switched networks and broadcast networks. The physical layer. Data transmission basics: Asynchronous and synchronous modes. Error control. Local area networks (LANs). Data link layer and protocols. Medium access control (MAC). IEEE 802 series of standards and MAC protocols. High-speed and bridged LANs. Repeaters, switches, hubs, bridges, routers, and gateways. Introduction to wide area networks. Discussion, one hour weekly.

0907432 Computer Design (3 Credit Hours)
Prerequisite: (0907335)
Exploiting instruction level parallelism, hardware and software approaches. Pipelined, Vector, Super scalar, and VLIW processors. Predication, Branch Prediction, and Control and Data Speculation. Case Studies of Modern Processors. Hierarchical Memory Design. Virtual memory. Input/Output Interfacing and System Integration. Introduction to Parallel Processing. Flynn's classification. Symmetric Multiprocessors. Cache coherence. Tutorial one hour weekly.

0907433 Performance Evaluation and Modeling (3 Credit Hours)
Prerequisite: (0301131 and 0907432)
Introduction to floating-point arithmetic and error analysis. Fundamentals of computer design. Technology trends. Performance metrics. Performance evaluation. Measurement techniques and tools. Workload characterization. Data presentation. Statistical methods for analyzing measured data. The quantitative approach: experimental design and analysis. Model types. Hardware Description Languages. Event-driven simulation. Introduction to queuing theory and modeling. Modeling and simulation packages and tools. Term project in simulation.

0907439 Computer Design Lab (1 Credit Hour)
Co requisite: (0907432)
Using CAD tools, the student designs and simulates the main parts of a computer: the ALU, registers, control unit, cache memory, system bus, memory, and I/O devices. Integration and simulation of computer design.

0907441 Software Engineering and Ethics (3 Credit Hour)
Prerequisite: (0907342)
Introduction to Engineering Ethics. Moral reasoning. Confronting moral dilemmas. Codes of ethics and honor. Responsibilities to employers and society. Computer ethics. Introduction to software engineering. The system engineering process. Project management: activities, planning, scheduling, tracking, and risk management. Software functional and non-functional requirements. System models: context, behavioral, and object models. Issues in the development of software systems: problem definition and specification, planning, structuring principles, and design and analysis methodologies. Essential software attributes: maintainability, dependability, efficiency, and reusability. Discussion, one hour weekly.

0907461 Digital Electronics (3 Credit Hours)
Prerequisite: (0903361)
Electronic devices. Diodes and transistors. BJT gates. RTL basic gates. RTL buffer. DTL basic gate. TTL Structure: operation, I/O characteristics, power dissipation, low power TTL, High-speed TTL, open-collector TTL, and Shottkey TTL. Main features of basic ECL gates. MOS gates. NMOS inverter and gates. CMOS inverter and gates. CMOS tri-state gates. Bilateral switches. Comparison and interfacing of logic families. Semiconductor ROM and RAM. A/D and D/A conversion. Timing circuits. Monostable and astable multivibrators. IC multivibrators. Discussion, one hour weekly.

0907521 Parallel and Distributed Systems (3 Credit Hours)
Prerequisite: (0907432)
Introduction to parallel processing and distributed systems. Multicomputers, multiprocessors, network of workstations, and scalable systems. Interconnection networks: topologies, routing, and protocols. Distributed systems design for scalability, reliability, availability, and security. Communication paradigms including shared memory, message passing, RPC, and distributed objects. Distributed system services including replication, caching, file system management, naming, clock synchronization, and multicast communication. Sample applications. Development of programs and applications for parallel and distributed systems.

0907522 Networks and Internet Programming (3 Credit Hours)
Prerequisite: 1901473 and 0907422
A review of basic networking principles: Protocol Stacks; The Transport Layer, TCP and UDP; The Network Layer, IP; The Link Layer, LANs; Application Protocols, HTTP, ftp; The Sockets interface, primarily on Unix/Linux; Advanced Sockets, select, socket options; Other socket types, Unix, Raw; Network programming methodologies and protocols, primarily for the World Wide Web: Name servers, DNS; IPv6; Server design, daemons, inetd; CGI; XML; Sockets in Java; Cookies, Javascript; Servlets, JSP; JDBC; Java RMI; Remote Procedure Calls; Network Security, firewalls, ssl, ssh; Grid computing, web spiders; Bluetooth; VoIP

0907528 Computer Networks Lab (1 Credit Hours)
Prerequisite: (0907422)
The Computer Networks Lab consists of a Set of Experiments to Give the Student the Practical Experience on Building Basic Local Area Networks (LANs). Introduction to Personal Computers Hardware, Installing Network Interface Cards, Networks Cabling, Local Area Networks and Basic Topologies, Understanding Routers and Routing Principles, Configuring Routers and Routing Protocols, Securing Local Area Networks Using Access Lists, Understanding Switches and Switching Principles, Configuring Switches, Building Virtual Local Area Networks, Trunking Protocols, IP Networks Address Translation and Dynamic Host Control Protocol.

0907529 Advanced Networks Lab (1 Credit Hours)
Prerequisite: (0907528)
A set of experiments to give the student the practical experience on the following components: wireless networks and networks security, installing wireless adapters, building adhoc wireless networks, configuring access points, configuring wireless bridges, basic wireless networks security, advanced router security, basic PIX firewall security, basic VPN configuration.

0907531 Special Topics in Computer Engineering (3 Credit Hours)
Prerequisite: (0907432 or 1901473)
Special topics of current interest in computer engineering.

0907533 Real-Time Computer Control (3 Credit Hours)
Prerequisite: (0907332 and 0907333)

Introduction to feedback control systems. Basic elements and benefits of computer-controlled systems. Overview of real-time systems: definition, classification, time constraints, programs, complexity, reliability and challenging issues. Concepts of computer control: sequence, loop, supervisory and centralized control, and human-computer interface (HCI). Computer hardware requirements for real-time systems: features of microprocessors/microcontrollers and process-related interfaces. Data transfer techniques: polling, interrupt and direct memory access. Direct digital control algorithms and their implementation: choice of sampling interval and the PID controller in the z-transform form. Real-time operating systems: single and multi-tasking OS, scheduling strategies, priority structures and task management. Design of real-time systems: single-program and multi-tasking approaches.Industrial applications on real-time computer control

0907534 Digital System Design (3 Credit Hours)
Prerequisite: (0907333 and 0907335)

Review of Digital Logic fundamentals. Combinational circuits: Representations (tables, maps, cubes, trees, diagrams), Analysis, Synthesis, and Optimization (MISO Minimization: Quine-McClusky, Espresso, SIS, and MIMO Minimization). Complex Registers, complex Counters, and Memory Units: SRAM and DRAM. Hardware Description Languages: VHDL and Verilog. FSM Minimization techniques: Graphical, Mealy FSM, Row Matching, and Implication Chart. Abstract (Algorithmic) State Machine (ASM) fundamentals. FSM partitioning methods. Asynchronous DSD techniques. Programmable logic devices (PLDs) and CPLDs. RAM and ROM systems and timing diagrams. PALs, GALs, and PLAs. Field Programmable Gate Arrays (FPGAs): Xilinx and Alterra FPGAs. Review of Computer Design fundamentals. Review of Microcontrollers and Embedded Systems fundamentals. Full FSM-based design and hardwired versus programmable implementations of a computerized digital system for: Control Unit, Data Path, Memory hierarchy, and Software and Hardware Interfacing. DSD using Systolic Architectures. Systems on chip (SOC). UC Berkeley CAD and optimization tools. Power considerations in DSD. Timing considerations in DSD. Testing and verification of digital systems. New DSD in emerging technologies.

0907541 Multimedia Engineering (3 Credit Hours)
Prerequisite: (0907343)

Introduction to Audio and Video signals. Transducer, Memory processing concepts. Audio and Video Signal Compression. Audio tools, Computer graphic tools and Video Production tools. Design fundamentals: Points, lines, design and creativity. Multimedia Processors. Introduction to multimedia Synchronization. Multimedia Networks and Applications: Audio and Video Conferencing. Multimedia application over the Intranet and the Internet.

0907542 Pattern Recognition (3 Credit Hours)
Prerequisite: (0907343)

Basic concepts in pattern recognition. Classifiers, data mining, and knowledge discovery. Basic concepts of decision functions. Linear decision functions, generalized decision functions, and orthogonal functions. Classification by distance functions and clustering. Minimum distance classification. Single prototypes, multi-prototypes, and nearest-neighbor classification. Clustering and clusters: threshold order-dependent clustering algorithm, Max-Min distance method, c-means iterative algorithm (CMI). The ISODATA algorithm. Classification using statistical approaches. A general Bayes classifier. Normally distributed patterns: univariate, multivariate, multiclass multivariate. Estimation of probability density functions. Feature selection: introduction, distance measures, and clustering transformations. Feature selection methods: entropy minimization, and functional approximation. Fuzzy concepts: fuzzy set theory, the extension principle, and fuzzy relations. Fuzzy and crisp classification. Fuzzy clustering: fuzzy c-means iterative algorithm (FCMI), and fuzzy partitioning. Fuzzy pattern recognition. Syntactic pattern recognition: grammar types, selecting primitives, syntax analysis for recognition, and stochastic languages. Introduction to NNs, the McCulloch-Pitts (MP) neuron, Hebb NN, the Perceptron, the ADALINE, and Backpropagation NN and its applications: Pattern classification using Neural Networks (NNs).

0907543 Optimizing Compilers (3 Credit Hours)
Prerequisite: (0907342)

Introduction to compiling techniques including parsing algorithms, semantic processing and optimization. In-depth study of compiler backend design for high-performance architectures. Topics include control-flow and data-flow analysis, optimization, instruction scheduling, register allocation. Advanced topics include memory hierarchy management, instruction-level parallelism, predicated and speculative execution.

0907544 Digital Image Analysis and Processing (3 Credit Hours)
Prerequisite: (1901231)

This course introduces the basics of digital image analysis and processing with emphasis on both theory and implementation. Image representation, image types, intensity transformations and spatial filtering, ,image enhancement, frequency domain processing, image restoration, geometric transformations and image registration, color image processing, image compression and vector quantization, morphological image processing, image segmentation, edge detection, line detection using the Hough transform, representation and description, object recognition. Hands-on computer work using MATLAB will be a major part of the learning experience.

0907551 Neural Networks and Fuzzy Logic

(3 Credit Hours)

Prerequisite: (0907343)

Neural versus conventional computing. The biological neuron. NN paradigm: topology (architecture), nodes, and learning (training) algorithm. General discussion of various NN paradigms. General learning/training processes: supervised, unsupervised, and reinforcement. NN learning representations: decision boundary, weight space, and error space (augmented weight space). The Perceptron and Perceptron learning rule. Hebbian learning algorithm and its variations: Hebb rule, pseudoinverse rule, filtered learning rule, and delta rule. Widrow-Hoff learning algorithm and its applications to adaptive filtering, noise cancellation, and echo cancellation. The back propagation (BP) learning algorithm. Variations on BP. Unsupervised Learning. Various Associative learning rules: Unsupervised Hebb rule, Instar rule, and outstar rule. Radial basis functions. Self-organizing maps. Recurrent neural networks. Reinforcement learning using Approximate Dynamic Programming (ADP). Introduction to fuzzy logic. Fuzzy sets and membership functions. Fuzzy relations, fuzzy implications, fuzzification, and defuzzification. Fuzzy rule base and fuzzy inference engine. Introduction to neuro-fuzzy systems. Reinforcement learning using neuro-fuzzy systems. Introduction to Evolutionary Computations (EC). Basic genetic-neuro-fuzzy learning systems. Applications in control systems, robotics, machine (artificial) intelligence, and data mining.

0907561 VLSI Design (3 Credit Hours)

Prerequisite: (0907461)

Design techniques for rapid implementation of Very Large Scale Integrated (VLSI) circuits. MOS devices and basic circuits. IC fabrication. Algorithmic and system design. Structural and logic design. Transistor-level design. Design rules and checking. Layout design and procedures. Logic and circuit simulation. Timing. Design of combinational and sequential circuits. Design of simple structures. Design of modular and array-type systems. System-level design using hardware description language. Design projects to cover specification, layout, logic simulation, and design verification of a simple VLSI system using an interactive layout system.

0907599 Project

(1 Credit Hours)

Prerequisite: Successfully passing 124 credit hours

Evaluation is in marks and not pass/fail. roject for two normal semesters.