II. UNDERGRADUATE COURSES (COURSE DESCRIPTIONS)

DEPARTMENT OF COMPUTER ENGINEERING

CMPE100 Introduction to Computer Engineering

A series of seminars are held in current topics and areas of specialization in Computer Engineering. Speakers are invited from different departments of EMU including Computer Engineering Department or other International Universities, Industry and Consulting firms, to deliver seminars in all aspects of engineering that are not normally covered in the lecture courses.

CMPE 101 Foundations of Computer Engineering (3, 1) 3

This course introduces the student to the fundamental concepts of the computer engineering discipline. Topics covered include: Computers and information processing -notion of computers, concepts of data and information, applications of computers, history of computing. Computer hardware -CPU, memory, input/output interface, secondary storage, ports, types of computer systems, computer software -system software, utilities, application software, data communication, an overview of operating systems. General Problem Solving Concepts: basic data types, constants and variables, basic operators and expressions, algorithms, pseudo codes, and flow charts, sequential, and conditional problem solving (IF statements and CASE logic), looping (WHILE/WHILE-END, REPEAT-UNTIL, FOR structures), formatted output, examples in C programming language. (Pre-requisite: none)

CMPE 112 Programming Fundamentals (4, 1) 4

An overview of C programming language, Sequential structure Data types and classes of data, arithmetic operators and expressions, assignment statements, type conversions, simple I/O functions (printf, scanf, fprintf, fscanf, gets, puts, fgets, fputs). Selective structure Relational operators, logical operators, conditional expression operator, conditional statements (if, switch). Repetitive structures While, do-while, for loops, loop interruptions (goto, break, continue), Null statement, comma operator. Functions Function definition and function call, external variables, storage classes, recursion. Arrays Array declaration, array initialization, arrays as function arguments. Pointers Basics of pointers, functions and pointers, arrays and pointers, strings and pointers, library functions for processing strings, pointer arrays. Structures Basics of structures, structures and functions, arrays of structures. (Pre-requisite: CMPE 101)

CMPE 211 Object-Oriented Programming (4, 1) 4

Basics of C++ and Control structures. Program design, Object-Oriented programming and its specific features. Layout of a simple C++ program (elementary C++ programming. Fundamental types, scope. Overview of selection and iteration structures of C and C++ languages. Examples of C++ programs. Functions and Arrays. Review of functions and arrays. Prototypes (declarations), function definition, function overloading, inline functions, scope resolution operator (::), call-by-value, call-by-reference (reference parameters), default arguments, array declarations, operations on arrays, using arrays as function arguments. Pointers, C strings and C++ strings. Pointer variables, declaration and initialization. Use of pointers in call-by-reference function calls, returning a reference, arrays of pointers, pointers to arrays, pointers to functions, dynamic memory allocation with C++ operators new and delete, C-strings, input/output operations, standard C-string functions, formatted and unformatted input /output, C++ string type (the standard string class). Classes and Data abstraction. Structure definition, accessing members

of structures, class declarations, constructors, constructor initialization lists. Class destructor, member access specifiers public and private, const member functions, friend functions and classes, static data and function members. Operator Overloading. Fundamentals and restrictions of operator overloading, this pointer, overloading unary and binary operators. Composition and Inheritance. Base classes and derived classes, protected class members, virtual functions and polymorphism, virtual destructors, private access vs. protected access, abstract base classes. Revision of the material discussed in the course. (Pre-requisite: CMPE 112)

CMPE 223 Digital Logic Design (4, 1) 4

Binary Systems (Binary Numbers, Octal and Hexadecimal Numbers, Number Base Conversions, Complements, Signed Binary Numbers, Binary Codes, Binary Logic). Boolean Algebra and Logic Gates (Basic Definitions, Basic Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Other Logic Operations, Digital Logic Gates, ICs). Simplification of Boolean Functions (The Map Method, Tow-and Three- Variable maps, Four- and Five- Variable Maps, Product of Sums Simplification, NAND and NOR Implementation, Other Two-Level Implementations, Don't-Care Condition, The Tabulation Method, Determination of Prime Implicants, Selection of Prime Implicants). Combinational Logic (Design Procedure, Adders, Subtractors, Code Conversion, Analysis Procedure, Multilevel NAND Circuits, Multilevel NOR Circuits, Exclusive-OR Functions). MSI and PLD Components (Binary Adder and Subtractor, Decimal Adder, Decoders and Encoders, Multiplexers, PLA and PAL). (Pre-requisite: MATH163)

CMPE 224 Digital Logic Systems (4, 1) 4

Synchronous Sequential Logic; Latches, Circuit Delay Model, Flip-Flops. Mealy and Moore Models for Sequential Circuits. Analysis of Clocked Sequential Circuits. Introduction to Sequential Circuit Design. State Reduction and Assignment. Flip-Flop Excitation Tables. Design Procedure. Design of Counters. Registers, Counters and the Memory Unit; Registers, Shift Registers. Ripple Counters. Synchronous Counters, Timing Sequences. Random Access Memory (RAM), Memory Decoding. Implementation Technology; Programmable Logic Devices (ROM, PLA, PAL, CPLD, FPGA). Algorithmic State Machines (ASM); ASM Flow Chart. Timing Considerations. Control Implementation. Asynchronous Sequential Circuits; Flow Table. Transition Table. Race Condition. Implementation with Lumped Delay Elements and Latches. Glitches and Hazards. (Pre-requisite: CMPE 223)

CMPE 226 Electronics for Computer Engineers (4, 1) 4

Circuits, currents and voltages, power and energy, Kirchoff's current and voltage laws. Circuit elements and circuits. Resistive circuits: resistance in series and parallel, resistive network analysis by series and parallel equivalents, node and mesh analysis. Thevenin and Norton equivalents. Superposition. Inductance and Capacitance, physical characteristics, practical capacitor and inductors. Basic diode concepts: Zener diode, Ideal diode model, rectifiers and waveshaping. Basic amplifier concepts, cascaded, ideal, and differential amplifiers, offset voltage, bias current and offset current. Bipolar Junction Transistors: Current and voltage relationship, common emitter characteristics, pnp BJT Large-Signal DC Circuit models. Common Emitter amplifiers. Emitter Follower. Operational Amplifiers: ideal OPAmp, summing point, inverting and noninverting amplifiers, Nonlinear imperfection, Differential and Instrumentation Amplifiers, Integrators and Differentiators. Logic Circuits: Basic concepts: TTL and CMOS implementation of logic gates. (Pre-requisite: MATH 241)

CMPE 231 Data Structures **(4, 1) 4**

Data types. Binary and decimal Integers. Floating point number. Pointers. Arrays. Structures. Array of structures. Self-referential structures. Dynamic memory allocation. Concept of Abstract Data Type (ADT). Memory allocation of arrays. Linked lists (singly linked, doubly linked, circular). Dynamic implementation of lists. The stack. Infix, postfix, and prefix notations. Applications of the stack: Infix-to-postfix conversion, evaluation of postfix expressions. Recursion. Binary search. The towers of Hanoi problem. Queues. Trees and their applications. Binary tree representations. Binary tree traversals. Binary search trees (definition, operations). Heaps (Pre-requisite: CMPE 112)

CMPE 242 Operating Systems **(4, 1) 4**

Operating system definition, simple batch systems, multiprogramming, time-sharing, personal computer systems, parallel systems. introduction to process, process scheduling, operations on processes, cooperating processes, interprocess communications, interrupts, process synchronization, critical-section problem, atomic instructions, semaphores, synchronization problems, CPU scheduling, scheduling criteria and algorithms, multiple processes and real-time scheduling, algorithm evaluation, deadlocks, characterization and handling of deadlocks, deadlock prevention avoidance and detection, deadlock recovery, memory management and virtual memory, address spaces, swapping, memory allocation, paging, segmentation, file-systems, file concepts, access methods, directory structure. (Pre-requisite: CMPE 112)

CMPE 318 Principles of Programming Languages **(4, 1) 4**

Evolution of programming languages and concepts. Syntax and semantics of programming languages. Context-free grammars. Lexical analysis. Syntax analysis. Top-down vs. bottom-up parsing. LR parsing tables. Names, scope and lifetime. Expressions. Statements. Subprogram linkage. Stack implementation of subprogram calls. Parameter passing methods. Object oriented concepts. Implementation of inheritance: virtual method tables. Concurrency. Exception handling. Functional or Logic programming. (Pre-requisite: CMPE 211)

CMPE321 Signals and Systems for Computer Engineers **(4, 1) 4**

Fundamental concepts of signals and systems for computer engineers with focus on discrete-time systems. Sinusoids, complex numbers, spectrum representation, sampling, frequency response, filters, and the z-Transform. Digital signal processing of multimedia signals. (Pre-requisite: CMPE 226)

CMPE 323 Microprocessors **(4, 1) 4**

Introduction to computing: Inside the computer, CPU-RAM-ROM. 80x86 microprocessor: short history, registers, mov and add instructions, program segments, data segments, logical and physical addresses, stack, push, pop, flag register, addressing modes. Assembly Language Programming: Directives, .asm, .lst, .obj, .map, linking, and .exe files, control transfer instructions, data types and data definition. Arithmetic Logic Instructions: unsigned multiplication and division, unsigned, signed, bcd, packed-bcd and ascii number conversion, rotate and shift instructions. Bios and DOS programming: bios display and keyboard interrupts, int 21h dos function calls. Macro definitions: mouse button and cursor position. 8088 PC/XT expansion slot, 80286 and the ISA bus, Memory and memory interfacing: EPROM, SRAM and DRAM devices, address decoding circuits, ISA bus memory interfacing. Memory mapped and Isolated I/O methods and device interfacing: ISA bus I/O address decoding and simple I/O ports, Programmable

Peripheral Interface 8255 and LED, 7-segment-display, switch, button, keypad, stepper motor interfacing. D/A converters, A/D converters. Hardware Interrupts: NMI and INTR pins, interrupt servicing and TSR programs. Serial Data Communication and 8251 USART. (Pre-requisite: CMPE 224)

CMPE 324 Computer Architecture and Organization (4, 1) 4

Introduction to RISC architecture, MIPS Instruction set: Representing instructions in the computer, Linkers, Supporting procedures in computer hardware, Passing the arguments to a procedure, Constant or immediate operands in MIPS, Addressing in branches and jumps in MIPS, MIPS addressing modes, MIPS assembly program. Integer Arithmetics: Negative number representations, Addition and subtraction, Logic operations, Constructing the Arithmetic Logic Unit (ALU), Multiplication algorithms, Division algorithms, Floating point arithmetic algorithms. Design Performance Measures: CPU performance, Evaluating the performance. Processor Data path: Logic conventions and clocking, MIPS single clock cycle implementation: (Building a datapath), The simple implementation scheme, The multiple clock cycle implementation, Designing the control unit for the multiple clock cycle implementation: Finite state machines (FSM) and Microprogramming. Enhancing Performance with Pipelining: A pipelined datapath, Pipelined control, Data hazards, Control for data hazards, Reducing data hazards, Branch hazards, Exceptions, Performance of pipelined systems. (Pre-requisite: CMPE 224)

CMPE 343 Systems Programming (4, 1) 4

Systems programming in an OS environment. UNIX and the objectives of systems programming in UNIX. A program in the UNIX environment. Command line parameters. System calls and their classification. System calls for interprocess communication and for networking programming. Processes as fundamental objects in UNIX. Creating a process. Process ID. Parent process ID. Child process ID. More about the fork() system call. A family of exec() system calls. Basic concepts of threads and multithreaded programming. Interprocess communication, its purpose and using in systems programs. Mechanisms of interprocess communication in UNIX. Importance of interprocess communication for computer networks. A client-server paradigm of interprocess communication in networks. Unnamed and named pipes for interprocess communication. Message queues, shared memory, signals and semaphores. Sockets and their using for interprocess communication in computer networks. Client/Server model and its implementation with sockets in computer networks. Using IP addresses and port numbers with sockets. TCP and UDP sockets for communication in networks. Organization of a Web client-server network system. Remote procedure call (RPC) for networks, its operation and parameter passing. Introductory concepts of systems and network programming in Windows operating systems. TCP and UDP sockets for network communication in Windows environment. (Pre-requisite: CMPE 242)

CMPE 344 Computer Networks (4, 1) 4

Introduction to fundamental concepts of computer networks. Basic performance and engineering trade-offs in the design and implementation of computer networks. Network hardware/software, protocols and layers, OSI and TCP/IP reference models. Data link layer design issues including encoding, framing, error detection, reliable delivery, and multiple access. Multiplexing, switching, and routing. LANs, wireless LANs, cellular networks. TCP/IP protocol family. Network applications. New trends in computer-communication networks.). (Pre-requisite: CMPE 242 ve MATH 322)

CMPE 354 Database Management Systems (4, 1) 4

This course introduces the student to the fundamentals of database management. Topics covered include: the Entity-Relationship model; the Relational model and its mathematical foundations; most important features of Structured Query Language (including basic structure, aggregate functions, nested queries, index definition, stored procedures and functions, views, database modification, domain constraints, assertions, triggers, transaction definition, data definition language, granting privileges, security), query languages Datalog and QBE; Object-Oriented and Object-Relational databases; design principles of Relational databases (normal forms, functional dependencies, decomposition). (Pre-requisite: CMPE 231)

CMPE 371 Analysis of Algorithms (4, 1) 4

Definition and properties of Algorithms. Design, analysis, and representation of Algorithms. Data abstraction. Pseudo code conventions. Models of computation. Mathematical Foundations: Growth of functions, asymptotic notations. Study of recursive algorithms and associated recurrence relations (substitution method, iteration method, master method, recursion trees). Design paradigms for algorithms: Brute-Force (Exhaustive Search), Divide-and-Conquer (Merge Sort, Binary Search Tree) Dynamic Programming (Matrix-Chain multiplication, LCS-length, 01-Knapsack Problem). Greedy algorithms (Greedy Activity Selector, Fractional Knapsack Problem). Graph Algorithms: Representation of sets and graphs. Breadth-first search, depth-first search. Minimum spanning trees. Single-source shortest paths. All-pairs of shortest paths. (Pre-requisite: CMPE 231)

CMPE 400 Summer Practice (-, -) 0

As a part of the fulfillment of the graduation requirements, all students must complete 40 work days of summer training after the second and/or third year, during summer vacations. The summer training should be carried out in accordance with the rules and regulations set by the department. (3rd/4th year standing)

CMPE 405 Graduation Project I/II (-, -) 1

The main aim of this course is to involve a student, as a team member and under the supervision of an instructor, in a preferably interdisciplinary capstone design project. The project, to be completed in CMPE406, includes a technical survey, the problem description and formulation, and detailed preliminary design documentation for the solution of a realistic computer engineering problem. It is an extended exercise in the professional application of the skills and experience gained in the undergraduate program. Students form teams, and each team chooses exactly one topic proposed by course instructors, and is expected to present its progress in the form of reports and presentation, both during the semester and at the end of the semester.

CMPE 406 Graduation Project II/II (-, -) 3

This course is the sequel to CMPE405. It consists in the implementation of a realistic, preferably interdisciplinary, engineering capstone project emphasizing engineering design principles on a computer engineering topic. It is carried out by a team of students under the supervision of an instructor. The team must complete the detailed design and implementation of the preliminary design they started in the CMPE 405 course. It is an extended exercise in the professional application of the skills and experience

gained in the undergraduate program. The team has to make a presentation and submit a detailed final report which documents the design, implementation and testing. (Pre-requisite: CMPE 405)

CMPE 412 Software Engineering (4, 1) 4

The software life cycle and the phases in software development: Project scheduling, feasibility study, analysis, specification, design, implementation, testing, quality assurance, documentation, maintenance. Management issues: Planning, organization, control. Also included are formal specification techniques, structured programming, modular system design and other current issues. (Pre-requisite: CMPE 211)

CMPE 413 Compiler Construction (4, 1) 4

This area elective course mainly focuses on the following topics; Introduction to compilers, A simple one-pass compiler, Lexical analysis, Syntactic specification of programming languages, The parsing problem, top-down and bottom-up parsing, Syntax-directed translation, Symbol tables, Run time environment and storage administration, Code generation and optimization, Compiler development (Pre-requisite: CMPE 318)

CMPE 414 Modern Programming Platforms (4, 1) 4

This course covers software development in the .Net framework and the C# programming language that makes full use of this framework and has all the important features that a modern language should have. The topics include the philosophy of the .Net framework and the .Net class library, object-oriented programming, event handling, graphical user interfaces, graphics and media, multithreading, exception handling, strings and characters, files and database connections. (Pre-requisite: CMPE 211)

CMPE 415 Visual Programming (4, 1) 4

The main concern of this course is to teach Graphical User Interface, event-driven programming and object-oriented programming for Windows and Internet environments with a visual programming language. Windows Presentation Foundation (WPF) Graphical User Interface, WPF Graphics and Multimedia, XML and XAML, Strings, and Database and Web Application development will also be introduced. (Pre-requisite: CMPE 231)

CMPE 416 Object-Oriented Programming and Graphical User Interfaces (4, 1) 4

The purpose of this course is to expose the Object Oriented Programming approach and its use in building Graphical User Interfaces. It will be done in fact through the presentation of the JAVA language. The student is to learn the language structure of JAVA, its object oriented aspect, the similarities and differences with C. He must also acquire a practical programming experience in Java through a number of exercises and projects. Concerning the applications of the language, we will focus on the implementation of Graphical User Interfaces as well as animation programs. Blueprints and a practical object oriented development methodology will be given for such applications. (Pre-requisite: CMPE 211)

CMPE 417 Advanced Topics in C (4, 1) 4

New C99 Standard (ISO/IEC 9899:1999). Historical notes (ANSI C committee & Numerical C Extensions Group, NCEG), borrowings from C++, new keywords and new types, headers stdint.h and inttypes.h, implicit/explicit int type, conversion specifiers in functions printf( ) and scanf( ), new preprocessor features, variable length arrays (VLA), designated initializers, declarations and executable statements within the block, etc. C Interfaces and Implementations. Memory management (automatic storage, static

storage, POD and non-POD objects, new and delete operators (C++) – examples of usage, guidelines for effective memory management). Key facts about pointers, using heap and stack, dynamic arrays, common memory usage errors, restricted pointers, pointers to functions, pointers to members (C++). Date and Time Library. Retrieving current time, breaking into tokens, time differences and time zones, measuring execution time. Traditional Error-handling methods. C-based Approaches to Handling Errors (exit( )/atexit( ), assert( ), return, setjmp( )/ longjmp( )). Reliability of the code. Exceptions and Assertions. Exceptions and Performance. Misuses of Exception Handling. Manual code optimization. Exceptions during construction and destruction (C++). Advanced Exception handling Techniques (C++). Rapid Sorting Techniques. Sorting Algorithms (fundamentals). Brief discussion of Insertion, Shell, Quick, etc. sorting techniques. Comparison and implementations. (Pre-requisite: CMPE 211)

CMPE 418 Internet Programming (4, 1) 4

This course is an introduction to the tools, technologies, and languages used for the design and implementation of Web applications. Hypertext Markup Language (HTML), Cascading Style Sheets (CSS), Extensible Markup Language (XML), Extensible Stylesheet Language transformations (XSLT), JavaScript and AJAX are covered for programming on the client side. XML Web services, a scripting language and the corresponding Web application development environment, session tracking, and using database are covered for programming on the server side. (Pre-requisite. CMPE354)

CMPE419 Mobile Application Development (4, 1) 4

This course is an introduction to mobile device programming that will cover the fundamental programming principles, software architecture and their development environments. Event-driven programming, object-oriented programming, graphical user interface design, database programing and developing Internet based applications for mobile devices will be the main topics of this course.

CMPE 421 Parallel Computer Architecture (4, 1) 4

This course discusses various processing techniques used to improve the performance of computing systems. MIPS architecture is considered as an example to Pipelined processing. Memory issues and cache memories are discussed, followed by main topics of parallel processing including a taxonomy of parallel computers, interconnection schemes, single-bus MIMD's and networked MIMD's. Memory bottleneck, memory consistency models and cache coherence issues are also considered. (Pre-requisite: CMPE 324)

CMPE 422 Microprocessor Systems (4, 1) 4

This unit aims to study the main aspects in microprocessor systems; Microprocessors: CISC and RISC microprocessor concepts. The Intel 80386 microprocessor: Addressing and memory, segmentation, and protection mechanisms. Tasking, virtual memory, and exceptions. The Motorola 68030 microprocessor: The user programming model. The 68030 supervisor state. (Pre-requisite: CMPE 323)

CMPE 423 Embedded System Design (4, 1) 4

The objective of the course is to introduce the concept of Harvard + RISC architecture microcontrollers and design of embedded computing systems on typical applications including interrupts, timers, LCD and LED displays, keypads, a/d converters, rotary coders, stepper motors, serial and parallel communication interfacing. The design applications are introduced on a very widely used typical 16-bit embedded microcontroller unit, PIC18F452. The scope of the course is the simple, distinct PIC18F452 embedded

system design with the applications in C and RISC assembly programming. The design/theory scale of the course is around 60/40. (Pre-requisites: CMPE 224)

CMPE 424 Introduction to Image Processing (4, 1) 4

Introduction to image processing, digital image fundamentals, image enhancement, image restoration, image analysis, segmentation, image compression. (Pre-requisite: CMPE 321)

CMPE 426 Digital Signal Processing (4, 1) 4

Course topics are as follows: Discrete-Time Signals, Discrete-Time Systems, Z-Transform, Frequency analysis of Continuous-Time and Discrete-Time Signals, Frequency Domain Sampling, The Discrete Fourier Transform (DFT), Efficient Computation of the DFT: FFT Algorithms, Realization of Discrete-Time Systems, Design of FIR and IIR digital Filters, Adaptive digital filtering applications. Course objective is to introduce the fundamentals of digital signal processing. The emphasis will be on analysis tools, the design of digital filters, and on the computation of the Discrete Fourier Transform (DFT). The theory developed in class will be confirmed by computer programming using MATLAB simulation package. (Pre-requisite: CMPE 321)

CMPE 427 Hardware Realization of Algorithms (4, 1) 4

The course introduces students to the key ideas and concepts of fast hardware implementation of algorithms in contrast to software realization. The organization of designing hardware is studied including hardware description languages, hardware-oriented algorithms and CAD-systems for FPGA implementation. Active student participation is expected for the successful completion of this course. Students must attend the lectures regularly and are responsible for all the reading assignments, homework, quizzes and other materials discussed in class. (Pre-requisite: CMPE 224)

CMPE 443 Real-time System Design (4, 1) 4

Course goal is to introduce students to key ideas, concepts and tools of Real-time systems design. Introduction to real-time systems, ADA programming, architecture and design of real-time systems, concurrent programming and synchronization, real-time scheduling, reliability and exception handling, real-time OS, and distributed real-time systems. (Pre-requisite: CMPE 242)

CMPE 444 Data Communications (4, 1) 4

This course concentrates on the exchange of data between devices. The key aspects of transmission, interfacing, link control, and multiplexing will be examined. The course then will proceed with wide area networks in examining the internal mechanisms and user network interfaces that have been developed to support voice, data, and multimedia communications. The traditional technologies of packet switching and circuit switching will be examined, as well as the more recent ATM. (Pre-requisite: CMPE 344)

CMPE 445 Internet Architecture and Protocols (4, 1) 4

An overview of the Internet architecture and its TCP/IP reference model. Protocols of the network layer. Addressing and routing datagrams in the Internet. Internet Control Message Protocol (ICMP) for dissemination of error and control messages. Transport layer, UDP and TCP protocols. Flow control and congestion control in TCP. Stream Control Transport Protocol (SCTP) for new applications. Routing protocols and communication between routers. Multicasting in the Internet and creation of multicast trees. Multicast routing protocols. Monitoring and managing IP networks with Simple Network

Management Protocol (SNMP). Protocols for real-time applications. Resource reservation and quality of service. Voice and video over IP. Securing TCP/IP environments. Next generation network protocol IPv6 and trends in the evolution of the Internet. (Pre-requisite: CMPE 344)

CMPE 446 Networked computing (4, 1) 4

Peer-to-peer (P2P) systems, Grids and Web services represent recent innovations in distributed networked computing on top of the Internet. In particular, in a P2P system, interacting entities are peer processes that perform in collaboration a broad range of tasks on remote data discovery, storage and management. Grid represents a distributed computing infrastructure for accessing computing resources for advanced science and engineering. Together, on the base of computing resources, that are available in the Internet, these technologies can be used to create a globally distributed and coordinated environment for the solution of those information processing tasks that require a huge size of memory and a super-high throughput. This course aims to give undergraduates the basic knowledge of these technologies and prepare students for a range of careers within this emerging area of the global networked computing industry. The course brings together information related to P2P systems, Grids and Web services. It will show, how these technologies can be used in science, research and industry. The experience, obtained by students during this course is a prerequisite for any professional work related to the design, implementation and usage of the highly effective networked computing systems and distributed applications. (Pre-requisite: CMPE 344)

CMPE 447 Fiber Optic Computer Communication (4, 1) 4

This course will describe the basic principles of fiber optics, light propagation theories, attenuation of optical fibers, dispersion and dispersion compensation of fiber optics. In addition, optical fiber transmitters, receivers and fiber optic system design are also discussed. Finally, an introduction to fiber optic network is considered. (Pre-requisite: CMPE 344)

CMPE451 Information Security (4, 1) 4

Information security requirements, security threats, attacks, and methods providing information protection, discretionary and mandatory access models. Malicious software. Symmetric and asymmetric cryptographic methods, DES, AES, RSA. Authentication, digital signature, certificates, one-time passwords, hash functions. Practical aspects of information security in operating systems, databases, network applications.

CMPE 461 Artificial Intelligence (4, 1) 4

Definitions of AI from different point of views , intelligent agents and agent architectures, rational intelligent agents, how agents should act and environments of intelligent agents. Problem solving agents, formulating problems, and searching for solutions. Uninformed search strategies: BFS, DFS, DLFS, IDFS. Informed search methods: Greedy algorithms, uniform cost search, heuristic functions, A*-search, memory-bounded search, iterative improvement algorithms. Constraint satisfaction problems (CSPs): Definitions, Backtracking search for CSPs, The structure of SCPs. Adversarial search: Games, Optimal decisions in games. Alpha-Beta pruning. Agents that reason logically: knowledge-based agents, representation of knowledge, reasoning, logic, and inference in propositional logic. First-order logic: syntax and semantics, extensions and notational variations, elements of first order logic, and inference in first-order logic. (Pre-requisite: CMPE 231)

CMPE 462 Functional and Logic Programming (4, 1) 4

This course is about the two main declarative programming paradigms, namely functional and logic. Prolog will be taught as a representative of the Logic programming paradigm, and ML will be the language used to demonstrate the functional paradigm. (Pre-requisite: CMPE 218)

CMPE 466 Computer Graphics (4, 1) 4

Fundamentals of computer graphics. Topics include graphics hardware and software, basic raster graphics algorithms, 2D and 3D geometric transformations, 2D and 3D viewing, color and illumination models, texture mapping. Programming examples in C/C++ and OpenGL. (Pre-requisite: CMPE 211)

CMPE 471 Automata Theory (4, 1) 4

Mathematical preliminaries and basic concepts. Strings, Languages and Grammars. Chomsky hierarchy of grammars. Deterministic and nondeterministic finite automata. Equivalence of deterministic and nondeterministic finite automata. Minimization of finite automata. Regular grammars and regular expressions. Pushdown automata. Context free grammars. Chomsky normal form. Greibach normal form. Correspondence of pushdown automata and context free grammars. Introduction to Parsing. (Pre-requisite: MATH 163)

CMPE 474 Performance Analysis of Computer Systems and Networks (4, 1) 4

Queuing models of computer systems and networks and applications of queuing theory to computer network modeling. Bounds on system performance. Mean-value analysis of computer systems. Modeling specific subsystems. Queuing models for analysis. Limitations of queueing models. Analysis of transaction processors, terminal-oriented systems, and batch processing. (Pre-requisite: MATH 322)

CMPE 475 Operations Research (4, 1) 4

This course focuses on: Linear programming. Solution techniques of linear programs. The transportation problem. Project scheduling by critical path method. Nonlinear programming. Integer programming. (Pre-requisite: MATH 241)

CMPE 476 System Simulation (4, 1) 4

General concepts of systems. Discrete and continuous systems. State variables. Models, modeling and simulation of systems. Principles and techniques for system modeling and simulation. Comparison of analytical modeling and simulation modeling techniques. General structure of a simulation system. Probability aspects of simulation. Techniques and methods of generation of random numbers and random variates with the desired probability distribution. Simulation languages and packages. Transaction-oriented and event-oriented simulation. Queuing systems in simulation. Validation and verification of simulation models. Output (statistical) analysis and representation of simulation results. (Pre-requisite: MATH 322)

MATH 151 Calculus I (4, 1) 4

Limits and continuity. Derivatives. Rules of differentiation. Higher order derivatives. Chain rule. Related rates. Rolle's and the mean value theorem. Critical Points. Asymptotes. Curve sketching. Integrals. Fundamental Theorem. Techniques of integration. Definite integrals. Application to geometry and

science. Indeterminate forms. L'Hospital's Rule. Improper integrals. Infinite series. Geometric series. Power series. Taylor series and binomial series. (Pre-requisite: none)

MATH 152 Calculus II **(4, 1) 4**

Vectors in R3. Lines and Planes. Functions of several variables. Limit and continuity. Partial differentiation. Chain rule. Tangent plane. Critical Points. Global and local extrema. Lagrange multipliers. Directional derivative. Gradient, Divergence and Curl. Multiple integrals with applications. Triple integrals with applications. Triple integral in cylindrical and spherical coordinates. Line, surface and volume integrals. Independence of path. Green's Theorem. Conservative vector fields. Divergence Theorem. Stokes' Theorem. (Pre-requisite: MATH 151)

MATH 163 Discrete Mathematics **(3, 1) 3**

Set theory, functions and relations; introduction to set theory, functions and relations, inductive proofs and recursive definitions. Combinatorics; basic counting rules, permutations, combinations, allocation problems, selection problems, the pigeonhole principle, the principle of inclusion and exclusion. Generating functions; ordinary generating functions and their applications. Recurrence relations; homogeneous recurrence relations, inhomogeneous recurrence relations, recurrence relations and generating functions, analysis of algorithms. Propositional calculus and boolean algebra; basic boolean functions, digital logic gates, minterm and maxterm expansions, the basic theorems of boolean algebra, simplifying boolean function with karnaugh maps. Graphs and trees; adjacency matrices, incidence matrices, eulerian graphs, hamiltonian graphs, colored graphs, planar graphs, spanning trees, minimal spanning trees, Prim's algorithm, shortest path problems, Dijkstra's algorithms. (Pre-requisite: none)

MATH 241 Linear Algebra and Ordinary Differential Equations **(4, 1) 4**

Linear Algebra; Matrix algebra, special matrices and row operations, Gaussian elimination method, determinants, adjoint and inverse matrices, Cramer's rule, linear vector spaces, linear independence, basis and dimension. First order ordinary differential equations; definitions and general properties of solutions, separable, homogeneous and linear equations, exact equations and integration factors. Higher order equations with constant coefficients; Basic theory and the method of reduction of order, second order homogeneous equations with constant coefficients, nonhomogeneous equations, the method of undetermined coefficients, the method of variation of parameters, the Cauchy-Euler equations. Power series solutions; classification of points, ordinary and singular points, power series solutions about ordinary points, power series solutions about regular singular points, the method of frobenius. Systems of differential equations; general properties of constant coefficient systems, eigenvalues and eigenvectors, diagonalizable matrices, solutions of linear systems with constant coefficients. Boundary value problems. (Pre-requisite: MATH 152)

MATH 322 Probability and Statistical Methods **(3, 1) 3**

Introduction to probability and statistics. Operations on sets. Counting problems. Conditional probability and total probability formula, Bayes' theorem. Introduction to random variables, density and distribution functions. Expectation, variance and covariance. Basic distributions. Joint density and distribution function. Descriptive statistics. Estimation of parameters, maximum likelihood estimator. Hypothesis testing. (Pre-requisite: MATH 152)

MATH 373 Numerical Analysis for Engineers (3, 1) 3

Numerical error. Solution of nonlinear equations, and linear systems of equations. Interpolation and extrapolation. Curve fitting. Numerical differentiation and integration. Numerical solution of ordinary differential equations. (Pre-requisite: MATH 241)

PHYS 101 Physics I (4, 1) 4

Measurement and units, Vectors, Motion Along a Straight Line, Motion in Two and Three Dimensions, Force and Motion-I, Force and Motion-II, Kinetic Energy and Work, Potential Energy and Conservation of Energy, Center of Mass, Impulse, and Linear Momentum, Rotation, Rolling, Torque, Angular Momentum, Equilibrium and Elasticity, Gravitation. (Pre-requisite: none)

PHYS 102 Physics II (4, 1) 4

Temperature, Heat and First Law of Thermodynamics, Kinetic Theory of Gases, Entropy and the Second Law of Thermodynamics, Coulomb's Law, Electric Fields, Gauss' Law, Electric Potential, Magnetic Fields, Magnetic Fields Due to Currents, Induction and Inductance. (Pre-requisite: none)

ENGL 191 Communication in English – I (3, 1) 3

The contents of the GEED192 course do not appear to exclusively focus on English language development. Instead they are becoming tutorials for the Critical Thinking Skills Courses. (Pre-requisite: none)

ENGL 192 Communication in English – II (3, 1) 3

The contents of the GEED192 course do not appear to exclusively focus on English language development. Instead they are becoming tutorials for the Critical Thinking Skills Courses. (Pre-requisite: ENGL191)

ENGL 201 Communications Skills (3, 1) 3

EFL 201/203/205 is a second year Basic/Mainstream/Advanced Communication Skills course for students at the Faculty of Engineering. The course aims to introduce a range of skills, including effective written and oral communication, research skills and study skills. Throughout the course the students will be involved in project work intended to help them in their immediate and future academic and professional life. This will include library research, technical report writing and an oral presentation. By investigating a topic of their own choice, students will develop their understanding of independent research skills. During the report writing process, students will improve their writing and develop the ability to produce organized, cohesive work. The oral presentation aims to enhance spoken fluency and accuracy and provide training in the components of a good presentation. (Pre-requisite: ENGL192)

IENG 355 Ethics in Engineering (3, 0) 3

This course is designed to introduce moral rights and responsibilities of engineers in relation to society, employers, colleagues and clients. Analysis of ethical and value conflict in modern engineering practice. Importance of intellectual property rights and conflicting interests. Ethical aspects in engineering design, manufacturing and operations. Cost benefit-risk analysis, safety and occupational hazard considerations. (Pre-requisite: none)

IENG 420 Engineering Economy **(3, 0) 3**

An introduction to the basics of economic analysis for decisions in engineering design; in manufacturing, in manufacturing equipment, and in industrial projects. Time value of money. Cash-flow analysis. Cost of capital. Return on investment. Elements of cost and cost estimation. Break-even analysis. Decision making among alternatives. Effects of depreciation. Taxes. Replacement analysis. Inflation. Sensitivity analysis. (Pre-requisite: none)

IENG 450 Industrial Management **(3, 0) 3**

The objective of this course is to equip engineers with the necessary modern managerial skills, which are essential to increase productivity in organizations through employee empowerment and effective communication, to develop plans that will put the organization ahead of the international marketing game, to overcome obstacles to personal and professional growth, to attain organizational strategic goals, and to develop action plans for organizational change. (Pre-requisite: none)

HIST 280 History of Turkish Reforms **(2, 0) 2**

A history of the foundation of the Turkish Republic under the light of Kemal Atatürk's principles. A required course for all Turkish students (This course is given in Turkish). (Pre-requisite: none)

TUSL 181 Introduction to Turkish Language **(2, 0) 2**

TURK 100/199 is a Basic Turkish course introducing the Turkish language. It incorporates all four language skills and provides an introduction to basic grammar structures. Students will be encouraged to develop their writing skills through a variety of tasks. The aim of this course is for students to be able to understand and communicate in everyday situations, both in the classroom and in a Turkish-speaking environment. (Pre-requisite: none)