## 5.3 COMPUTER ENGINEERING DEPARTMENT

The Department of Computer Engineering offers a range of basic computer engineering courses relating to the major computer engineering disciplines, to prepare the students to all educational programs of the department.

The department requirements include 127 credit hours of different courses:

i) 23 credit hours in Basic Sciences as detailed in Table 3.32/Chapter 3.

ii) 31 credit hours in Engineering Sciences as detailed in the Table 3.33/Chapter 3.

iii) 57 credit hours in Specialization compulsory courses as detailed in the Table 3.34/Chapter 3.

iv) 16 credit hours in Specialization elective courses as detailed in the Table 3.35/Chapter 3.

## 5.3.1 COMPUTER DEPARTMENT BASIC SCIENCE COURSES

### *5.3.1.1 EC171 "DISCRETE MATHEMATICS": 4Cr [3-2-0]*
***Pre-requisites: EB102***

**Course Catalogue Description:**

This course aims to acquaint the students with linear algebra concepts, propositional and predicate logic and methods of theorem proving. It introduces the students with methods of proving program correctness, discrete probability and graph theory.

## 5.3.2 COMPUTER DEPARTMENT ENGINEERING SCIENCE COURSES

### *5.3.2.1 EC121 "INTRODUCTION TO DIGITAL LOGIC DESIGN": 4Cr [3-1-2]*
***Pre-requisites: UEC01***

**Course Catalogue Description:**
The course introduces an overview of Digital Logic Design: Number Systems, Operations, and Codes, Logic Signals and Gates, Combinational Circuit Analysis and Minimization, Functions of Combinational Logic, Latches, Flip-Flops, and Timers, Counters, Shift Registers, Introduction to Programmable Logic Devices.

### *5.3.2.2 EC222 "ADVANCED DIGITAL LOGIC DESIGN": 4Cr [3-1-2]*
***Pre-requisites: EC121***

**Course Catalogue Description:**
This course is concerned with the design and the implementation of digital systems: Multi-level circuits, PLA, combinational logic structures, memory logic design, synchronous and asynchronous sequential machines. It presents various medium scale integration (MSI) circuits, combinational and sequential programmable logic devices such as ROMs, PLAs, PALs and the design of application specific integrated circuits (ASCIs) using schematic diagram and VHDL . It explores different types of control units.

### *5.3.2.3 EC281 "MICROPROCESSORS AND ASSEMBLY LANGUAGE": 4Cr [3-1-2]*
***Pre-requisites: EC222***

**Course Catalogue Description:**
Fundamentals to microprocessors, Evolution of Intel microprocessors, Internal architecture of the 8088/86 microprocessors, Memory address space and data organization, Microprocessor bus System, Data types and definitions, 8088/86 Microprocessor assembly language programming, addressing modes, MACROS, memory and I/O interfacing, microprocessor interfacing, Interrupt and interrupt applications.

### *5.3.2.4 EC361 "DATA AND COMPUTER COMMUNICATIONS": 3Cr [2-2-1]*
***Pre-requisites: EB208-EE241***

**Course Catalogue Description:**
Introduction, information and coding, data transmission, transmission media, encoding techniques: analog and digital, digital communication techniques, data link control, multiplexing.

### *5.3.2.5 EC363 "COMPUTER NETWORKS": 4Cr [3-2-1]*
### *Pre-requisites: EC361*

**Course Catalogue Description:**
The overall goal of the course is to give the student basic knowledge and skills in local area networks, wide area networks, network architecture layers and corresponding network layer protocols and transport layer protocols, applications, Wireless LANs, the Internet, current trends in the field. Moreover, the course will create a foundation for further studies in IP based LANs and WANs.

## 5.3.3 COMPUTER SPECIALIZATION COMPULSORY COURSES

### *5.3.3.1 EC132 "STRUCTURED PROGRAMMING": 4Cr [3-1-2]*
### *Pre-requisites: UEC02E*

**Course Catalogue Description:**
This course develops algorithmic design and problem solving using structural programming techniques and the C programming language. Programming emphasis will be on block structures and stepwise refinement of algorithms. Programming language paradigms, compilers, program structure, input, output, conditionals, loops, functions, recursion, arrays, pointers, structures and abstract data types are presented. Basic searching and sorting algorithms are studied. Modular coding, parameter passage, correct use of local and global variables and debugging techniques are stressed.

### *5.3.3.2 EC233 "DATA STRUCTURES AND ALGORITHMS": 4Cr [3-1-2]*
### *Pre-requisites: EC132, EC171*

**Course Catalogue Description:**
The course provides students with adequate knowledge and skills on advanced programming techniques and manipulation of data structures including arrays, linked lists, stacks, queues, trees and hash tables. In addition, the course develops students' skills of specification and representation of linked data structure and its manipulation algorithms. Moreover, an introduction to the analysis of algorithms and recursive calls is provided. Basic sorting and searching algorithms are also illustrated.

### *5.3.3.3 EC234 "OBJECT ORIENTED PROGRAMMING": 4Cr [3-1-2]*
### *Pre-requisites: EC132*

**Course Catalogue Description:**
The main Topics are : Object-Oriented Concepts: encapsulation and information-hiding, separation of behavior and implementation, generalization and specialization: objects, scope, attributes, operations and methods, object Identification, object vs. value semantics, classes, object type Identification, class scope, instance creation, inheritance, visibility, polymorphism and virtual method tables. Design methodologies: introducing UML. Introduction to event-driven and concurrent programming and to web programming. Java, C++ and C# overviewed and compared.

### *5.3.3.4 EC235 "ADVANCED ALGORITHMS": 3Cr [2-2-1]*
### *Pre-requisites: EC233*

**Course Catalogue Description:**
The course is an introduction to Techniques for analyzing the time and space complexity of algorithms (sequential and recursive). It includes as Applications: sorting, searching, graph problems. It also introduces General design methodologies for problem solving: divide-and-conquer, dynamic programming, B-trees, depth first and breadth first search algorithms, Huffman codes and greedy algorithms. It gives a brief overview of NP-complete problems.

### *5.3.3.5 EC241 "SYSTEMS PROGRAMMING": 3Cr [2-2-1]*
### *Pre-requisites: EC132*

**Course Catalogue Description:**
The main Topics are: Machine architecture: instruction formats, operations, registers, memory, addressing modes. Basic assembler design: design methodology, relocation, basic two-pass design. Advanced assembler design: expressions, complex addressing modes, relocation, literals, program blocks, multi-pass design, one-pass design. Loaders and linkers :absolute loaders, bootstrap loaders, linking loaders, linkages editors, dynamic linking. Macro processors: design of a basic macro processor, recursive design for nested macro definitions, conditional macro expansion. Introduction to APIs.

### *5.3.3.6 EC271 "COMPUTER ORGANIZATION": 3Cr [2-2-1]*
### *Pre-requisites: EC222*

**Course Catalogue Description:**
The course is an introduction to Machine architecture: design abstractions, a recent chip. Instruction set design. Assessing and understanding performance: CPU performance, evaluating performance, SPEC examples. Processor Micro-architecture: data-path design, multi-cycle design, exceptions, microprogramming, microarchitecture of a recent processor. Pipelined design: pipelined control, data hazards and forwarding, stalls, branch hazards, exceptions, recent processor pipeline. Memory hierarchy: basics of cache design, cache performance, virtual memory, recent memory hierarchies. Buses and interfacing, Performance.

### *5.3.3.7 EC292 "CONCURRENT PROGRAMMING": 3Cr [2-2-1]*
### *Pre-requisites: EC234*

**Course Catalogue Description:**
This course introduces Language design parameters, Models of parallel machines, Load balancing, Scalability, Portability, Efficiency measures, Design and implementation techniques for several classes of concurrent programming languages (such as object-oriented, functional, logic, and constraint programming languages).

### *5.3.3.8 EC312 "EMBEDDED SYSTEMS": 3Cr [2-1-2]*
### *Pre-requisites: EC281*

**Course Catalogue Description:**
The course introduces the History and overview, embedded microcontrollers, embedded programs, real-time systems, low-power computing, reliable system design, design methodologies, tool support, interfacing and mixed-signal systems, computer system overview, life cycle, requirements analysis and elicitation, specification, architectural design, testing, maintenance, project management

### *5.3.3.9 EC342 "OPERATING SYSTEMS": 3Cr [2-2-1]*
### *Pre-requisites: EC241-EC271*

**Course Catalogue Description:**
The course introduces History and overview of Operating Systems, process concept, concurrency, scheduling and dispatching, memory management, disk scheduling, file systems, virtual machine architecture, security and protection, performance analysis, case studies of operating systems, current trends in operating systems.

### *5.3.3.10 EC351 "DATABASE MANAGEMENT SYSTEMS": 3Cr [2-1-2]*
### *Pre-requisites: EC234, EC235*

**Course Catalogue Description:**
The main Topics are: organization and access techniques. Introduction to DBMS architecture and environment, structured top down database development lifecycle, data modeling and data flow diagrams. Database organizations: hierarchical, network and relational, relational algebra, ANSI SQL, relational database design, integrity and security of database systems, recovery and concurrency control, query optimization, tuning of physical database design, introduction to Object Oriented DBMS, current trends in DBMS.

### *5.3.3.11 EC352 "SOFTWARE ENGINEERING": 3Cr [2-2-1]*
### *Pre-requisites: EC351*

**Course Catalogue Description:**
The course introduces Issues relevant to the development of large software systems, such as specifications, design and synthesis of reliable software.

### *5.3.3.12 EC359 "PROGRAMMING LANGUAGES & TRANSLATORS": 3Cr [2-2-1]*
### *Pre-requisites: EC241, EC171*

**Course Catalogue Description:**
The course introduces translation: interpretation and compilation. Principles of language compilation. Error handling and symbol table management. Run-time storage management.

### *5.3.3.13 EC365 "COMPUTER SECURITY": 3Cr [2-2-1]*
### *Pre-requisites: EC361, EC342*

**Course Catalogue Description:**
The course introduces Cryptography, computer security, computer threats, and computer networks security. Computer networks threats, Web and email security, Web and email threats, E-commerce security.

### *5.3.3.14 EC372 "COMPUTATIONAL MODELS": 2Cr [2-1-0]*
### *Pre-requisites: EC235*

**Course Catalogue Description:**
The main Topics are: Regular languages, finite-state automata, and regular expressions: determinism and non-determinism, Chomsky hierarchy, context-free grammars, and push-down automata, Turing machines and recursively enumerable languages: Church's thesis, decidability and the halting problem and computability, The P and NP classes and space classes.

### *5.3.3.15 EC383 "INTELLIGENT SYSTEMS": 3Cr [2-1-2]*
### *Pre-requisites: EC234, EC235*

**Course Catalogue Description:**
The course introduces the students to the Intelligent Systems. It mainly introduces the different problem solving and searching techniques, the knowledge representation, the reasoning and inference, the concept of machine learning, the solution of a real-time problem using Neural Network, the Natural Language and its applications.

### *5.3.3.16 EC400-1 , EC400-2 "GRADUATING PROJECT": 5Cr [3-0-6]*
### *Pre-requisites: department approval at9$^{TH}$ semester and EC400-1 for EC400-2*

**Course Catalogue Description:**
The main Topics are: Comprehensive project spanning two semesters, students undertake a project which involves addressing a significant technical problem under the guidance of a supervisor. Students are expected to demonstrate an ability to apply a disciplined approach in addressing the solution to the problem. Group cooperation and project management are key issues. Students produce a final thesis on the work and this together with a demonstration of the working system will form the assessment.
Lab: Hands on suitable H/W components and S/W tools, packages and libraries.

## 5.3.4 COMPUTER ELECTIVE COURSES: *INTERNET AND DISTRIBUTED SYSTEM ENGINEERING*

### *5.3.4.1 EC343 "WORKFLOW MANAGEMENT": 3Cr [2-1-2]*
### *Pre-requisites:EC233, EC234*

**Course Catalogue Description:**
The course is an introduction to Modeling workflows, management of workflows, analyzing workflows, architecture of workflow systems, standards, Examples.

### *5.3.4.2 EC373 "DISTRIBUTED SYSTEMS AND WEB SERVICES": 3Cr [2-1-2]*
### *Pre-requisites:EC361, EC342*

**Course Catalogue Description:**
The course introduces IPC and RPC standards: CORBA and RMI, web services for B2B projects. XML overview, SOAP protocol, UDDI and WSDL, security issues, middle ware products and multi-tier architecture, new trends.

### *5.3.4.3 EC381 "COMPUTER GRAPHICS AND VISUALIZATION": 3Cr [2-1-2]*
### *Pre-requisites:EC234, EB204 AND EC233*

**Course Catalogue Description:**
The course introduces the principles and techniques for Computer Graphics and Visualization. It introduces Fundamental principles and techniques for computer graphics, Basic raster algorithms, Scene representation, OpenGL, coordinate manipulations, perspective. It also introduces the basics of illumination and shading, color models, texture maps, fundamentals of scene constructions. It teaches the students how to apply their knowledge of Computer Graphics and Visualization to practical problems.

### *5.3.4.4 EC385 "E-BUSINESS": 2Cr [1-1-2]*
### *Pre-requisites:EC234*

**Course Catalogue Description:**
The course examines the field of E-business and related fields: e-commerce, e-payment, e-government, E-marketing, e-procurement. Applicable models, process of building a successful E-business, online monetary transactions, integration of computer hardware and software for E-business functionality, Internet security and customer relationship management. A comprehensive course project is required.

### *5.3.4.5 EC386 "MULTIMEDIA SYSTEMS": 3Cr [2-1-2]*
### *Pre-requisites:EC361, EC234*

**Course Catalogue Description:**
The main Topics are: Introduction to multimedia, authoring tools, multimedia data representation, images, audio, video, multimedia data compression: standards, multimedia networks, example applications, current trends.

### *5.3.4.6 EC387 "DECISION SUPPORT SYSTEMS": 2Cr [1-1-2]*
### *Pre-requisites:EC351*

**Course Catalogue Description:**
Definition of DSS, Differences between DSS and management information systems, Phases of data preparation, Data warehousing, Online analytical processing, Data mining. Current trends in DSS.

### *5.3.4.7 EC384 "MODELING AND SIMULATION": 2Cr [1-1-2]*
### *Pre-requisites:EB208, EC233*

**Course Catalogue Description:**
This course is an introduction to the fundamentals of system modeling and simulation techniques. It explores simulation definitions, history, background and languages. Conceptualization, implementation, testing, verification and validation of the simulation model are also inspected. In addition, the course studies different types of systems (continuous, discrete time and discrete event, deterministic and stochastic processes). Stochastic features (Monte Carlo, generation of random statistical variables with different probability distributions) are underlined. Furthermore, Data collection, generation, reduction and analysis are studied. At the end of the course, some applications, such as analytic and simulation techniques for the performance analysis of computer architecture, operating systems and robotics, are studies as well as recent paradigms and applications.

### *5.3.4.8 EC395 "IMAGE PROCESSING": 3Cr [2-1-2]*
### *Pre-requisites:EE241*

**Course Catalogue Description:**
Expose students to current technologies and issues that are specific to image processing systems, familiarize with MATLAB Image Processing Toolbox.

## 5.3.5 COMPUTER ELECTIVE COURSES: *EMBEDDED SYSTEM ENGINEERING*

### *5.3.5.1 EC313 "COMPUTER ARCHITECTURE": 3Cr [2-1-2]*
### *Pre-requisites:EC271*

**Course Catalogue Description:**
The course introduces Quantitative design approach, computer design problem, technology trends, cost trends, measuring and reporting performance, quantitative principles. Multimedia instruction set design. Addressing modes, operands, operations, control-flow, encoding. Superscalar design, memory hierarchy design, and multiprocessors.

### *5.3.5.2 EC362 "DIGITAL SIGNAL PROCESSING": 3Cr [2-1-2]*
### *Pre-requisites: EE241*

**Course Catalogue Description:**
After the course, each student is expected to be able to use a combination of theory and software implementations to solve signal-processing problems. In addition, student will be able to implement and use methods to increase or decrease the data rate of a sampled signal and to determine how the signal is affected in the time and frequency domains. Furthermore; to use filter banks to split a signal into Sub bands and reconstruct the original signal, know how to discrete-Time Signals and Systems Classification of signals and systems, linear, time-invariant and time-variant systems, impulse response, convolution, causality and stability.

### *5.3.5.3 EC382 INTRODUCTION TO BIOMEDICAL ENGINEERING: 2Cr [1-1-2]*
### *Pre-requisites:EC235, EE232*

**Course Catalogue Description:**
The main Topics are: Introduction: mathematical modeling, physiological systems: linear system approximation, stochastic modeling, models for: cardiopulmonary system, myocardial mechanics, respiratory mechanics, ECG models, introduction to bioinformatics, recent topics.

### *5.3.5.4 EC384 "MODELING AND SIMULATION": 2Cr [1-1-2]*
### *Pre-requisites: EB208*

**Course Catalogue Description:**
The course provides students with adequate knowledge and skills on the fundamentals of system modeling and simulation techniques. It explores simulation definitions, history, background and languages. Conceptualization, implementation, testing, verification and validation of the simulation model are also inspected.

### *5.3.5.5 EC388 "INTRODUCTION TO MECHATRONICS": 3Cr [2-1-2]*
### *Pre-requisites:EE290, EB112, EC312*

**Course Catalogue Description:**
The main Topics are: Overview and historical introduction, physical system modeling, sensors and actuators, data acquisition, control, case stud (automotive), current trends.

### *5.3.5.6 EC397 "ADVANCED COMPUTER ARCHITECTURE AND PARALLEL PROCESSING": 3Cr [2-1-2]*
### *Pre-requisites:EC313*

**Course Catalogue Description:**
The main Topics are : fundamentals of the central issues concerning distributed processing, progressing from an overview of hardware aspects, through an introduction to important software concerns, and ending with a discussion of significant issues in the design of distributed applications.

## 5.3.6 COMPUTER COURSES OFFERED TO OTHER DEPARTMENTS

### *5.3.6.1 EC201 "COMPUTER PROGRAMMING": 3Cr [2-1-2]*
***Pre-requisites:UEC02E***

**Course Catalogue Description:**
This course develops algorithmic design and problem solving using structural programming techniques and the C programming language. Programming emphasis will be on block structures and stepwise refinement of algorithms. Programming language paradigms, compilers, program structure, input, output, conditionals, loops, functions, recursion, arrays, pointers and abstract data types are presented. Modular coding, parameter passage, correct use of local and global variables and debugging techniques are stressed.

### *5.3.6.2 EC202 "DATA STRUCTURES": 2Cr [1-1-2]*
***Pre-requisites:EC201***

**Course Catalogue Description:**
The course provides students with adequate knowledge and skills on advanced programming techniques and manipulation of data structures including arrays, linked lists, stacks, queues, trees and hash tables. In addition, the course develops students' skills of specification and representation of linked data structure and its manipulation algorithms. Moreover, an introduction to the analysis of algorithms and recursive calls is provided. Basic sorting and searching algorithms are also illustrated.

## 5.3.7 COURSES FOR NON-COMPUTER ENGINEERS

### *5.3.7.1 EC423 "COMPUTER AIDED CONTROL": 2Cr [2-0-1]*
***Pre-requisites: EE424***

**Course Catalogue Description:**

Introduction to Computer development, Design and programming, hardware , And software Basics of computer design .Computer instruction sets, command forming, addressing method Types of Instructions -Design of control unit.