COMSATS Institute of Information Technology (CIIT)

Bachelor of Science in COMPUTER ENGINEERING (2011)
Bachelor of Science in Computer Engineering

Introduction

Computer Engineering is an enormously vibrant area of study. It focuses on the design, analysis and application of the computer system. It is a practical field intended to solve real world problems by combining ideas from engineering with basic science. The curriculum of Bachelor of Science in Computer Engineering is developed in such a way that during the first year, reinforcement in science and mathematic subjects are provided. During the second year, graduates will be reinforced with the Electronic Engineering and Computer Engineering fields. In the third and fourth year, major emphasis is on Computer Architecture and Interfacing, Digital Systems and Computer Science.

Program Objectives:

The objective of this program is:

- To equip students with the sound knowledge of Computer Engineering
- To produce well-trained, skilled and efficient professional engineers
- To develop their communication skills
- To develop their analysis, synthesis and design skills
- To prepare graduates who are capable of entering and succeeding in an advanced degree program in their field of study
- To create an excellent environment for research and development activities

Program Outcomes:

The graduates of the program will be able to:

- Possess essential engineering knowledge for meeting the requirements of industries and other organizations needing graduate engineers
- Do planning, specification, design, implementation, and operation of systems
- Apply engineering knowledge, mathematical tools and probabilistic/statistical methods to solve technical problems
Scheme of Studies
for
Bachelor of Science in Computer Engineering

Duration: 04 Years
No. of Semesters: 08
No. of Credit Hours / Semester: 13-19
Total No. of Credit Hours: 134-139
Non-Engineering Courses: 13
Engineering Courses: 26

Course Distribution

<table>
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<th>Domain</th>
<th>Knowledge Area</th>
<th>Total Courses</th>
<th>Total Credits</th>
<th>Overall %age</th>
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<td></td>
<td>Natural Sciences</td>
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<td>Engineering Foundation</td>
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<td>Pakistan Studies</td>
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### Courses of Engineering Domain

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<td>Signals and Systems</td>
<td>4(3,1)</td>
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<td>Digital Logic Design</td>
<td>4(3,1)</td>
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<td>Data Communication and Computer Networks</td>
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<td>Principles of Communication Systems</td>
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<tr>
<td>Object Oriented Programming</td>
<td>4(3,1)</td>
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<td>Database Systems</td>
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<td><strong>94-99</strong></td>
<td><strong>70%</strong></td>
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* The student has the flexibility of selecting between Major Elective and Inter disciplinary Elective
Tentative Plan of Studies

The course offering in each semester as given below is not fixed; it may vary depending on the availability of faculty and needs of the students.

### Semester – 1

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<tr>
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<tr>
<td>CSC141</td>
<td>Introduction to Computer Programming</td>
<td>4(3,1)</td>
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<tr>
<td>PHY121</td>
<td>Applied Physics for Engineers</td>
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<td>HUM100</td>
<td>English Comprehension and Composition</td>
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### Semester – 2

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<td>Multivariable Calculus</td>
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<td>MTH104</td>
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<td>MTH241</td>
<td>Ordinary Differential Equations</td>
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<td>EEE241</td>
<td>Digital Logic Design</td>
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<td>EEE121</td>
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<td>CSC141</td>
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### Semester – 3

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<td>EEE214</td>
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<td>EEE222</td>
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<td>EEE231</td>
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<td>EEE342</td>
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<td>CSC271</td>
<td>Database Systems</td>
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### Prerequisite(s)
- MTH104, CSC141

## Semester – 6

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<td>Principles of Communication Systems</td>
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<td>Major Elective-3*</td>
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### Prerequisite(s)
- EEE223

## Semester – 7

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<td>Major Elective-5* / IDEE-1**</td>
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### Prerequisite(s)
- HUM100

## Semester – 8

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### Total Credit Hours
- 134 – 139

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Scheme of Studies: BS Computer Engineering
## Elective Courses

<table>
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<th>Credits Hours</th>
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<tbody>
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<td>Artificial Intelligence</td>
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<td>Systems Programming</td>
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<td>CSC341</td>
<td>Network Programming</td>
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<td>EEE314, CSC141</td>
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<td>EEE434</td>
<td>VLSI Design</td>
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<tr>
<td>EEE415</td>
<td>Digital Image Processing</td>
<td>4(3,1)</td>
<td>MTH231, EEE223</td>
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<tr>
<td>EEE461</td>
<td>Neural Networks</td>
<td>3(3,0)</td>
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<tr>
<td>CSC336</td>
<td>Web Engineering</td>
<td>4(3,1)</td>
<td>CSC141</td>
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<tr>
<td>CSC443</td>
<td>Scripting Languages</td>
<td>3(3,0)</td>
<td>CSC336</td>
</tr>
<tr>
<td>CSC451</td>
<td>Multimedia &amp; Hypermedia System</td>
<td>3(3,0)</td>
<td>CSC253</td>
</tr>
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<td>CSC452</td>
<td>Virtual Reality</td>
<td>3(3,0)</td>
<td>CSC253</td>
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<tr>
<td>CSC454</td>
<td>Computer Animations</td>
<td>3(3,0)</td>
<td>CSC253</td>
</tr>
<tr>
<td>CSC455</td>
<td>Computer Vision</td>
<td>3(3,0)</td>
<td>CSC253</td>
</tr>
<tr>
<td>EEE455</td>
<td>Optical Fiber Communications</td>
<td>3(3,0)</td>
<td>EEE351 or EEE353</td>
</tr>
<tr>
<td>CSC341</td>
<td>Network Programming</td>
<td>4(3,1)</td>
<td>EEE314, CSC141</td>
</tr>
<tr>
<td>EEE456</td>
<td>Broadband Technologies</td>
<td>3(3,0)</td>
<td>EEE314</td>
</tr>
<tr>
<td>EEE464</td>
<td>Wireless Communication Systems</td>
<td>3(3,0)</td>
<td>EEE351 or EEE353</td>
</tr>
<tr>
<td>EEE354</td>
<td>Telecommunication Systems Engineering</td>
<td>3(3,0)</td>
<td>EEE351 or EEE352</td>
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<tr>
<td>EEE353</td>
<td>Digital Communication Systems</td>
<td>4(3,1)</td>
<td>EEE351 or EEE352</td>
</tr>
</tbody>
</table>

‼ 03 credit hours of theory is equivalent to 03 hours of lectures whereas 01 credit hour of lab is equivalent to 03 hours of lab session. All the lab sessions are graded. Students have to pass both theory and lab to earn the course credits.

† Courses with prerequisites can only be allowed if all prerequisite courses have been passed.

* With the consent of Academic Advisor and Department the student has to select one major field of study from which s/he can select any elective course.

** With the consent of Academic Advisor and Department the student can take any approved course of EE which he/she has not taken before according to his/her aptitude and/or future plans.
Course Hierarchy
Course Contents
Humanities
COURSE TITLE:  English Comprehension and Composition  

Credit Hours:  3 (Theory)  
Pre-requisites:  none  

COURSE OBJECTIVES:  
To improve the students’ proficiency in English Language.  

ESSENTIAL TOPICS TO BE COVERED:  
- Reading Comprehension  
- Writing  
- Listening  
- Speaking  

COURSE DESCRIPTION:  
This is a basic language course which not only familiarizes the students with the four skills of English language (reading, writing, listening, speaking) but also enables them develop each skill in integration with the other.  

Recommended Text(s):  
Practical English Usage (Michael Swan)  
A Selection of English Prose for B.Sc students.  
(Compiled by Nosheen Khan)  

References:  
A Writer’s Reference (Diana Hacker)  
The Business of Writing and Speaking (Larry M. Robins)
COURSE TITLE: Report Writing Skills

Credit Hours: 3 (Theory)
Pre-requisites: Communication Skills

COURSE OBJECTIVES:

To engage students in the process of technical writing vis-à-vis preparing them for the professional world.

ESSENTIAL TOPICS TO BE COVERED:

- All essential elements of technical writing

COURSE DESCRIPTION:

Identifying the author’s main idea/central theme of the selected passages from literature, social studies and science. Critical analysis & interpretation of selected passages, expository writing, listening and speaking.

Recommended Text(s):

Technical Writing: A Practical Approach
COURSE TITLE: Islamic Studies

Credit Hours: 3 (Theory)
Pre-requisites: none

COURSE OBJECTIVES:

To introduce the basic teachings of Islam to all computer engineering students.

ESSENTIAL TOPICS TO BE COVERED:

- Fundamentals of Islam
- Basic Sources of Shariah
- Sources of Knowledge
- Moral and social philosophy of Islam
- Islamic Political Principles
- Economics order of Islam
- Islam as a living force

COURSE DESCRIPTION:

**Tauheed:**
Arguments for the oneness of God, impact of *Tauheed* on human life. Place of man in the universe, purpose of creation, textual study of Surah al-Rehman and Surah al-Furqan, Prophethood, need for prophet, characteristics of a prophet, finality of prophethood, *seerat* life of the prophet as embodiment of Islamic ideology, faith in the hereafter *aakhirat*, effects of the belief on worldly life.

**Ibadah:**
Concept of *Ibadah*, major *Ibadah*, Salat, Saom, Zakat, Hajj and Jehad.

**Basic Sources of Shariah:**

**Sources of Knowledge:**
Islamic approach to institution, Reason and experience. Revelation Wahi as as source of knowledge.

**Moral and social philosophy of Islam:**

**Islamic Political Principles:**
Salient features of the Islamic state, Madina character, Responsibilities of the Head of the state, Rights and Duties of citizens.

**Economics order of Islam:**
COURSE TITLE: Pakistan Studies

Credit Hours: 3 (Theory)
Pre-requisites: none

COURSE OBJECTIVES:

To introduce the students to the history and ideology of Pakistan

ESSENTIAL TOPICS TO BE COVERED:

- Pakistan movement
- Two nation theory
- Economy and natural resources

COURSE DESCRIPTION:

Land of Pakistan: Land and people-strategic importance, natural resources. A brief historical background of creation of Pakistan, government and politics in Pakistan, languages and cultures of Pakistan.

Recommended Text(s):

Hamid Abdul., Muslim separatism in India A brief survey 1858-1947
Rizvi , Hasan Askari, military , state and society in Pakistan Lahore 2000.
Mehdi , nelofer., Foreign policy of Pakistan. Lahore.
Aziz K.K the making of Pakistan. A study in nationalism. Lahore
Management Sciences
COURSE TITLE: Engineering Economics

Credit Hours: 3 (Theory)
Pre-requisites: none

COURSE OBJECTIVES:

To provide students with a sound understanding of the principles, basic concepts and methodology of engineering economics.

ESSENTIAL TOPICS TO BE COVERED:

COURSE DESCRIPTION:


Recommended Text(s):

Engineering Economy by William G. Sullivan, James A. Bontadelli, Elin M. Wicks

Reference:

Contemporary Engineering Economics by Chan S. Park
COURSE TITLE: Project Planning and Management

Credit Hours: 3 (Theory)

Pre-requisites:

COURSE OBJECTIVES:

To develop ability to plan and manage computer engineering projects successfully, maximizing the return from each stage of the hardware and software development life cycle.

COURSE DESCRIPTION:

Designed for any one working in a project team environment or engineers who see an increasing management component in their work, this course will equip you with general project management skills to help deal with problems that can occur. It is suitable for people in any field of work but specially one that have a high technological content. You will also gain practical experience of using project management, techniques, including the use of software tool, with a real project of your own. The course topic includes project initiation, risk, estimating and contracts, planning human factors, project execution and standard methods.
Natural Sciences
COURSE TITLE: Calculus and Analytical Geometry
Credit Hours: 3 (Theory)
Pre-requisites: none

COURSE OBJECTIVES:
To introduce basic concepts of differential and integral calculus.

COURSE DESCRIPTION:
Inequalities, functions, shifting graphs, limits of function, continuity. Introduction to complex numbers, demorgan’s theorem, derivative of a function, application of derivatives, integration, indefinite integrals, definite integrals, application of integral, area, arc-length, transcendental functions, L’Hopital’s rule, Techniques of Integration, improper integrals, infinite series, limit of sequences of numbers, convergence and divergence tests, alternating series test, absolute and conditional convergence, power series, taylor’s series and Maclaurin series, convergence of taylor series: error estimates, applications of power series.

Recommended Text(s):
G.B. Thomas & R. L Finney: Calculus and Analytical Geometry (8 ed)
Calculus by Anton, Biven and Davis, 9th ed.
COURSE TITLE: Linear Algebra

Credit Hours: 3 (Theory)
Pre-requisites: none

COURSE OBJECTIVES:

To develop expertise in linear algebra and analysis of vector spaces through matrix operations.

ESSENTIAL TOPICS TO BE COVERED:

- Matrix and vector algebra
- Determinants
- Vector spaces
- Solution of linear equations
- Eigen-analysis

COURSE DESCRIPTION:


Recommended Text(s):

COURSE TITLE: Multivariable Calculus

Credit Hours: 3 (Theory)
Pre-requisites: Calculus and Analytical Geometry

COURSE DESCRIPTION:

Recommended Text(s):
COURSE TITLE: Ordinary Differential Equations

Credit Hours: 3 (Theory)
Pre-requisites: Calculus and Analytical Geometry

COURSE OBJECTIVES:
To introduce solution of ordinary differential equations.

ESSENTIAL TOPICS TO BE COVERED:

- Physical concept of differential equations
- Solution of first and second order differential equations
- Partial differential equations
- Fourier series and transforms
- Laplace transforms
- Z-transforms
- applications

COURSE DESCRIPTION:
Introduction to Differential Equations, ODE of First order and first degree, ODEs of second and higher orders. Complementary function and particular integral, Non-homogeneous linear differential equations. Systems of linear differential equations. Partial differentiation; functions of two or more variables; partial derivatives; higher order partial derivatives; total differentials and their applications to small errors; differentiation of implicit functions; chain rule, maxima and minima of a function of two variables, examples illustrating application to computer engineering.


Recommended Text(s):

E. Kreyszing, Advanced Engineering Mathematics (8th ed)
Glyn James, Modern Engineering mathematics.
COURSE TITLE: Applied Physics for Engineers

Credit Hours: 3 (Theory) + 1(Lab)
Pre-requisites: none

COURSE OBJECTIVES:

To introduce the students to basic concepts of physics as applied in computer engineering.

ESSENTIAL TOPICS TO BE COVERED:

- Basics of wave motion
- Elementary concepts of thermodynamics
- Basic optics
- Basic electricity and magnetism

COURSE DESCRIPTION:


Recommended Text(s):

*University Physics by Freedman and Young (Latest Edition),*
*College Physics by Resnick, Halliday and Krane (Latest Edition)*
COURSE TITLE: Numerical Computation

Credit Hours: 2 (Theory) + 1(Lab)
Pre-requisites: Ordinary Differential Equations

COURSE OBJECTIVES:

To introduce commonly used numerical techniques in computer engineering

ESSENTIAL TOPICS TO BE COVERED:

- Numerical solution of algebraic equations
- Numerical differentiation and integration
- Computer based solutions of difference and differential equations

COURSE DESCRIPTION:


Recommended Text(s):

Curtis F.Gerald Patrick O. Wheatley: Applied Numerical Analysis, Addison-Wesley
Donald Greenspan & Vincenzo Casulli: Numerical Analysis For Applied Mathematics, Science, and Engineering, Addison-Wesley
David Kahaner: Numerical Methods and Software, Prentice Hall.
COMPUTING
COURSE TITLE: Introduction to Computer Programming

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: none

COURSE OBJECTIVES:

To develop capabilities of the student to write structured/object oriented programs in an appropriate high level programming language, design input, expected output and user interface.

ESSENTIAL TOPICS TO BE COVERED:

- Program structures
- Elementary data types
- Functions/Objects
- Input/Output
- User Interface

COURSE DESCRIPTION:

Arrays, c-strings, 2-d arrays, multi-dimensional arrays, Records (structs), Pointers, Classes and Data Abstraction, Inheritance and Composition, polymorphism, Operator Overloading, Recursion, Procedural versus object oriented programming languages, object oriented design strategy and problem solving

Recommended Text(s):

Dietel & Dietel, C/C++: How to Program

References:

Simple Program Design: A step-by-step approach, Lesley Anne Robertson, Course Technology, 2000
COURSE TITLE: COMPUTER APPLICATION IN ENGINEERING

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: Introduction to Computer Programming

COURSE OBJECTIVES:

To introduce engineering drawing concepts using various tools required for software & hardware design.

ESSENTIAL TOPICS TO BE COVERED:

- Tools and techniques for engineering design
- Simulation tools

COURSE DESCRIPTION:

This is a practical course aimed at enabling students to use engineering drawing concepts using various tools required for software & hardware design. Tools like Visio and Rational Rose are used for software drawing like process diagrams, class diagram, sequence diagram, interaction diagrams and deployment diagram, Entity-Relationship diagram etc. Matlab and Orcad is used for electrical/computer systems design while AutoCAD like design tools are taught for 3D engineering drawings. Introduction to computer-aided design tools including AutoCAD, OrCAD, MATLAB, LabVIEW, Rational Rose and Vision, etc. Provide an understanding of computer-aided drafting principles and practices, and provide knowledge of engineering drawing fundamentals using AutoCAD. Drawing of electrical circuits and layouts of electronic assemblies. Study of theoretical concepts of electronic components and circuits using simulation softwares: PSPICE, MATLAB, and LabVIEW. Design of software designs using Visio and Rational Rose for understanding and implementing object oriented designs and standards like UML.

Recommended Text(s):
ENGINEERING FOUNDATION
COURSE TITLE: Electrical Circuits Analysis -I

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: none

COURSE OBJECTIVES:

To introduce basic electrical concepts, laws and simple DC circuit analysis.

ESSENTIAL TOPICS TO BE COVERED:

- Basic electrical elements
- Basic electrical laws
- D.C. analysis

COURSE DESCRIPTION:


Recommended Text(s):

COURSE TITLE: Electric Circuits Analysis -II

Credit Hours: 3 (Theory)
Pre-requisites: Electric Circuits Analysis –I

COURSE OBJECTIVES:

To introduce transient and steady state analysis of DC and AC circuits

ESSENTIAL TOPICS TO BE COVERED:

- Elementary Transient Analysis
- Sinusoidal State Analysis
- Exponential Excitation and the Transformed Network
- Mutual inductance

COURSE DESCRIPTION:

Differential and integral forms of circuit equations, consideration of initial conditions, analysis of first and second order circuits, network response to sinusoidal driving functions, complex impedance and admittance functions, development of concept of phasors, power considerations, complex power, maximum power transfer, series and parallel LC tuned circuits, quality factor, representation of excitation by exponential functions, single element response, forced response with exponential excitation, introduction to the transformed network, driving point impedance and admittance, mutual inductance, Laplace transform in circuit analysis

Recommended Text(s):

COURSE TITLE: Computer Organization

Credit Hours: 3 (Theory)
Pre-requisites: Digital Logic Design

COURSE OBJECTIVES:

To introduce the internal working and organization of various building blocks of a digital computer as well as simple assembly language programming techniques.

ESSENTIAL TOPICS TO BE COVERED:

- Organization of the CPU
- Fundamentals of computer organization
- Performance evaluation
- Computer arithmetic
- Memory system organization

COURSE DESCRIPTION:

Introduction to computers, central processing unit, RISC, CISC and VLIW, metrics for performance evaluation, control unit, ALU, registers, busses, instruction sets and addressing modes, arithmetic functions – adders, subtractors, multipliers and dividers, comparators, RTL, CPU structure, stack operations, main memory organization and technologies, RAID systems, I/O interfacing, parallel and serial transfer, memory mapped input/output, isolated input/output, interrupts and DMA, interrupt driven I/O, secondary storage organization, input/output devices.

Recommended Text(s):

COURSE TITLE: Algorithms and Data Structure

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: Introduction to Computer programming

COURSE OBJECTIVES:

To identify data structures and use them efficiently in algorithms for solving various problems.

ESSENTIAL TOPICS TO BE COVERED:

- Standard Data Types, Abstract Data Types (ADT) and their use
- User defined Data structures
- Searching and sorting algorithms, and their efficiency
- Use algorithms in solving various problems

COURSE DESCRIPTION:

Fundamental data structures, data types, abstract data types, user defined data types, algorithms and their complexity, time-space trade off, arrays, records and pointers, matrices, linked lists, circular lists, two way lists, sequential (array) and linked implementation of stacks and queues, polish notation, recursion, towers of Hanoi, recursive implementation of stacks and queues, priority queues, tree, binary tree, binary search tree, traversals, threaded trees, heap, general trees, graphs, depth-first/breadth first traversal, adjacency matrix, shortest distance algorithms, sorting (insertion sort, selection sort, merge sort, radix sort), hashing, searching: (linear search, binary search, depth first /breadth first search).

Recommended Text(s):

COURSE TITLE: Digital Logic Design

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: none

COURSE OBJECTIVES:

To introduce the basic knowledge of Boolean algebra, design and analysis of Combinational Logic Circuits, design and analysis of Sequential Logic Circuits, Registers, Counters, Memory and programmable logic devices.

ESSENTIAL TOPICS TO BE COVERED:

- Switching theory
- Combinational logic circuits
- Modular design of combinational circuits
- Memory elements
- Sequential logic circuits

COURSE DESCRIPTION:

Digital Computers and Binary Systems, Boolean Algebra and Logic Gates, Simplification of Boolean Functions, Combinational Logic Design, Combinational Logic with MSI and LSI, Sequential Logic/Circuits, Registers and Counters, Memory and Programmable Logic Devices,

Recommended Text(s):

COURSE TITLE: Electronics -I

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites:
- Applied Physics for Engineers
- Electric Circuits Analysis -I

COURSE OBJECTIVES:

To introduce large signal analysis and design of diode circuits and transistor based amplifiers.

ESSENTIAL TOPICS TO BE COVERED:

- Diode circuit analysis and applications
- Biasing of BJT amplifier.
- Biasing of FET amplifier.
- Modeling of amplifiers.
- Operational amplifier application.

COURSE DESCRIPTION:

Introduction to diodes and their applications (rectifiers, clippers and clampsers). BJT biasing, bias stability. Design and analysis of common emitter, common base and common collector amplifiers. FET biasing, design of common source, common drain and common gate amplifiers. Hybrid parameters, ac gain and frequency analysis of single/multistage amplifiers. Classes of amplifiers, power amplifiers, differential amplifiers, operational amplifiers and applications.

Recommended Text(s):

COURSE TITLE: Probability Theory and Random Variable

Credit Hours: 3 (Theory)
Pre-requisites: Calculus and Analytical Geometry

COURSE OBJECTIVES:

To introduce the basic concepts and engineering applications of probability.

ESSENTIAL TOPICS TO BE COVERED:

- axioms of probability
- random variables and distribution functions
- functions and sequences of random variables
- representation of random processes

COURSE DESCRIPTION:

Basic concept of probability, conditional probability, independent events, Baye’s formula. Concept of random variables, discrete and continuous one and two dimensional random variables, probability distributions, marginal and joint distributions and density functions. Important probability distributions (Binomial, Poisson, Uniform, Normal, Exponentials and hyper-geometric). Mean, variance, moments and moment generating functions, linear regression and curve fitting. Central limit theorem, autocorrelation and cross-correlations, power spectral density functions and stochastic processes.

Recommended Text(s):

COURSE TITLE: Signals and Systems

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: Ordinary Differential Equations

COURSE OBJECTIVES:

To introduce mathematical representation of signals and dynamic systems, and provide basis for frequency domain courses like DSP, communication systems and control systems.

ESSENTIAL TOPICS TO BE COVERED:

- Signals Representation
- Impulse Response, Convolution
- Dynamic System Representation through Differential and Difference Equations
- Physical concept of Fourier Series
- Physical concept of Fourier Transform
- Physical concept of Laplace Transform
- Dynamic System Representation through Transfer Functions

COURSE DESCRIPTION:

Linear Time-invariant systems, convolution integral for continuous-time systems, convolution sum for discrete-time systems, properties of linear time-invariant systems, systems described by differential and difference equations, Fourier Series, properties of continuous-time Fourier series, Continuous-time Fourier Transform and its inverse, properties of the transform, common transform pairs, discrete-time Fourier transform and its properties, frequency response corresponding to difference equations. sampling, uniform sampling, sampling theorem, aliasing, decimation, interpolation. Laplace Transform, region of convergence, properties, analysis of LTI systems, solution of differential equations, continuous and discrete-time filtering.

Recommended Text(s):

MAJOR BASED CORE  
(Breadth)

The breadth courses introduce students to different specialties in the field of computer engineering early in their studies. These courses are essential for all computer engineering students.
COURSE TITLE: Database Systems

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: Algorithms and Data Structures

COURSE OBJECTIVES:

To introduce various components, models and optimization techniques of data storage in a database.

ESSENTIAL TOPICS TO BE COVERED:

- Basic Database concepts
- Relational Database System: understanding, query and report
- Various problems in Database management and their solutions

COURSE DESCRIPTION:

Basic database concepts; Entity Relationship modeling, Relational data model and algebra, Structured Query language; RDBMS; Database design, functional dependencies and normal forms; Transaction processing and optimization concepts; concurrency control and recovery techniques; Database recovery techniques; Database security and authorization. Introduction to data mining, object oriented, distributed and multi dimensional databases. Small Group Project implementing a database

Recommended Text(s):


References:

COURSE TITLE: Data Communication and Computer Networks

Credit Hours: 3 (Theory) + 1 (Lab)

Pre-requisites:

COURSE OBJECTIVES:

To introduce basics of computer communication and fundamental principles behind modern data networks such as Internet

ESSENTIAL TOPICS:

- Introduction to OSI and TCP/IP Models
- Transmission Techniques
- Medium Access Control
- Routing Mechanisms
- Transport Protocols and Applications

COURSE DESCRIPTION:


Recommended Text(s):


References:

COURSE TITLE: Microprocessor Systems and Interfacing

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: Computer Organization

COURSE OBJECTIVES:

To introduce the organization and operation of microprocessor and microcontroller based systems. To introduce interfacing techniques.

ESSENTIAL TOPICS TO BE COVERED:

- Overview of microprocessors and microcontrollers
- Microprocessor system architecture
- Assembly language fundamentals
- Interfacing

COURSE DESCRIPTION:

Introduction to microprocessors and microcontrollers, microprocessor organization, internal/external architecture of example microprocessors, addressing techniques, addressing modes, machine language coding and the debug software development program, instruction set, assembly language program development through hardware and the MASM assembler, memory devices, cycles and sequencing, interfacing, microcontrollers, microprocessor applications, interrupts and ISRs; timings; I/O interfacing.

Recommended Text(s):

The x86 family by John Uffenbeck
The Intel Microprocessors, Architecture, Programming and Interfacing, 6th edition Walter Triebel

References:

COURSE TITLE: Object Oriented Programming

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: Introduction to Computer Programming

COURSE OBJECTIVES:

To introduce objects, class hierarchy, operations on objects and use them in solving real life problems.

ESSENTIAL TOPICS TO BE COVERED:

- Procedural versus object oriented programming techniques
- Object Modeling, design and development
- Class Hierarchy and object reuse techniques
- Practical problem solving using objects

COURSE DESCRIPTION:

Procedural versus object oriented programming languages, UML modeling, object oriented design strategy and problem solving, objects and classes, member functions, public and private members, dynamic memory management, constructors and destructors, templates, object encapsulation, derived classes, class hierarchies, inheritance and polymorphism, operator overloading, stream class, practical design through Object Oriented Programming

Recommended Text(s):


References:

COURSE TITLE: Operating Systems Concepts

Credit Hours: 3 (Theory)
Pre-requisites: Algorithms and Data Structures

COURSE OBJECTIVES:

To introduce various basic operational and management functions of an operating system.

ESSENTIAL TOPICS TO BE COVERED:

- History and evaluation of Operating Systems
- Process, CPU, Memory, File and input/output Management
- User and kernel modes and protection problems

COURSE DESCRIPTION:


Recommended Text(s):


References:

COURSE TITLE: Principles of Communication Systems

Credit Hours: 3 (Theory) + 1(Lab)
Pre-requisites: Signals and Systems

COURSE OBJECTIVES:

To introduce analog and digital modulation techniques, multiplexing schemes and spread spectrum communications.

ESSENTIAL TOPICS TO BE COVERED:

- Amplitude and frequency modulation
- Pulse modulation
- Multiplexing
- Digital modulation

COURSE DESCRIPTION:


Recommended Text(s):

Reference:
MAJOR BASED CORE
(Depth)

The depth courses offer specialization within the field of computer engineering. The HEC template requires that five courses be taught in this category. The students may select electives from any of the areas of specialization with some guidelines from their respective advisors. All depth courses must integrate a substantial design component. A partial list of possible “depth” courses is given below:
COURSE TITLE: Computer Architecture

Credit Hours: 3 (Theory) + 1(Lab)
Pre-requisites: Computer Organization

COURSE OBJECTIVE:

Upon completion of this course, the student will have basic understanding of computer system architecture including CPU design, memory subsystem design and performance enhancement techniques.

ESSENTIAL TOPICS TO BE COVERED:

- Processor systems design
- Memory subsystem design
- Device subsystems
- Performance enhancement techniques
- Parallel architectures

COURSE DESCRIPTION:

Overview of main computer architectures and their performance comparison, instruction set architecture, CPU design, cache memory, different designs of cache memory system, virtual memory system, address mapping using pages, pipeling, super scaling, and threading, instruction level parallelism (ILP), introduction to parallel processing. Branch prediction, pre-fetching, multithreading.

Recommended Text(s):

COURSE TITLE: Control Systems

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: Signals and Systems

COURSE OBJECTIVES:

To introduce modeling and linearization of dynamic systems. To introduce frequency based controller design and analysis techniques.

ESSENTIAL TOPICS TO BE COVERED:

- Modeling of Dynamic Systems
- Dynamic System Representations
- Transient and Steady State Analysis
- Controller Design

COURSE DESCRIPTION:

System modeling, modeling of electrical, mechanical, thermal, hydraulic and biological systems, transfer functions, open- and closed-loop control systems, block diagrams, block-diagram reduction, signal flow graphs, continuous-time system response of 1st, 2nd and higher order systems, response components, stability, poles and zeroes, Routh-Hurwitz test, performance specifications, type number, system sensitivity, Step and impulse response, analysis and design with the root-locus method, Frequency domain analysis and design, Nyquist criterion, gain and phase margins, PID controller implementation and tuning, introduction to State-space method, state equations, state transformations and diagonalization, time response from state equations, industrial applications of control systems, basic concept of PLC.

Recommended Text(s):

COURSE TITLE: Digital Signal Processing

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: Signals and Systems

COURSE OBJECTIVES:

To introduce concepts of digital filter design and spectrum analysis.

ESSENTIAL TOPICS TO BE COVERED:

- Convolution and frequency response
- Sampling
- Fast Fourier Transform
- Z-transforms
- Digital filters, FIR, IIR
- Industrial Applications

COURSE DESCRIPTION:

Applications of DSP, digital signals, systems and convolution. Flip and Slide Convolution & Frequency Response, Fourier transform and frequency response, discrete time Fourier transform, symmetry properties, sampling theorem & D/A reconstruction, DFT and FFT algorithms, DFT properties & Circular Convolution (spectrum analysis & windowing), FFT algorithms and high speed (block) convolution, Z-transform and its properties with inverse, FIR and IIR filters and their implementations, FIR filter design methods, IIR filter design methods, resolution & side lobes, spectrum analysis, power spectrum for random signals, porting of DSP algorithms on embedded systems especially on DSP chips including fixed point programming.

Recommended Text(s):

COURSE TITLE: Digital System Design

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: Digital Logic Design

COURSE OBJECTIVE:

The introduce the skills to write VHDL/Verilog code that can be synthesized to efficient logic circuits.

COURSE DESCRIPTION:

Introduction to Hardware Description Languages (HDLs), VHDL, Synthesizable Subset of VHDL, Digital System Modeling & Design using VHDL, Implementation Architectures, Finite State Machines, Digital Logic Testing and Simulation, Fault Simulation Techniques Design and Implementation Using FPGAs, Introduction to Application Specific Integrated Circuits (ASIC), ASIC Technologies, Design Methodologies, Design Verification, Analysis of Faulted Circuits, Design Methods for Data Intensive Applications (Digital Signal Processing and Telecommunication)

Text(s):

Reference:

COURSE TITLE: Electronics -II

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: Electronics -I

COURSE OBJECTIVES:

To introduce small signal “analysis and design” of amplifiers, and analysis of wave generation and regulation circuits.

ESSENTIAL TOPICS TO BE COVERED:

- Small signal analysis of transistor circuits
- Analysis of the basic operational amplifier
- Feedback amplifiers
- Classification of amplifiers
- Wave generation circuits
- Power supply circuits and regulation

COURSE DESCRIPTION:


Recommended Text(s):

Reference:
COURSE TITLE: Real Time Embedded Systems

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: Microprocessor System and Interfacing

COURSE OBJECTIVES:

To introduce sufficient knowledge required to understand the design of complete embedded systems, including their hardware and software.

ESSENTIAL TOPICS TO BE COVERED:

- Embedded system overview and fundamentals
- Embedded design life cycle
- Sensors and actuators
- Real time operating systems

COURSE DESCRIPTION:

Introduction to embedded systems; components, tools and platforms; The C2M embedded design process; sensors and actuators; embedded system software, mixing C and assembly, HW/SW co-design; fundamentals of real-time operating systems, concurrent software and multi-tasking, scheduling, inter-task communication & synchronization, case studies using examples of embedded systems.

Recommended Text(s):

COURSE TITLE:  Artificial Intelligence

Credit Hours:  3 (Theory)

Pre-requisites:  Algorithms and Data Structures

COURSE OBJECTIVES:

To introduce the foundations of artificial intelligence.

ESSENTIAL TOPICS TO BE COVERED:

- Expert systems
- Natural language processing
- Knowledge engineering

COURSE DESCRIPTION:


Recommended Text(s):

COURSE TITLE: Digital Image Processing

Credit Hours: 3 (Theory) + 1(Lab)
Pre-requisites: Linear Algebra, Signals and Systems

COURSE OBJECTIVES:

To introduce underlying concepts involved in processing digital images.

ESSENTIAL TOPICS TO BE COVERED:

• Image enhancement in spatial and frequency domain
• Image transforms (DFT, DCT, wavelet)
• Segmentation
• Restoration

COURSE DESCRIPTION:

Image formation process, types of images (Infrared, Thermal and Video etc), Image acquisition techniques, digitization, acquisition flaws, image storage, compression techniques, image transformation (translation, scaling, rotation, stereo), image enhancement, image histogram, contrast enhancement, histogram manipulation, thresh-holding, binarization, Grey scale and color images, smoothing, sharpening, edge detection, Image restoration, morphological operators (erosion, dilation, opening, closing), image segmentation, (Hough transform, skeletonization, thinning).

Recommended Text(s):
COURSE TITLE: Software Engineering

Credit Hours: 3 (Theory)
Prerequisites: Algorithms and Data Structures

COURSE OBJECTIVES:

To understand, analyze and develop complex software by going through different phases of software engineering methodology.

ESSENTIAL TOPICS TO BE COVERED:

- Requirement Engineering
- Analysis Models
- Design Models
- Project Management Processes
- Testing and Quality Assurance
- Deployment and Maintenance

COURSE DESCRIPTION:

Introduction to software engineering, Models of the software development process, Software requirements and specifications, Project planning, organization and management, Software analysis and design techniques, Team project activities, Software quality assurance, Software testing, Software Engineering tools (CASE Tools) and environments.

Recommended Text(s):

References:
COURSE TITLE: Distributed Computing

Credit Hours: 3 (Theory) + 1(Lab)
Pre-requisites: Computer Architecture, Operating Systems

COURSE OBJECTIVES:

To introduce various parallel computing approaches, and utilize parallel and distributed computing for solving real-world problems.

ESSENTIAL TOPICS TO BE COVERED:

- Multiprocessor systems
- Parallel Programming Models and Software Tools

COURSE DESCRIPTION:

Shared-Memory Multiprocessor Architecture: Symmetric Multi-Processor (SMP), CC-NUMA, and Distributed Shared Memory (DSM), Message-Passing Multicomputer Clusters: PC clusters, workstation clusters, server farms, cluster of SMPs, availability support, single-system image, job management in clusters, Grid Computing Infrastructure and Technologies: Grid technologies, major Grid Projects, Globus, GridSim, Condor-G, Nimrod, GridSec, etc.

Recommended Text(s):
COURSE TITLE: Systems Programming

Credit Hours: 3 (Theory) + 1(Lab)
Pre-requisites: Operating Systems Concepts
Microprocessors Systems and Interfacing

COURSE OBJECTIVES:

To introduce the basics of writing device drivers for typical operating systems.

ESSENTIAL TOPICS TO BE COVERED:

- Device drivers for various systems
- File system drivers

COURSE DESCRIPTION:

Introduction to the Microsoft Windows ® Operating System, File Processing, Memory Management, Memory Mapped Files and DLLs, Process management, Threads and scheduling, Thread synchronization, Inter-process Communication, Input/Output, Device Drivers (USB or Parallel Port), File System Drivers, Filter Drivers

Recommended Text(s):

Windows System Programming 3rd edition, Johnson M. Hart, Addison Wesley
COURSE TITLE: Computer Graphics

Credit Hours: 3 (Theory) + 1(Lab)
Pre-requisites: Introduction to Computer Programming

COURSE DESCRIPTION:

Introduction to Computer Graphics; Introduction to OpenGL; Vectors Review; Matrices Review; Graphics Pipeline; Line Drawing Algorithm; Bresenham; Clipping of Line, Cohen Sutherland; Aliasing; Anti-aliasing technique; 2D Transformation; Homogeneous 2D Transformation; 3D Transformation; Homogeneous 3D Transformation; Drawing Circles, Arcs Drawing Curves; Hierarchical Modeling; Projections; Camera Concepts; Back Face Detection; Light Sources; Material Properties; Texture Mapping; Environmental Mapping; Ray Tracing; Graphics in Games; Graphics in Movies

Text(s):

References:
INTER-DISCIPLINARY ENGINEERING ELECTIVES

These courses offer specialization in fields, closely associated with computer engineering. The HEC template requires that two courses be taught in this category. A partial list of possible IDEE courses is given below.
COURSE TITLE: Robotics

Credit Hours: 3 (Theory)
Pre-requisites: Control Systems

COURSE OBJECTIVES:

To introduce the basic terminology of robotics, and derive mathematical models for simple robotic systems.

ESSENTIAL TOPICS TO BE COVERED:

- Spatial Description
- Transformations
- Manipulator Kinematics

COURSE DESCRIPTION:

Introduction, components and subsystems, object localization, spatial description and transformations, kinematics (manipulator position / motion), statics, dynamics, mobile robots, task planning, sensors measurement and perception, control, programming.

Recommended Text(s):

Introduction to Robotics by Phillip John Mckerrow.
COURSE TITLE: Power Electronics

Credit Hours: 3 (Theory) + 1 (Lab)
Pre-requisites: Electronics II

COURSE DESCRIPTION:

Introduction of Power Electronics, Solid State Devices for Power Electronics, Power Diodes, Power BJTs, Power MOSFETs, IGBT, SCR’s, GTO, and TRIAC and DIAC, SCR Firing and Commutation Techniques, Thyristors Characteristics, Construction, Operations and Applications Thyristors Commutation, Half Wave and Full Wave Rectifiers, Un-Controlled and Controlled Rectifiers, 3-Phase, 6-Phase, 12-Phase and 24-Phase Rectifiers, AC Voltage Controllers, DC to AC Converters, Single Phase DC to AC Converters, Invertors, Half Bridge and Full Bridge Invertors, 3-Phase, 6-Phase and 12-Phase Inverters, DC to DC Converters, Design and Analysis of Regulated Power Supplies, Switch Mode Power Supplies, Uninterrupted Power Supplies.

Recommended Books:

Power Electronics: Converters, Applications, and Design by Ned Mohan
COURSE TITLE:  Power Distribution and Utilization

Credit Hours:  3 (Theory) + 1 (Lab)
Pre-requisites:  Electric Circuit Analysis II

COURSE DESCRIPTION:


Recommended Books:
Power distribution system by Dr. Sohail Aftab Qureshi.
Electrical Power distribution by Anthony J. Pansins