SYLLABUS

for

B.Tech. Programme

in

**Department of Computer Science & Engineering**

Effective from 2019-20

राष्ट्रीय प्रौद्योगिकी संस्थान अगरतला

**National Institute of Technology Agartala**

*Department of Computer Science and Engineering*

**Agartala, Jirania– 799046**

# Course Structure

| Subject Category | Number | Credits |
|---|---|---|
| Total Departmental Core subjects including laboratories | 27 | 88 |
| Total Departmental Elective subjects | 07 | 21 |
| Total Subjects from Basic Science | 02 | 08 |
| Total Subjects from Humanities | 02 | 06 |
| Seminar | 01 | 01 |
| Project | 02 | 07 |
| Comprehensive Viva Voce | 01 | 01 |
| **Total** | **42** | **132** |

**Subject Codes:**

| UCS | SEMESTER | TYPE= B/C/E/P | SERIAL NO. |
|---|---|---|---|

B = Departmental Core, C = Basic Core, E=Departmental Elective,
P =Laboratory/Practical/Seminar/Project/Viva

**Credit Composition:**

| L | T | P |
|---|---|---|

Where L=Lecture, T=Tutorial, P=Practical

**THIRD SEMESTER**

| COURSE CODE | COURSE NAME | L | T | P | CREDITS | PREREQUISITE |
|---|---|---|---|---|---|---|
| UCS03B01 | DATA COMMUNICATION | 3 | 1 | 0 | 4 | |
| UCS03B02 | DATA STRUCTURE AND PROGRAMMING METHODOLOGY | 3 | 1 | 0 | 4 | |
| UCS03B03 | DIGITAL CIRCUIT AND LOGIC DESIGN | 3 | 1 | 0 | 4 | |
| UCS03B04 | DISCRETE MATHEMATICAL STRUCTURES | 3 | 1 | 0 | 4 | |
| UCS03C01 | ENGINEERING MATHEMATICS - III | 3 | 0 | 0 | 3 | |
| UCS03B05 | INTRODUCTION TO GRAPH THEORY | 3 | 1 | 0 | 4 | |
| UCS03P01 | DATA STRUCTURE & PROGRAMMING METHODOLOGY LABORATORY | 0 | 0 | 3 | 2 | |
| UCS03P02 | DIGITAL CIRCUIT AND LOGIC DESIGN LABORATORY | 0 | 0 | 3 | 2 | |
| | **TOTAL** | | | | **27** | |

**FOURTH SEMESTER**

| COURSE CODE | COURSE NAME | L | T | P | CREDITS | PREREQUISITE |
|---|---|---|---|---|---|---|
| UCS04B06 | FORMAL LANGUAGE AND AUTOMATA THEORY | 3 | 1 | 0 | 4 | UCS03B04 |
| UCS04B07 | DESIGN AND ANALYSIS OF ALGORITHM | 3 | 1 | 0 | 4 | UCS03B02, UCS03B05 |
| UCS04C02 | ENGINEERING MATHEMATICS - IV | 3 | 0 | 0 | 3 | |
| UCS04B08 | MICROPROCESSOR & MICROCONTROLLER | 3 | 1 | 0 | 4 | UCS03B03 |
| UCS04B09 | OBJECT ORIENTED PROGRAMMING | 3 | 1 | 0 | 4 | |
| UCS04P03 | DESIGN AND ANALYSIS OF ALGORITHM LABORATORY | 0 | 0 | 3 | 2 | |
| UCS04P04 | OBJECT ORIENTED PROGRAMMING LABORATORY | 0 | 0 | 3 | 2 | |
| | **TOTAL** | | | | **23** | |

**FIFTH SEMESTER**

| COURSE CODE | COURSE NAME | L | T | P | CREDITS | PREREQUISITE |
|---|---|---|---|---|---|---|
| UCS05B11 | COMPUTER ARCHITECTURE AND ORGANIZATION | 3 | 1 | 0 | 4 | UCS03B03 |
| UCS05B12 | DATA BASE MANAGEMENT SYSTEM | 3 | 1 | 0 | 4 | |
| UCS05C03 | ENGINEERING ECONOMICS AND COSTING | 3 | 0 | 0 | 3 | |
| UCS05B13 | OPERATING SYSTEM | 3 | 1 | 0 | 4 | |
| | ELECTIVE - I | 3 | 0 | 0 | 3 | |
| UCS05P06 | COMPUTER ARCHITECTURE AND ORGANIZATION LABORATORY | 0 | 0 | 3 | 2 | |
| UCS05P07 | DATA BASE MANAGEMENT SYSTEM LABORATORY | 0 | 0 | 3 | 2 | |
| UCS05P08 | OPERATING SYSTEM LABORATORY | 0 | 0 | 3 | 2 | |
| | SEMINAR | 0 | 0 | 2 | 1 | |
| | **TOTAL** | | | | **25** | |

**SIXTH SEMESTER**

| COURSE CODE | COURSE NAME | L | T | P | CREDITS | PREREQUISITE |
|---|---|---|---|---|---|---|
| UCS06B13 | ARTIFICIAL INTELLIGENCE | 3 | 1 | 0 | 4 | |
| UCS06B14 | COMPILER DESIGN | 3 | 1 | 0 | 4 | UCS04B06 |
| UCS06B15 | COMPUTER NETWORK | 3 | 1 | 0 | 4 | UCS03B01 |
| UCS06C04 | MANAGEMENT AND MANAGERIAL ECONOMICS | 3 | 0 | 0 | 3 | |
| UCS06B16 | SOFTWARE ENGINEERING | 3 | 1 | 0 | 4 | |
| | ELECTIVE - II | 3 | 0 | 0 | 3 | |
| UCS06P09 | COMPILER DESIGN LABORATORY | 0 | 0 | 3 | 2 | |
| UCS06P10 | COMPUTER NETWORK LABORATORY | 0 | 0 | 3 | 2 | |
| UCS06P11 | SOFTWARE ENGINEERING LAB | 0 | 0 | 3 | 2 | |
| | **TOTAL** | | | | **28** | |

**SEVENTH SEMESTER**

| COURSE CODE | COURSE NAME | L | T | P | CREDITS | PREREQUISITE |
|---|---|---|---|---|---|---|
| | MACHINE LEARNING | 3 | 1 | 0 | 4 | UCS06B13, UCS03C01 |
| | ELECTIVE –III | 3 | 0 | 0 | 3 | |
| | ELECTIVE - IV | 3 | 0 | 0 | 3 | |
| UCS07P13 | PROJECT – I | 0 | 0 | 12 | 4 | |
| UCS07P14 | INDUSTRIAL TRAINING | | | | NON CREDIT | |
| | **TOTAL** | | | | **14** | |

**EIGHTH SEMESTER**

| COURSE CODE | COURSE NAME | L | T | P | CREDITS | PREREQUISITE |
|---|---|---|---|---|---|---|
| | ELECTIVE - V | 3 | 0 | 0 | 3 | |
| | ELECTIVE - VI | 3 | 0 | 0 | 3 | |
| | ELECTIVE - VII | 3 | 0 | 0 | 3 | |
| UCS08P15 | PROJECT - II | 0 | 0 | 12 | 4 | |
| UCS08P16 | COMPREHENSIVE VIVA VOCE | 0 | 0 | 0 | 2 | |
| | **TOTAL** | | | | **15** | |

**EIGHTH SEMESTER (ONLY FOR STUDENTS WHO WILL DO PROJECT WORK IN INDUSTRY)**

| SL NO. | COURSE | CREDIT |
|---|---|---|
| 1 | PROJECT | 10 |
| 2 | PROJECT SEMINAR PRESENTATION | 03 |
| 3 | COMPREHENSIVE VIVA VOCE | 02 |
| | **TOTAL** | **15** |

**LIST OF DEPARTMENTAL ELECTIVES IN FIFTH SEMESTER**

| COURSE CODE | COURSE NAME | L | T | P | CREDITS | PREREQUISITE |
|---|---|---|---|---|---|---|
| UCS05E01 | COMPUTER GRAPHICS | 3 | 0 | 0 | 3 | |
| UCS05E02 | DIGITAL IMAGE PROCESSING | 3 | 0 | 0 | 3 | |
| UCS05E03 | FOUNDATION OF CRYPTOGRAPHY | 3 | 0 | 0 | 3 | |

**LIST OF DEPARTMENTAL ELECTIVES IN SIXTH SEMESTER**

| COURSE CODE | COURSE NAME | L | T | P | CREDITS | PREREQUISITE |
|---|---|---|---|---|---|---|
| UCS06E04 | COMPUTER AND NETWORK SECURITY | 3 | 0 | 0 | 3 | UCS05B12 |
| UCS06E05 | DATA WAREHOUSING & DATA MINING | 3 | 0 | 0 | 3 | UCS05B11 |
| UCS06E06 | MOBILE COMPUTING | 3 | 0 | 0 | 3 | |

**LIST OF DEPARTMENTAL ELECTIVES IN SEVENTH SEMESTER**

| COURSE CODE | COURSE NAME | L | T | P | CREDITS | PREREQUISITE |
|---|---|---|---|---|---|---|
| UCS07E07 | BIG DATA ANALYTICS | 3 | 0 | 0 | 3 | UCS05B11 |
| UCS07E08 | CLOUD COMPUTING | 3 | 0 | 0 | 3 | |
| UCS07E09 | INFORMATION RETRIEVAL | 3 | 0 | 0 | 3 | UCS03B02, UCS04B07 |
| UCS07E10 | PATTERN RECOGNITION | 3 | 0 | 0 | 3 | |
| UCS07E11 | SOFT COMPUTING | 3 | 0 | 0 | 3 | UCS06B13 |
| UCS07E12 | UNIX SYSTEM PROGRAMMING | 3 | 0 | 0 | 3 | UCS05B12 |

**LIST OF DEPARTMENTAL ELECTIVES IN EIGHTH SEMESTER**

| COURSE CODE | COURSE NAME | L | T | P | CREDITS | PREREQUISITE |
|---|---|---|---|---|---|---|
| UCS08E13 | DEEP LEARNING | 3 | 0 | 0 | 3 | |
| UCS08E14 | EMBEDDED AND REAL TIME SYSTEM | 3 | 0 | 0 | 3 | UCS04B08 |
| UCS08E15 | HUMAN COMPUTER INTERACTION | 3 | 0 | 0 | 3 | |
| UCS08E16 | NATURAL LANGUAGE PROCESSING | 3 | 0 | 0 | 3 | UCS06B13, UCS03C01 |
| UCS08E17 | PRINCIPLES OF PROGRAMMING LANGUAGE | 3 | 0 | 0 | 3 | UCS03B02, UCS04B07, UCS04B06 |
| UCS08E18 | WEB TECHNOLOGY | 3 | 0 | 0 | 3 | |
| UCS08E19 | WIRELESS SENSOR NETWORK | 3 | 0 | 0 | 3 | UCS05B15 |

**LIST OF OPEN ELECTIVE IN EIGHTH SEMESTER**

| COURSE CODE | COURSE NAME | L | T | P | CREDITS | PREREQUISITE |
|---|---|---|---|---|---|---|
| UCS08E20 | APPLICATION OF MACHINE LEARNING IN TIME SERIES ANALYSIS | 3 | 0 | 0 | 3 | |

**TOTAL CREDIT IN B.TECH 1$^{ST}$ AND 2$^{ND}$ SEMESTER = 43**

**TOTAL CREDIT FROM B.TECH 3$^{RD}$ SEMESTER TO 8$^{TH}$ SEMESTER = 132**

**TOTAL CREDIT IN B.TECH CURRICULUM OF CSE DEPT. = 43 + 132 = 175**

# DETAILED SYLLABUS

*for*

# BACHELOR OF TECHNOLOGY

*in*

## Department of Computer Science and Engineering

Effective from 2019 -20

राष्ट्रीय प्रौद्योगिकी संस्थान अगरतला

National Institute of Technology Agartala
Agartala, Jirania– 799046

| INTRODUCTION TO PROGRAMMING | UCS12B01/ UCS21B07 |
|---|---|
| L T P<br>2 - 1 - 0 : 3 Credits | Prerequisites: *None* |

**Course Objective**:

Programming is the process of writing instructions for computers to produce software for users. More than anything, it is a creative and problem-solving activity. This is an inter- disciplinary subject taught to the undergraduate engineering students in their first year course. The main goal is to give basic knowledge about computer and basic computer language like C to them and to make the student learn a programming language. This course also offers to teach the student to write programs in C to solve the problems.

**UNIT-I :**

**BASICS OF COMPUTERS:**

**Introduction to Computers:** What is Computer, Characteristics of Computer, Evolution of Computers, Generations of Computers, Classifications of Computers, The Computer System, and Application of Computers.

**Number Systems and Logic Gates:**

Decimal-Binary-Octal-Hexadecimal Number System, Bits and Bytes, Conversion between Number Bases, Arithmetic System (Addition and Subtraction), Signed - Unsigned Numbers and Complements , Concept of Overflow, Binary Coding, Basic Logic Gates(AND, OR, NOT), Laws of Boolean Algebra , Construction of Logic circuit, Combination of Logic Gates (NAND, NOR, XOR, XNOR).

**Computer Architecture:** Basic Overview of: CPU, Memory, Primary Memory, Secondary Memory, Input Devices, Output Devices.

**Computer Program and Software:** What is Computer Program, What is Computer Programming Language, Classification of Programming Languages, Software: Definition, Relationship between Software and Hardware, Software Categories and their subcategories, Operation System: Definition, Function of Operating System, Types of Operating System.

**UNIT II:**

**C PROGRAMMING LANGUAGE:**

**Introduction to C Programming:** Characteristic of C, Structure of a C Program, Preprocessor directive, Files used in a C Program(Source file, Header file, Object file, Executable file), Escape sequences (Viz. \n, \t etc.), Compiling and executing C program, Using Comments, Keywords, Identifiers, Basic Datatypes in C, Variables and Constants, Input/Output Statement in C : Overview of text stream and binary stream, Formatting Input/Output, Printf(),scanf(),Specifier field in printf()and scanf() viz., c, d, f etc.

**Operators in C Programming:** Arithmetic Operators (+, -, *, /, %), Relational Operators (<, >, <=, >=), Equality Operators (==, !=), Logical Operators (Logical AND, Logical OR, Logical NOT), Unary Operators (Unary Minus, Increment, Decrement), Conditional Operator(?:), Bitwise Operators (Bitwise AND, Bitwise OR, Bitwise XOR, Bitwise NOT, Shift Operator), Assignment Operator, Comma Operator, Sizeof Operator, Properties of Operators: Priority and Associativity, Type Conversion and Type Casting.

**Decision Control and Looping Statements:** Selection/branching statements (Conditional Type: if, if-else; Unconditional Type: if-else-if, switch), Iterative Statements (While Loop, Do-while Loop, For Loop), Break Versus Continue Statement.

**Functions:** Function Declaration, Function Definition, Function Call, Passing Parameters to the Function: Call by Value and Call by Reference, Scope of Variables: Block Scope-Function Scope- Program Scope-File Scope,

Storage Classes: Auto-Register-Extern-Static, Recursive Functions, Types of Recursion, Recursion Versus Iteration.

**Arrays:** Declaration of Array, accessing Elements of the Array, Calculating the Address of Array Elements, Storing Values in Array( Initialization of Arrays, Inputting Values, Assigning Values), Calculating Length of the Array, Operations performed on Array (Traversal, Insertion, Search, Deletion, Merging, Sorting), One-Dimensional Array for Inter-Function Communication (Passing Individual Element by data values/addresses, Passing an entire array), 2-D Array, Multidimensional Array.

**Strings:** Reading a String, Writing a String, Operations on Strings (Concatenating two strings, Reversing a String etc.), String Manipulation Functions (strncat, strcpy, strcmp, strlen etc.) Array of Strings.

**Pointers:** Introduction to Pointers, Declaring Pointer Variables, Pointer Expression and Pointer Arithmetic, Null Pointer, Generic Pointer, Passing Arguments to Function using Pointers, Pointers and Array, Pointers and String, Array of Pointers, Function Pointers, Array of Function Pointers, Memory allocation/de-allocation Functions: malloc-calloc-free-realloc, Drawback of Pointers.

**Structure, Union, and Enumerated Data Types:** Structure, Nested Structure, Array of Structures, Self-Referential Structures, Union, Unions inside Structures, Enumerated Datatypes, enum Variables, Typedef, Enumeration Type Conversion, Single Linked List.

**Files:** Read data from File, Write data to File.

**Text Books:**

1. Introduction to Computer Science - ITL Education solutions limited, Pearson Education.
2. The C Programming Language by Dennis Ritchie And Brian Kernighan, PHI.

**Reference Books:**

1. An introduction to Computing & C Language-by Dr. P.N. Basu, New Light.
2. C How to Program - 5th Edition by Deitel, PHI.
3. Computer Science: A Structured Programming Approach Using C by Behrouz A.
4. Computer Basics and C Programming by V. Rajaraman, PHI.
5. Let's C- YashwantKanetkar, Allied Publishers.
6. Programming in C- ReemaThareja, Oxford.
7. C – programming By-E.Balagurusamy, TMH.
8. How to Solve it by Computer- G. Dromey, Prentice-Hall Inc.

| **COMPUTER PROGRAMMING LAB** | **UCS11P01/ UCS21P07** |
|---|---|
| L T P<br>0 - 0 - 2 : 1 Credit | Prerequisites: *None* |

**Objective of the Course**:

Main objective of the course is to introduce computer programming to a beginner using the programming language C.

**UNIT I: C PROGRAMMING LANGUAGE:**

**Introduction to C Programming:** Characteristic of C, Structure of a C Program, Preprocessor directive, Files used in a C Program(Source file, Header file, Object file, Executable file), Escape sequences (Viz. \n, \t etc.), Compiling and executing C program, Using Comments, Keywords, Identifiers, Basic Datatypes in C, Variables and Constants, Input/Output Statement in C : Overview of text stream and binary stream, Formatting Input/Output, Printf(),scanf(),Specifier field in printf()and scanf() viz., c, d, f etc.

**UNIT II: Operators in C Programming:**
Arithmetic Operators (+, -, *, /, %), Relational Operators (<, >, <=, >=), Equality Operators (==, !=), Logical Operators (Logical AND, Logical OR, Logical NOT), Unary Operators (Unary Minus, Increment, Decrement), Conditional Operator(?:), Bitwise Operators (Bitwise AND, Bitwise OR, Bitwise XOR, Bitwise NOT, Shift Operator), Assignment Operator, Comma Operator, Sizeof Operator, Properties of Operators: Priority and Associativity, Type Conversion and Type Casting.

**UNIT III: Decision Control and Looping Statements:**
Selection/branching statements (Conditional Type: if, if-else; Unconditional Type: if-else-if, switch), Iterative Statements (While Loop, Do-while Loop, For Loop), Break Versus Continue Statement.

**UNIT IV: Functions:**
Function Declaration, Function Definition, Function Call, Passing Parameters to the Function: Call by Value and Call by Reference, Scope of Variables: Block Scope-Function Scope- Program Scope-File Scope, Storage Classes: Auto-Register-Extern-Static, Recursive Functions, Types of Recursion, Recursion Versus Iteration.

**UNIT V Arrays and Strings:**
**Arrays:** Declaration of Array, accessing Elements of the Array, Calculating the Address of Array Elements, Storing Values in Array Initialization of Arrays, Inputting Values, Assigning Values), Calculating Length of the Array, Operations performed on Array (Traversal, Insertion, Search, Deletion, Merging, Sorting), One-Dimensional Array for Inter-Function Communication (Passing Individual Element by data values/addresses, Passing an entire array), 2-D Array, Multidimensional Array.
**Strings:** Reading a String, Writing a String, Operations on Strings (Concatenating two strings, Reversing a String etc.), String Manipulation Functions (strncat, strcpy, strcmp, strlen etc.) Array of Strings.

**UNIT VI Pointers:**
Introduction to Pointers, Declaring Pointer Variables, Pointer Expression and Pointer Arithmetic, Null Pointer, Generic Pointer, Passing Arguments to Function using Pointers, Pointers and Array, Pointers and String, Array of Pointers, Function Pointers, Array of Function Pointers, Memory allocation/de-allocation Functions: malloc-calloc-free-realloc, Drawback of Pointers.

**UNIT VII: Structure, Union, and Enumerated Data Types:**
Structure, Nested Structure, Array of Structures, Self-Referential Structures, Union, Unions inside Structures, Enumerated Datatypes, enum Variables, Typedef, Enumeration Type Conversion, Single Linked List.

**UNIT VIII: Files:**
Read data from File, Write data to File.

**Text Books:**

1. The C Programming Language by Dennis Ritchie And Brian Kernighan PHI.

**Reference Books:**

1. C How to Program - 5th Edition by Deitel published by PHI.
2. Programming With C - by Gottfried, Byron S, Publisher: TMH
3. Computer Science: A Structured Programming Approach Using C by Behrouz A.
4. Let's C- YashwantKanetkar, Allied Publishers.
5. Computer Basics and C Programming by V. Rajaraman, PHI.
6. Programming in C- ReemaThareja, Oxford.
7. C – programming By-E.Balagurusamy, TMH.

# Third Semester

| **DATA COMMUNICATION** | **UCS03B01** |
|---|---|
| L T P<br>3 -1 -0 : 4 Credits | Prerequisites: *None* |

**Course Objective:**

1. To understand the concept of data communication and modulation techniques.
2. To comprehend the use of different types of transmission media and network devices.
3. To understand the error detection and correction in transmission of data.
4. To understand the concept of flow control, error control and LAN protocols.
5. To understand the functions performed by Network Management System.

**UNIT-I**

Basic goals of communication-components, Data flow, protocol and standards; Signals for communication: Time-domain and frequency-domain representation of signals, Analog/digital/sampled, Periodic/A periodic signals.

**UNIT-II**

Fourier series, Fourier transform frequency spectrum, filtering and bandwidth, Transmission impairments: Attenuation and distortion problems and remedies, Maximum data rate of a channel, Nyquist sampling theorem, Communication channel: Important characteristics of a communication channel, Available communication channels (media): guided and unguided media and their properties, Data communication over radio/microwave/satellite/infrared links. Baseband data communication: Basic concepts of analog and digital communication in the baseband.

**UNIT-III**

Various encoding formats for data, Analog Modulation and Demodulation techniques: AM/FM/PM, Digital modulation- ASK/FSK/PSK, Pulse modulation and pulse coded modulation schemes- PAM/PCM/DM etc, Transmission modes: synchronous and asynchronous, sampling, , filtering, pass band need for quantization, aliasing, and reconstruction filter, problem of quantization, quantizer design and noise. Various multiplexing techniques: FDM, WDM, TDM. Principles of Spread spectrum communication (DSSS, FHSS).

**UNIT-V**

Errors in transmission/storage need for forward error detection and control, need for feedback error detection and control, field, group and algebra of error control coding, Error detection and correction in a frame LRC/VRC/Checksum/ CRC and Hamming code.

**UNIT-VI**

Data link protocols: noisy and noiseless channels. Ethernet and IEEE 802.11 standards, Bluetooth

architecture, Resource allocation and performance issues in wired/wireless LAN, Multimedia communication and data compression.

**Text Books:**


1. B.A. Forouzan, "*Data Communications and Networking*", 4th edition, Tata McGraw Hill, 2003.
2. W. Stallings, "*Data and Computer Communications*", 6th edition, Pearson education Asia (IPE), 2000.Social Media Mining.


**Reference Books:**


1. S. Haykin, "*Communication Systems*", 3rd edition, John Wiley, 1994.
2. H. Taub and D. Schilling, "*Principles of Communication Systems*", 3rd edition, Tata McGraw Hill.
3. F. Halshall, "*Data Communications, Computer networks and Open Systems*", 4th edition, Pearson Education Asia (IPE), 1996.
4. D. Bertrekas and R. Gallagar, "*Data Networks*", 2nd edition, Prentice Hall (EEE), 1992.
5. J.Proakis and M.Salehi, "*Communication System Engineering*", Prentice Hall, 1995 Schiller, "Mobile Communications", Pearson Education Asia, 2000.


**List of Open Source Software/learning website:**

1. http://nptel.ac.in
2. www.youtube.co

| **DATA STRUCTURES & PROGRAMMING METHODOLOGY** | **UCS03B02** |
|---|---|
| L T P<br>3 - 1 - 0 :4 Credits | Prerequisites: *None* |

**Course Objective**:

- Be familiar with basic techniques of algorithm analysis and in writing recursive methods.
- Master the implementation of linked data structures such as linked lists and binary trees.
- Be familiar with advanced data structures such as balanced search trees, hash tables and priority queues.
- Be familiar with several sub-quadratic sorting algorithms including quick sort, merge sort and heap sort
- Be familiar with some graph algorithms such as shortest path and minimum spanning tree
- Master analyzing problems and writing program solutions to problems using the above techniques

**UNIT-I**

**INTRODUCTION:**

Basic concepts and notations: data structures and data structure operation, Interrelationship of Data structure and algorithms. Asymptotic complexity analysis, Abstract Data Types, Recursive programming and recurrence relations.

**ARRAYS:**

Different representation of Array, Sparse matrix - its implementation and usage, Array representation of polynomials, Circular arrays.

**UNIT -II**

**STACKS and QUEUES:**

Fundamental of stacks, Operations on stacks, Evaluation of postfix and prefix expressions, conversion from infix to postfix representation, implementing recursive functions, Application of Stack. Fundamental of Queues, Representation with arrays, Operation on Queues, Circular queue, multiple queues dynamics, Dequeues.

**UNIT -III**

**LINK LISTS:**

Singly linked list and their manipulation, doubly linked list, Circular linked list, Circular doubly linked list, Dynamic storage management, Garbage collection, Generalized list, Linked stacks and queues.

**TREES:**

Binary trees and its representation arrays, Tree traversals (Preorder, Inorder and Postorder), Threaded binary tree, Binary tree representation of tree, Binary search trees, Balanced binary search trees, heaps,Height balanced binary tree ,AVL tree,B- Trees.

**UNIT -IV**

**SORTING AND SEARCHING:**

Searching –linear search, binary search, Different algorithms for sorting – Bubble sort, Selection sort, Insertion sort, Merge sort, Quick sort, Heap sort, Radix sort.

**UNIT -V**

**GRAPH REPRESENTATION**:

Graph definitions and concepts. Graph Traversal Techniques: Breadth First Search (BFS) and Depth First Search (DFS), Applications of BFS and DFS, Minimum Spanning Trees (MST), Prim's and Kruskal's algorithms for MST.

**HASHING AND HEAPS:**

Comparing direct address tables with hash tables, hash functions, concept of collision and its resolution using open addressing and separate chaining, double hashing, rehashing. Representing a heap in memory, operations on heaps, application of heap in implementing priority queue.

**Text Books:**


1. D. Samanta, "Classic Data Structures", PHI.
2. S. Lipschutz, "Data Structure", Schaum's Outline Series, TataMcGraw – Hill.


**Reference Books:**


1. M. Tenenbaum and Augestien, "Data Structures using C", Third Edition, Pearson Education 2007.
2. J.P. Tremblay and P.J. Sorenson, "An Introduction to Data Structures With Applications", Tata Mcgraw Hill.
3. S. Horowitz and S. Sahani "Fundamentals of Data Structures", Computer Science Press.

Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson, II Ed, 2004.

| DIGITAL CIRCUIT & LOGIC DESIGN | UCS03B03 |
|---|---|
| L T P<br>3 - 1 - 0 : 4 Credits | Prerequisites: *None* |

**Course Objective**:
Digital Logic Design is foundational to the fields of electrical engineering and computer engineering. Digital Logic designers build complex electronic components that use both electrical and computational characteristics. These characteristics may involve power, current, logical function, protocol and user input. The course teaches digital design fundamentals for combinational logic circuits along with an introduction to sequential logic circuits. The aim of this course is to provide an understanding of the fundamentals of digital logic design to the students. Digital Logic Design is used to develop hardware, such as circuit boards and microchip processors. This hardware processes user input, system protocol and other data in computers, navigational systems, cell phones or other high-tech systems.

**UNIT I**

**Number System & Codes:**
Number Systems: Binary, Decimal, Octal and Hexadecimal, Number Base conversion Complements, Binary Codes, Binary Logic.

**Boolean Algebra & Logic Gates:**
Basic Definitions: Axiomatic definition of Boolean algebra, basic theorems and properties of Boolean algebra, Boolean functions, canonical & standard forms, Digital logic Families: Operation, characteristics of digital logic family.
The Karnaugh map method, The tabulation method or Quine McCluskey Method, Determination of prime implicants, selection of prime-implicants.

**UNIT II**

**Combinational Logic UNITs and their applications**:
Arithmetic UNITs- adders, Subtractors, Comparators and ALU, Design examples.
Decoders, Three-State Buffers. Encoders, Multiplexer, Demultiplexer, Exclusive OR Gates and Parity Generator and Checker, Documentation Standards, Circuit Timing. Combinational PLDs; PLAs; PALs; GALs; Bipolar PLD Circuits.

**UNIT III**

**Synchronous Sequential Logic:**
Definition of state machines, state machine as a sequential controller; Basic sequential circuits- latches and flip-flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop;
Timing hazards and races; Analysis of state machines using D flip-flops and JK flipflops; Design of state machines - state table, state assignment, transition/excitation table, excitation maps and equations, logic realization; Design examples.

**Asynchronous Sequential Logic:**
Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards, Counters, Shift Registers, Iterative versus Sequential Circuits, Synchronous Design Methodology.

**UNIT IV**

**Memory and Programmable Logic:**
Memory: Read-Only Memory, Read/Write Memory, Static RAM, Dynamic RAM.
Programmable Logic Devices: PLAs, PALs and their applications; Sequential PLDs and their applications; State machine design with sequential PLDs; Introduction to field programmable gate arrays (FPGAs).

**Digital Integrated Circuits**:
Introduction to digital logic families, RTL and DTL circuits, integrated injection –logic, transistor logic,

emitter coupled, Metal Oxide Semiconductor, complementary MOS.
Study to different types of analog to digital & digital to analog converters and their resolution, conversion time, sensitivity, accuracy and other parameters.

**Text Books:**


1. Digital Logic and Computer Design by M. Morris Mano, Prentice Hall of India
2. Digital Electronics Principles by D.P. Malvino and Leach, McGraw Hill Inc.


**Reference Books:**


3. Digital Electronic Circuits by T.C. Bartee, Mcgraw Hill Inc.
4. Digital Design Principles and Practices by John F Wakerly, Pearson Education.
5. Modern Digital Electronics by R. P. Jain, Mcgraw Hill Education.
6. Fundamentals of Digital Analysis by Sandige, Richard S., Mcgraw Hill Inc.


| **DISCRETE MATHEMATICAL STRUCTURES** | **UCS03B04** |
|---|---|
| L T P<br>3 - 1 - 0 :4 Credits | Prerequisites: *None* |

**Course Objective**:

To teach the students the art of reasoning. The course focusses on techniques for constructing mathematical proofs, some fundamental mathematical concepts and terminology; sets, functions, relations, orders, and sequences. The principles of mathematical logic, and some discrete structures is discussed. Understand some basic properties of graphs and related discrete structures, and be able to relate these to practical examples.

**UNIT I**

**SET THEORY:**

Basic concepts – Notations – Subset – Algebra of sets – The power set – Ordered pairs and Cartesian product – Relations on sets –Types of relations and their properties – Relational matrix and the graph of a relation – Partitions – Equivalence relations – Partial ordering – Poset – Hasse diagram – Lattices and their properties – Sublattices – Boolean algebra – Homomorphism.

**UNIT II**

**FUNCTIONS:**

Definitions of functions – Classification of functions - Composition of functions – Inverse functions – Binary and n-ary operations – Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions.

**UNIT III**

**PROPOSITIONAL CALCULUS:**

Propositions – Logical connectives – Compound propositions – Conditional and biconditional propositions – Truth tables – Tautologies and contradictions – Contrapositive – Logical equivalences and implications – DeMorgan's Laws - Normal forms – Principal conjunctive and disjunctive normal forms – Rules of inference – Arguments - Validity of arguments.

**UNIT IV**

**PREDICATE CALCULUS:**

Predicates – Statement function – Variables – Free and bound variables – Quantifiers – Universe of discourse – Logical equivalences and implications for quantified statements – Theory of inference – The rules of universal specification and generalization – Validity of arguments.

**UNIT V**

**GROUPS AND RINGS:**

Algebraic systems – Definitions – Examples – Properties – Semigroups – Monoids – Homomorphism – Sub semigroups and Submonoids - Cosets and Lagrange's theorem – Normal subgroups – Normal algebraic system with two binary operations - Codes and group codes – Basic notions of error correction - Error recovery in group codes.

**MONOIDS AND GROUPS:**

Groups Semigroups and monoidsCyclicsemigraphs and submonoids, Subgroups and Cosets. Congruence relations on semigroups.Morphisms.Normal subgroups. Structure of Cyclic groups permutation groups, dihedral groups Elementary applications in coding theory. Rings and Boolean algebra: Rings Subrings morphism of rings ideals and quotient rings. Euclidean domains Integral domains and fields Boolean Algebra direct product morphisms Boolean sub-algebra Boolean Rings Application of Boolean algebra in logic circuits and switching functions.

**Text Book:**

Seymour Lipschutz , Marc Lipson ,Schaum's Outline of Discrete Mathematics, 3rd Edition

**Reference Books:**


1. Kenneth H.Rosen, "Discrete Mathematics and its Applications", Fifth Edition, Tata McGraw – Hill
2. Swapan Kumar Chakraborty, BikashKanthiSarkar, Discrete Mathematics, Oxford , 1st Edition


| **ENGINEERING MATHEMATICS III** | **UCS03C01** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: *None* |

**1.Probability and Statistics:**

**1.1.Probability and Random Variable:** Axioms of probability, Conditional probability, Independent events, Baye's Theorem, Random variables, Probability mass function, Probability density function - properties, Moments, Moment generating functions and their properties.

**1.2.Standard Distributions:** Binomial, Poisson Normal distribution and their properties, function of random variables.

**1.3.Two-dimensional random variables:** Joint distribution, Marginal and conditional distribution, covariance, correlation and regression, Transformation of random variables, Central limit theorem.

**1.4.Testing of hypothesis:** Sampling distribution, Testing of hypothesis of mean, variance, proportion and differences using Normal, t and Chi-square.

**2. Fourier Series:** Periodic functions, Fourier series, Dirichlet's conditions, function defined in two or more sub-ranges, discontinuous functions, even function, odd function, half range series, change of interval.

**3. Partial Differential Equations:** Order, Method of forming Partial Differential Equations, Solution of Equation by Direct Integration, Lagrange's Linear equation, Method of Multipliers, Partial Differential equations non-linear in p,q, Charpits Method, Linear Homogeneous Partial Differential equation, Non-Homogeneous Linear Equations, Method of Separation of variables, Equation of vibrating string, Solution of wave equation by D'Alembert's method, One dimensional heat flow, Two dimensional Heat flow.

**Text Book:**

1. Advanced Engineering Mathematics: E. Kreyszig.
2. Advanced Engineering Mathematics: H.K.Dass.
3. A Textbook of Engineering Mathematics: N.P.Bali& Manish Goyal.
4. Advanced Engineering Mathematics: B.S.Grewal.
5. Statistical Methods: Gupta &Kapoor/Kapoor&Sexena.
6. Integral Calculas: Maity&Ghosh

| **INTRODUCTION TO GRAPH THEORY** | **UCS03B05** |
|---|---|
| L T P<br>3 - 1 - 0 : 4Credits | Prerequisites: *None* |

**Course Objective:**

Due to its simplicity, graph theory has a wide range of applications in different branches of engineering. This subject is also used in social science, linguistics and in numerous other areas. This course is aimed to cover a variety of different problems in Graph Theory. In this course students will come across a number of theorems and proofs. Theorems will be stated and proved formally using various techniques and also applications related to each theorem will be solved further. Various graph theoretic algorithms will also be taught and discussed for their use in various field of Computer Science & Engineering.

**Outcome:**

After the course the student will have a strong background of graph theory which has diverse applications in the areas of computer science, like Computer Network, Social Network Analysis, Software Engineering etc.

**UNIT I**

**Introduction:** Graphs and their applications, graph theoretic terms: incidence, adjacency, degree, null graph, walk, trail, path, circuit, connected and disconnected graphs, various operations on graphs, isomorphism, Euler's graphs, Hamiltonian graphs, directed graph and its uses.

**UNIT II**

**Trees and Fundamental circuits:** Properties of trees, Jordan's Theorem, rooted trees, binary trees, counting trees, Cayley's theorem, spanning trees, matrix-tree theorem, fundamental circuits.

**UNIT III**

**Connectivity:** Cut set & its properties, Vertex and edge connectivity, Menger's theorem, 1-Isomorphism and 2-isomorphism.

**Planer graphs:** Planer graphs and their representation, detection of planarity, Geometric dual, thickness and crossing.

**UNIT IV**

**Matrix representation:** Different matrix and their representation in directed and undirected graphs.

**Coloring, matching and covering:** Chromatic number, Chromatic partitioning, Chromatic polynomial, bipartite graph, matching and Hall's theorem, Covering, four-color and five-color theorem.

**UNIT V**

**Graph Theoretic Algorithms:** Prim's & Kruskal's algorithm, Dijkstra's algorithm, Bellman-Ford Algorithm, Floyd-Warshall algorithm, Ford-Fulkerson Algorithm.

**Text Book:**


1. Graph Theory with applications to Engineering and Computer Science; N. Deo., 3rd Edition, PHI Learning.
2. Introduction to Graph Theory: Douglas West, 2nd Edition, Pearson Publisher.


**Reference Book:**


1. Graph Theory with Applications: C. Vasudev, 1st Edition, New Age International Publisher.
2. Graph Theory: F. Harary, 3rd Edition, Addison-Wesley Publisher.
3. Algorithmic Graph Theory: Alan Gibbons, 6th Edition, Cambridge University Press.


| **DATA STRUCTURE & PROGRAMMING METHODOLOGY LABORATORY** | **UCS03P01** |
|---|---|
| L T P<br>0 - 0 - 3 : 2 Credits | Prerequisites: *None* |

**UNIT I**

Introduction to Data Structure using C, implementation of 1D Array, perform different operations on 1D Array like insert, delete, search etc, implementation of matrix using 2D Array, perform different operations on 2D Array like insert, delete, search etc, implementation of sparse matrix, implementation of Polynomials.

**UNIT II**

Implementation of Stack using Array, different operations on Stack, evaluation of postfixes and prefix expressions, implementing recursive functions, implementation of Queue using Array, Operations on Queues, implementation of circular Queue.

**UNIT III**

Implementation of Linked list using Array, Practicing types of Linked list (double, circular, circular double), Different operations on Linked list, Implementation of Stack using Linked list, Implementation of Queue using Linked list.

**UNIT IV**

Implementation of Binary tree, implementation of Binary tree traversal methods: Pre-order, In-order, Post-ordered traversal, implementation of Binary Tree using Recursion, implementation of Binary search tree operation-search, addition, deletion.

**UNIT V**

Implementation of different searching technique, implementation of Bubble sort, Selection sort, Insertion sort, Merge sort, Quick sort, Heap sort, Radix sort, implementation of graph and different Graph Traversal Techniques.

**Text Book:**

1. Robert Kruse & Bruce Leung, "Data Structures & Program Design in C", Pearson Education.

**Reference Books:**

1. Ellis Horowitz, SatrajSahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", W. H. Freeman and Company.
2. E. Balaguruswamy, "Programming in ANSI C", Tata McGraw-Hill.
3. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Prentice Hall of India.

| **DIGITAL CIRCUIT & LOGIC DESIGN LABORATORY** | **UCS03P02** |
|---|---|
| L T P<br>0 - 0 - 3 : 2 Credits | Prerequisites: *None* |

**UNIT I**

To study and verify the truth table of various logic gates (NOT, AND, OR, NAND, NOR, X-OR, & X-NOR).

**UNIT II**

Study on basic theorems and properties of Boolean algebra, Boolean functions, canonical & standard forms, Digital logic Families: Operation, characteristics of digital logic family

Implementation of Demorgans theorem using Logic gates; Implementation of Boolean Expression Simplification

**UNIT III**

**Combinational Logic Circuit**:

Designing of adders, Subtractors, Comparators, Three-State Buffers.Encoders, Decoders, Multiplexer, Demultiplexer, Parity Generator and Checker.

**UNIT IV**

**Sequential Logic Circuit:**

Designing of SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop;

Analysis of state machines using D flip-flops and JK flipflops; Design of state machines - state table, state assignment, transition/excitation table, excitation maps and equations, logic realization; Design examples.

Analysis and Design of Asynchronous Sequential Circuits; Designing of Binary Counter, Decade Counter, Shift Register.

**UNIT V**

**Code converters:**

Study of different types of code converters; Designing of Binary to Gray and viceversa; Designing of BCD to EXCESS 3 code and viceversa etc.

**Text Book:**

1. Digital Logic and Computer Design by M. Morris Mano, Prentice Hall of India

# Fourth Semester

| FORMAL LANGUAGE AND AUTOMATA THEORY | UCS04B06 |
|---|---|
| L T P<br>3 - 1 - 0 : 4 Credits | Prerequisites: UCS03B0 |

**Course Objective:**

After completion of this course, the student should be able to:

- Explain and manipulate the different concepts in automata theory and formal languages such as formal proofs, (non-)deterministic automata, regular expressions, regular languages, context-free grammars, context-free languages, Turing machines;
- Explain and manipulate the different concepts in automata theory and formal languages such as formal proofs, (non-)deterministic automata, regular expressions, regular languages, context-free grammars, context-free languages, Turing machines;
- Explain the power and the limitations of regular languages and context-free languages.
- Design automata, regular expressions and context-free grammars accepting or generating a certain language;
- Describe the language accepted by an automata or generated by a regular expression or a context-free grammar;
- Transform between equivalent deterministic and non-deterministic finite automata, and regular expressions;
- Simplify automata and context-free grammars;
- Determine if a certain word belongs to a language;
- Define Turing machines performing simple tasks.

**Unit I:**

Finite Automata-Deterministic, non-deterministic and equivalence - Equivalence of regular expressions and FA - Moore and Mealy machines.

**Unit II:**

Regular Languages-Pumping lemma of regular sets - MyhillNerode theorem - Minimization of finite automata - Chomsky hierarchy of languages.

**Unit III:**

Text-Free Language- Context-free grammar - Derivation trees - Ambiguity simplification - Normal forms - Applications.

**Unit IV:**

Pushdown Automata- Definitions - Context free languages - Construction of PDA for simple CFLs - Linear bounded automata.

**Unit V:**

Turing Machines-The Turing machine, programming techniques for Turing machine, extensions to the basic Turing machine, restricted Turing Machines, Turing machines and Computers, Undecidable Problem about Turing Machine, Post's Correspondence Problem.

**Reference Book:**

1. Introduction to languages and the theory of computation by John C. Martin

2. Theory of Computer Science: Automata, Languages and Computation, by Mishra K.L.P., Chandrasekaran N., PHI publication.
3. An introduction to Automata Theory & Formal Languages, Adesh K. Pandey, Katson Books publication.

| **DESIGN AND ANALYSIS OF ALGORITHM** | **UCS04B07** |
|---|---|
| L T P<br>3 - 1 - 0 : 4 Credits | Prerequisites: UCS03B02,<br>UCS03B05 |

**Course Objective:**

This course shall cover solving techniques of different problems in computer science with algorithms and their computational complexities. It will cover algorithms used in computer networking, Computer securities, Encryption & data compression, Operating system optimization, and other real life problem solving applications. The later part shall cover NP and approximation algorithms in details.

**UNIT I**

**Foundation:** Asymptotic Notation: Big-oh, Big-omega, Theta, Little-oh, Little-omega, Complexity Analysis (Best, Worst and Average Case).

**UNIT II**

**Algorithm Design and Analysis Techniques:**

**Divide and Conquer Method:** Long Integer Multiplication, Strassen's matrix multiplication, Recurrences, Master method.

**Greedy Method:** Activity Selection Problem, Huffman Codes and Knapsack fractional.

**Dynamic Programming Method:** Knapsack 0 – 1, Matrix Chain Multiplication, Optimal Binary Search Tree and Longest Common Subsequence.

**UNIT III**

**Graph Algorithms:** Graph Representation.

**Graph Traversal:** Breadth First Search, Depth First Search.

**Growing of a minimum spanning tree:**Kruskal and Prim's algorithm.

**Single Source Shortest Paths:** Bellman Ford and Dijkstra's algorithm.

**All Pairs Shortest Paths:** Floyd Warshall algorithm.

**Maximum Flow:** Ford Fulkerson method.

**UNIT IV**

**Miscellaneous Algorithms:** Multithreaded algorithms, Polynomial Multiplication, Fast Fourier Transform, Extended Euclid Algorithm.

**String Matching:**Naïve's algorithm, Rabin Karp algorithm and string matching with finite automata.

**Finding the convex hull:** Graham's Scan and Jarvi's March method, finding the closest pair of points.

**UNIT V**

**Computational Complexity:**

**Backtracking**: N Queen Problem, Sum of Subset, Graph Coloring, Hamiltonian Cycle Problem.

**Branch & Bound:** 15 – Puzzle Game, Assignment Problem, Travelling Salesman and Knapsack Problem.

**NP Completeness:** The classes P and NP, NP Hard and NP Complete Problems.
**Approximation Algorithms:** vertex-cover, travelling-salesman, set-covering, subset-sum Problem.

**Text Books:**
1. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, PHI.

**Reference Books:**
1.Computer Algorithms by E. Horowitz, S. Sahni& S. Rajsekaran, Galgotia Publications (P) Ltd.
2.Fundamentals of Algorithmics by Brassard and Bratley, PHI
The Design and Analysis of Computer Algorithms by Alfred V. Aho, John E. Hopcroft and J. D. Ullman, Addison Wesley Publishing Company

| **ENGINEERING MATHEMATICS IV** | **UCS04C02** |
|---|---|
| L T P<br>3- 0 - 0 : 3 Credits | Prerequisites: *None* |

**Operation Research:** Recapitulation of n-tuples of real nos, addition and scalar multiplication of vectors, Convex combination, Linearly dependence and independence, basis and dimension.

Linear programming, Simplex method, Duality, Two-phase method, Big-M method, Dualsimplex method, Transportation and Assignment models, Game theory and solution.

**Numerical Analysis:** Solution of algebraic and transcendental equations by bisection method, iteration method, Regular-Falsi (False position) method, Newton-Raphson method, Solution of Simultaneous linear equations by Gauss Elimination and Gauss-Seidal method.
**Interpolation:** Concept of interpolation, difference operators, divided difference interpolation, Newton's forward, backward interpolation, Lagrange's interpolation, Starling and Bessel's interpolation, Numerical differentiation (1st and 2nd order), Numerical integration (Trapezoidal, Simpson's one-third, Weddle's rule).

**Numerical Solution of Ordinary differential equation:** Taylor's method, Picard's method, Runge's method, Runge-Kutta's method, Euler's method and Euler's modified method, Predictor-corrector method.
**Text Books:**
1. Linear programming problem, Chakraborty&Ghosh.
2. Advanced Engineering Mathematics: H.K.Dass.
3. Advanced Engineering Mathematics: E. Kreyszig.
4. Numerical Analysis, S.A.Molla.
5. Numerical Analysis, Datta& Jana

| MICROPROCESSOR AND MICROCONTROLLER | UCS04B08 |
|---|---|
| L T P<br>3-1-0 : 4 Credits | Prerequisites: UCS03B03 |

**Course Objective:**

1. To understand the services provided by and the design of an operating system.
2. To understand the structure and organization of the file system.
3. To understand what a process is and how processes are synchronized and scheduled.
4. To understand different approaches to memory management.
5. Students should be able to use system calls for managing processes, memory and the file system.
6. Students should understand the data structures and algorithms used to implement an OS.

**UNIT I**

**INTRODUCTION to 8085 :**

Evolution of 8085,Pin Description of 8085,Instructions of 8085,

**UNIT II**

**8086 based systems :**

The 8086 Microprocessor Bus Interface Unit, Execution Unit, Pin configuration of 8086, Pin details of 8086 ,Memory Organisation of 8086.8086 Minimum Mode Configuration, Demultiplexing of the Multiplexed buses , Transceiver 8286, Generations of Control Signals, Maximum Mode Configuration of 8086,Bus Cycles of 8086.Minimum Mode Bus Cycles, Maximum Mode Bus Cycles , Bus request and Bus Grant Timing in Minimum and Maximum Mode system.

**UNIT III**

**ASSEMBLER DIRECTIVES**

Assembly Languages , TASM Assembler, MASM Assembler,

**Instructions Set and Programming of 8086**

Addressing Modesof 8086,Data addressing Modes ,Address addressing Modes, Instruction Format, Instructions format, Instructions template, Instrction set of 8086,Interrupts of 8086,

**IO and Memory Interfacing**

IO Devices and their Interfacing, Interfacing of IO devices with Microprocessor, Interfacing of Input and output Device ,Basic concepts in Memory interfacing ,Memory Organization of 8086 .

**UNIT IV:**

**DMA Controller 8257 and 8237** :
Introduction ,DMAcontroller,opereation of DMA cycle,Programable interface Unit.

**Basic Assembly Language Programming Concepts :**

The Assembly Language Programming Process, Programming Tools and Techniques, . Data Transfer and Logical Instructions.

Arithmetic Operations, Decimal Arithmetic.Jump and Call Instructions, Further Details on Interrupts.

**UNIT V**

**The 8051 Architecture:**
Block Diagram of Microcontroller, Special Function Registers, Instructions set of Microcontroller 8051,Addressing modes of 8051.

**Programming and Interface of 8051:**
Introduction, General Programming concept, Timer/Counter programming concept.

**Text Books:**


1. Microprocessor Architecture ,programming and Applications with the 8085 by Ramesh Gaonkar
2. Fundaments of Microprocessor and Microcontroller by B.Ram
3. Microprocessor nad Microcontrollers by Sunil Mathur ,PHI Publisher


| **OBJECT ORIENTED PROGRAMMING** | **UCS04B09** |
|---|---|
| L T P<br>3 - 1 - 0 : 4 Credits | Prerequisites: *None* |

**Course Objective:**
Understand object oriented programming and advanced C++ concepts. Beable to explain the difference between object oriented programming andprocedural programming. Be able to program using more advanced C++features such as composition of objects, operator overloads, dynamicmemory allocation, inheritance and polymorphism, file I/O, exceptionhandling, etc. Be able to build C++ classes using appropriateencapsulation and design principles.

**UNIT-I**

Object oriented programming concepts – objects – classes – methods and messages –abstraction and encapsulation – inheritance – abstract classes – polymorphism. Introduction to C++ – classes – access specifiers – function and data members – defaultarguments – function overloading – friend functions – const and volatile functions –staticmembers – Objects – pointers and objects – constant objects – nested classes – localclasses

**UNIT-II**

Constructors – default constructor – Parameterized constructors – Constructor with dynamic allocation – copy constructor – destructors – operator overloading – overloading through friend functions – overloading the assignment operator – type conversion – explicit constructor

**UNIT-III**

Function and class templates - Exception handling – try-catch-throw paradigm –exception specification – terminate and Unexpected functions – Uncaught exception.

**UNIT-IV**

Inheritance – public, private, and protected derivations – multiple inheritance–virtualbase class – abstract class – composite objects Runtime polymorphism – virtualfunctions – pure virtual functions.

**UNIT-V**

Streams and formatted I/O – I/O manipulators - file handling – random access – object serialization – namespaces - std namespace – ANSI String Objects – standard template library.

**Text Book:**

1. Object Oriented Programming with C++ by E Balaguruswamy

**Reference Book:**

1. The Complete Reference C++ by Herbert Schildt

| **DESIGN AND ANALYSIS OF ALGORITHM LABORATORY** | **UCS04P03** |
|---|---|
| L T P<br>0 - 0 - 3 : 2 Credits | Prerequisites: |

Programme to implement the following:

1) Traversing a graph using BFS and DFS
2) Growing a minimum spanning tree using Kruskal's and Prims'salgoeithm
3) Bellman Ford and Dijkstra's algorithm
4) Floyd Warshall algorithm
5) Ford Fulkerson method
6) Implement Activity Selection problem, Huffman Coding and Fractional Knapsack using Greedy Approach.
7) Implement 0 – 1 Knapsack, Matrix – Chain, Optimal BST and Longest Common Subsequence using Dynamic Programming method

8) Implement Activity Selection, 15 puzzle game, Travelling Salesperson Problem using Branch and Bound Technique
9) Implement 4 queen problem, sum – of – subset problem, graph coloring and Hamiltonian cycle problem using Backtracking method.
10) Few programmes based on Approximation method.

| **OBJECT ORENTED PROGRAMMING LABORATORY** | **UCS04P04** |
|---|---|
| L T P<br>0 - 0 - 3 :2 Credits | Prerequisites: *None* |

**UNIT I:** Program using functions- functions with default arguments- implementation of call by value, address, reference -simple classes for understanding objects, member functions & constructors- classes with primitive data members- classes with arrays as data members- classes with pointers as data members- classes with constant data members- classes with static member functions

**UNIT II:** Compile time polymorphism- operator overloading- function overloading- Run time polymorphism- inheritance- virtual functions- virtual base classes- templates

**UNIT III: Regular Expressions and Filters:** sequential access-random access

**UNIT IV:** Simple java applications for understanding references to an instant of a class- handling strings in JAVA-Simple package creation- developing user defined packages in java

**UNIT V:** Interfaces- developing user defined interfaces- use predefined interfaces-Threading creation of threading in java applications-multi threadingexception handling mechanism in java handling predefined exceptions- handling user defined exceptions

# Fifth Semester

| **COMPUTER ARCHITECTURE AND ORGANIZATION** | **UCS05B10** |
|---|---|
| L T P<br>3- 1 - 0 : 4 Credits | Prerequisites: UCS03B03 |

**PART-I**

**UNIT-I**

The Concept of Computer Architecture – Architecture at Micromachine (for Microprogrammed processors), processor, and computer system levels – Abstract (or logical) and concrete (or physical) architectures.

**UNIT-II**

Instruction-level parallel (IPL) processors – Dependencies between instructions – Pipelined.

Data-Parallel Architectures – The concept of Data-parallel computation – Connectivity: Near-neighbor, Tree, Pyramid, and Hypercube networks – Classes of Data-Parallel Architectures: SIMD, Systolic.MIMD Architectures – Distributed Memory and Shared-memory systems – Lack of scalability of sharedmemory systems – Concept of multi-threaded Architectures.

**UNIT-III**

RISC – Characteristics of CISC Processors – The RISC concept – Hardwired control.

**PART-II**

**UNIT-IV**

CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU - registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study - instruction sets of some common CPUs.

Arithmetic operations-- construction of ALU, different implementation techniques for Adders, Subtractors.Multiplication and division -- different algorithms and their implementation.Implementation of floating point arithmetic.

**UNIT-V**

Hardware Description Language—Concepts and Principles Datapath and control unit—construction of data paths, Single and multi-cycle implementation, Hardwired and Microprogrammed control units. Bit slice processor design

**UNIT-VI**

Memory Hierarchy-- Cache and its Performance Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policy.

I/O interfacing—types and characteristics of I/O devices. Buses. Interfacing I/O devices to memory and processor, Design of I/O system.

**Recommended Books:**


1. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability and Programmability, McGraw-Hill 1993, pp. 770, ISBN 0-07-113342-9.
2. David A. Patterson and John L. Hennessy, Computer Architecture: A Quantitative Approach, Harcourt Asia PTE Ltd. 2000, pp. 760, ISBN 981-4033-227.
3. Daniel Tabak, Advance Microprocessors, McGraw-Hill 1995, pp. 523, $18.50, ISBN 0-07-113715-7.
4. James L. Antonakos, The Pentium Microprocessor, Prentice-Hall Inc. 1997, pp. 539, ISBN 0-02-303614-1.

5. J.P. Hayes ,Computer Architecture &Organization,McGraw-Hill.
6. Computer Organization,5th Ed.-Carl Hamacher et. Al. McGraw-Hill.
7. P .Pal Chowdhury, Computer Organization andDesign.PHI Publication.
8. Computer Organization And Architecture-Stallings Publisher:Pearson Education

| **DATABASE MANAGEMENT SYSTEM** | **UCS05B11** |
|---|---|
| L T P<br>3 - 1 - 0 : 4 Credits | Prerequisites: None |

**Course Objective** :

Behind the development and design of this course is to know how to design, manipulate and manage databases. The course participants are exposed to the various forms, types and models of database systems to enable them make viable choices. Supportive and complimentary concepts of managing data and documents are thoroughly examined to give a wholesome view of data/information management.

**UNIT 1**

**An Overview of Database**:

Database, Database System, BBMS Components, Data Independence, Data Abstraction, DDL, DML, Data Dictionary, Data Integration, Database Access Method, Characteristics of the Database Approach, Advantages of Using a DBMS, Implications of the Database Approach.

**Database System Architecture**:

Data Models, Schemas, and Instances, DBMS Architecture, Data Independence, Database Languages and Interfaces, Database System Environment, Classification of Database Management Systems.

**UNIT 1I**

**Data Model Using E-R Model & Object Model**:

High-Level Conceptual Data Models, Entity Types, Entity Sets, Attributes and Keys, Relationships, Relationship Types, Roles, and Structural Constraints, Weak Entity Types, Refining the E-R Design, ER Diagrams, Naming Conventions and Design Issues, Subclasses, Super Classes, Inheritance.

**Relational Data Model**:

Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators: selection, projection, cross product, various types of joins, division, example queries, tuple relation calculus, domain relational calculus, converting the database specification in E/R notation to the relational schema.

**UNIT 1II**

**Constraints, Views and SQL:**

Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL - basic select-from-where block and its semantics, nested queries - correlated and uncorrelated, notion of aggregation, aggregation functions group by and having clauses, embedded SQL.

**Dependencies and Normalization:** Functional Dependencies, Normal Forms based on Primary Keys: 1NF, 2 NF, 3 NF….,Boycee - Codd Normal Form, Normalization through Synthesis, Normalization using Join Dependency and definition of 5NF.

**UNIT 1V**

Transaction management and Database Recovery:

Transactions, Recovery Concepts, Transaction Recovery, ACID properties, serializability and concurrency control, System Recovery, Recovery Technique, Recovery in Multi Database Systems, Database Security Issues, Access Control for Multilevel Security, Data Encryption.

**Text Books:**

1. Elmsari and Navathe, “Fundamentals of Database Systmes”, Pearson Education.

**References Books:**

1. Database System Concept By Henry F. Korth Abraham Silber Schatz ; McGraw-Hill Publication
2. Database System Concept by C.J. Date.
3. Database Management System, by Raghu Ramakrishnan , Johannes Gehrke.

| **ENGINEERING ECONOMICS AND COSTING** | **UCS05C03** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: *None* |

**Purpose of the inclusion of the subject:** This subject will help the engineering students to understand the basic concepts of Economics and Costing. It will also providing the idea related to engineering economic analysis and its role in engineering decision making in executing any project for a company, the engineer needs knowledge besides technical aspects on markets and its agents. The project will be successful only if it is commercially viable.

**Courses objective:**

1. To make the Engineering student know about the basic concepts and law of Economics and their application to understand the behaviour of agents present in the market. The subject will address the requirement of evaluating the commercial viability of projects undertaken by graduate engineers
2. To make the Engineering student know about the basic concepts of cost and costing, Accounts and financial statements and their application to understand the issue of commercial viability of any projects.

**Unit- 1**

**Engineering Economics**- meaning, nature, scope and subject matter

**Unit 2**

**Utility**- definition, total, marginal and average; cardinal utility theory; indifference curves theory; **Demand**- factors effecting demand, elasticity of demand- different types of elasticity, classification of goods based on various elasticity of demand

**Unit – 3**

**Production**- Production function; Iso-quant; returns to scale; Total, Average & Marginal Product; law of variable proportions; Cobb-Douglas production function; Iso-cost curve; Derivation of cost curve from production function; Production optimization; expansion path

**Unit – 4**

**Cost-** short run and long run cost (the ‘Envelope Curve’); shape of different types of cost curves; **Revenue-** total revenue and marginal revenue, relation between marginal revenue and price elasticity of demand

**Unit – 5**

**Firm-** different types of firm and its characteristics; traditional theory of firm; objectives of firm.

**Unit – 6**

**Introduction to Accounting-** Definition of Accounting and accountancy, objectives of accounting, users of accounting information, Double Entry system of Book-Keeping, Journal and Ledger, Cash book, Trial balance.

**Unit – 7**

**Final Accounts-** Basic concepts, uses and preparation of Trading account; Profit and Loss account; and Balance Sheet. Issue and Forfeiture of Share and Re-Issue of Company.

**Unit – 8**

**Introduction to Costing-** Elements of Cost, Direct Materials, Direct Labour, Direct Expenses, Overheads, Production, Office and Administration, Selling and Distribution, Allocation of overhead, machine hour rate, labour hour rate, practical problems.

**Course outcome:**

1. Be able to identify and explain economic concepts and theories related to the behavior of economic agents present in market.
2. Be able to analyse the impact of various government policies in production and profitability of the company.
3. Be able to identify the basic features of alternative representations of human behavior in economics.
4. Be able to understand the impact various decisions or transactions will have on the company's statements and financial health.
5. Be able to comfortably communicate with senior financial and non-financial leaders about financial statement issues and the financial impact of business decisions.

| **OPERATING SYSTEM** | **UCS05B12** |
|---|---|
| L T P<br>3 -1 -0 : 4 Credits | Prerequisites: *None* |

**Course Objective:**

- To understand the services provided by and the design of an operating system.
- To understand the structure and organization of the file system.
- To understand what a process is and how processes are synchronized and scheduled.
- To understand different approaches to memory management.
- Students should be able to use system calls for managing processes, memory and the file system.
- Students should understand the data structures and algorithms used to implement an OS.

**UNIT–1**

**Introduction:** What is an Operating System, The need for Operating System, Evolution of Operating System, Types of Operating System: batch, multi-programmed, time-sharing, real-time, distributed, parallel ,Goals of an Operating System, Operating System Architectures .

**UNIT-2**

**Processes management:** Fundamentals of Process Management, Implicit/System and Non–implicit/User Process, Life cycle of a process, Process State and State Transitions, Suspended Process and Their State Transition, Process Control Block, Context Switching, Process Switching .

**Processes scheduling:**Introduction, Scheduling types, Scheduling Levels, Pre-emptive & Non-preemptive Scheduling, Scheduling Algorithm-(FIFO, SJF, SRTN, SRRN, RR and Multilevel Queue).

**UNIT- 3**

**Process communication and synchronization:**

Introduction, Concurrent Process, Critical section, Algorithm Approach to CS Implementation –Two Process Solution, Dekker's Solution , Peterson's Solution ,Semaphore ,Solution of Producer –Consumer , Solution of Reader –writer Problem, Monitor.

**Deadlocks:** Introduction**,** Definition of Deadlock ,Modelling Of Deadlock, Conditions for Deadlock , Dealing With Deadlock, Deadlock Prevention, Deadlock Avoidance- Dijkstra's Bankers Algorithm , Deadlock detection , Recovery from Deadlock, Starvation.

**Thread:** Introduction, Threading issues, Thread Control Block , Types of Threads-User Threads, Kernel Threads, Hybrid Threads , Linux Threads, Java Threads.

**UNIT-4**

**Memory management:**

Introduction, logical vs. physical address space, Swapping, Contiguous memory allocation, Non - Contiguous memory allocation , Paging Concept , Page Table Structure , Segmentation.

**Virtual memory:** Introduction, Need for Virtual Memory, Demand Paging, Page Replacement Algorithm-FIFO Page-replacement Algorithm, Optimal Page-replacement Algorithm, Least Recently Page-replacement Algorithm, Thrashing.

**UNIT-5**

**I/o and file systems:** File concept, Access methods, Directory structure , File Attributes, File Operation, file system hierarchy**,** Types Of I/O , Input-Output Software, Kernel I/O Sub-Syatem

**Disk management:** Disk Structure, Disk Scheduling (FCFS, SSTF, SCAN, C-SCAN), RAID Structure.

**Security:** Security Problem,User Authentication , Security Levels, Computer-Security Classifications

**Text Books:**

1. Operating System Principles by Silberschatz A. and Peterson J. L., Wiley
2. Operating Systems by Dhamdhere, TMH
3. Operating Systems by Naresh Chauhan ,Oxford

**Reference Books:**

1. Operating Systems by P.Balakrishna Prasad
2. Operating Systems by Deitel, & Choffnes.
3. Operating Systems by Stalling, Pearson

| **COMPUTER ARCHITECTURE AND ORGANIZATION LABORATORY** | **UCS05P05** |
|---|---|
| L T P<br>0 - 0 - 3 : 2 Credits | Prerequisites: None |

[Labs will be scheduled as per Theory class basis]

| **DATABASE MANAGEMENT SYSTEM LABORATORY** | **UCS05P06** |
|---|---|
| L T P<br>0 - 0 - 3 : 2 Credits | Prerequisites: None |

Implementation of various SQL queries programming for designing databases and accessing them for reasonably large applications

| **OPERATING SYSTEM LABORATORY** | **UCS05P07** |
|---|---|
| L T P<br>0 -0 -3 : 2 Credits | Prerequisites: None |

**LIST OF EXPERIMENTS**:

(Implement the following on LINUX or other Unix like platform. Use C for high level language implementation)

1. Write programs using the following system calls of UNIX operating system: fork, exec, getpid, exit, wait, close, stat, opendir, readdir

2. Write programs using the I/O system calls of UNIX operating system (open, read, write, etc)

3. Write C programs to simulate UNIX commands like ls, grep, etc.

4. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time. (2 sessions)

5. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for Priority and Round robin. For each of the scheduling policies, compute and print the average waiting time and average turnaround time. (2 sessions)

6. Developing Application using Inter Process communication (using shared memory, pipes or message queues)

7. Implement the Producer – Consumer problem using semaphores (using UNIX system calls).

8. Implement some memory management schemes – I

9. Implement some memory management schemes – II

10. Implement any file allocation technique (Linked, Indexed or Contiguous)

# Departmental Elective Subjects in Fifth Semester

| COMPUTER GRAPHICS | UCS05E01 |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: None |

**Course Objective:**

Computer Graphics is a study of the hardware and software principles of interactive raster graphics. In this course topics include an introduction to the basic concepts, 2-D and 3-D modeling and transformations, viewing transformations, projections, rendering techniques, graphical software packages and graphics systems. Students will use various standard computer graphics API to reinforce concepts and study fundamental computer graphics algorithms.

Primary practical work will start with C graphics, OpenGl and Introduction to Open CV.

The goal of this course is to convey understanding of the process of modeling and generating images of objects.

The course will start by studying the basic process of drawing primitive objects on a display (lines, circles, polygons). Next step is to look at the process of building two and three dimensional mathematical models of more complex objects, manipulating and combining these models, and projecting the models onto a two dimensional image space.

**Unit I**

**Development of Computer Graphics:** Basic graphics systems and standards. Raster Sean and random Sean graphics, Continual refresh and Storage displays, display processors, Color display techniques, frame buffer and bit operations, concepts in raster graphics.

**Unit II**

**Output Primitives :**Points and lines, Line drawing algorithms, circle and ellipse/generation algorithms, Conic sections, Polynomials and Spline curve, polygon filling. Ant aliasing.

**Unit III**

**Two Dimensional Geometric Transformation:** Basic transformation, Matrix representations and homogeneous coordinates, composite transformations, Transformation between coordinates system, Transformation functions. Raster methods for transformations.

**Unit IV**

**Two Dimensional viewing :**The viewing pipeline viewing coordinates reference frame, Window to view port coordinate transformation, Two-dimensional viewing function, clipping operations. Points, line. Polygon and character clipping.

**Unit V**

**Three Dimensional Concept :**3-D representation and transformations,3-D viewing, Algorithm for 3-D volumes, Fractal geometric method.

**Unit VI**

**Rendering:**A simple illustration model, Determining surface normal, Determining the reflection vector, transparency, lights, colors and shading.

**Unit VII-**

**Hidden lines and surfaces :** Back-face removal, depth comparisons, Z-Buffer algorithms, scan-line algorithms, floating horizon

**Unit VIII**

**Computer animation :**Types of animation, animation language, methods of controlling animation.

**Unit IX**

Brief Introduction to Graphic Processors.Introduction to Graphical Input Devices and Input Handling Algorithms.

**Text Book:**

1.Computer graphics by Hearn & Baker, PHL Ltd.

**Reference Books:**

1. Principle of interactive computer graphics by Newman & Sprout, McGraw Hill. I.E.
2. Procedural Elements for computer graphics by D.F.Rogers,McGrawHill,I.E.

| DIGITAL IMAGE PROCESSING | UCS05E02 |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: None |

**Course Objective:**

Describe and explain basic principles of digital image processing.
Design and implement algorithms that perform basic image processing (e.g., noise removal and image enhancement).
Design and implement algorithms for advanced image analysis (e.g., image compression, image segmentation).
Assess the performance of image processing algorithms and systems.

**UNIT I:**

**Introduction** -Fundamental steps in image processing; digital image representation; Image acquisition and storage.
**Visual Perception** – Basic concepts; Structure of human eye; Image formation in eye; Discrimination of brightness and adaptation; Sampling and quantization.

**UNIT II :**

**Image transforms** – Overview of Fourier Transform, DFT, 2D Fourier Transform, Convolution and correlation; FFT ; Inverse FFT ; Walse, Hadamard and K-L transforms ; Single value decomposition.
**Image enhancement** – Fundamental concepts; Enhancement by point processing; Intensity transform; Histogram processing; Spatial filtering: smoothening, median, sharpening and derivative filters; enhancement in frequency domain; Low-pass and High-pass filtering.

**UNIT III:**

**Image restoration** – Degradation model: continuous and discrete; Inverse filtering; removal of blur caused by uniform linear motion.

**UNIT IV:**

**Image Compression** – Lossy and loss-less compression techniques; Feature extraction. **Image segmentation** – Edge detection techniques; edge linking and boundary detection: local and global

approaches; Thresholding; Region-oriented segmentation: Region growing split and mergetechniques.Object recognition and identification – Case study of various applications.

**Text Books:**

1. R.C.Gonzalas and R.E.Woods, Digital Image Processing, Prentice Hall, 3rd Ed.

**Reference Books:**

1. A.K.Jain, Fundamentals of Digital Image Processing, Prentice Hall.
2. S.Sridhar, Digital Image Processing, Oxford University Press.
3. S Jayaraman,SEsakkiranjan and T Veerrakumar Digital Image Processing, McGraw Hill Education Pvt Ltd.

| **FOUNDATION OF CRYPTOGRAPHY** | **UCS05E03** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: None |

Catalogue Description

This course provides an introduction to cryptography, its mathematical foundations, and its relation to security. It covers classical cryptosystems, private-key cryptosystems (including DES and AES), hashing and public-key cryptosystems (including RSA). The course also provides an introduction to data integrity and authentication.

Course Outcomes

- Students will be able to implement and cryptanalyze classical ciphers.
- Students will be able to describe modern private-key cryptosystems and ways to cryptanalyze them.
- Students will be able to describe modern public-key cryptosystems and ways to cryptanalyze them.
- Students will be able to explain the mathematical concepts underlying modern cryptography.
- Students will be able to describe the field of cryptography and its relation to security.
- Students will be able to read, analyze, and summarize technical papers in the field.

Unit 1: Introduction to Cryptography

This unit provides an overview of cryptography, the study of information-hiding and verification. Cryptography insures the confidentiality/privacy, message integrity, authentication, and non-repudiation of information. This unit will also go over the basics of information theory to get a feel for message encoding before addressing various classical ciphers, which can now be easily cryptanalyzed and broken. Lastly, various methods and techniques used to cryptanalyze any algorithm that enciphers text.

Unit 2: Classical Cryptography

Describe and analyzevarious classical ciphers like Affine, Caesar, Columnar Transposition, Hill, Playfair, Rail-fence, Simple Substitution, Vigenere, Autokey, Enigma ciphers etc. These ciphers are intuitively

easy to understand and seem to encrypt the message well, but they have many shortcomings, which will be discussed. Shannon's perfect security.

Unit 3: Symmetric-Key Cryptography

Substitution-permutation network, modern block ciphers, modern stream ciphers which works through the series of linked mathematical operations. This unit also uses the complete mathematical algorithm to describe the data encryption standard before finishing with a description of the advanced encryption standard for a symmetric-key encryption.

Unit 4: Asymmetric-Key Cryptography

In this unit, will learn the basic idea behind public key cryptography and explain in detail RSA as the most important example of public key cryptography. Next, discuss the algorithms used to determine whether an input number is prime. This unit will present the mathematical background you need in order to understand these algorithms and in turn get a better picture of public key cryptography.

Unit 5: Hash Functions

This unit will introduce the concept of "hash" and then present the important MD5 and SHA-1 hash functions. We will finish the unit with a look at message authentication code.

Unit 6: Digital Signature and Authentication Protocols

This unit begins with a general discussion of key exchange methods, or methods designed to distribute keys securely so that they can be later used in a cryptographic algorithm. Digital signature process, services and applications. Various entity authentication protocol like challenge-response, Zero-knowledge scheme, biometrics. Authentication techniques based on Shared Secret Key, Key Distribution Centre, Kerberos, Public Key Encryption and Public Key certificates, X.509 Directory Authentication Service.

**Text Book:**

1. Forouzan and Mukhopadhyay, Cryptography and Network Security, McGraw Hill.

**Reference Book :**


1. Bruce Schneier, Applied Cryptography, John Wiley and Sons
2. Jonathan Katz and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press.
3. Christof Paar and Jan Pelzl, Understanding Cryptography, Springer.
4. O. Goldreich, “Foundations of Cryptography - Vol. I and Vol. II”, Cambridge University Press

# Sixth Semester

| ARTIFICIAL INTELLIGENCE | UCS06B13 |
|---|---|
| L T P<br>3 - 1 - 0 : 4 Credits | Prerequisites: None |

**Course Objective:**

° To have an appreciation for and understanding of both the achievements of AI and the theory underlying those achievements.

° To have an appreciation for the engineering issues underlying the design of AI systems.

° To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language.

° To have an understanding of the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as minimax, resolution, etc. that play an important role in AI programs.

**UNIT-I :**

Introduction to AI

Definition of Artificial Intelligence, Foundation of AI and Expert Systems, Approaches to AI, Brief History; Intelligent Agents, Different Agent Architectures, Stimulus Response Agents, State Based Agents, Goal-Directed Agents, Utility-based Agents

**UNIT-II**:

Problem Solving Using Search

State Space Search, N Queens Problem, 8-Puzzle; Uninformed Search, DFS, BFS, Iterative Deepening Search, Bidirectional Search; Informed Search, Heuristic Function, A*, Greedy, Uniform Cost Search, IDA*; Two Players Games - Two Players Search, Game Trees, Minimax Search, HeuristicMinimax Search, Heuristic Evaluation Function, Behavior of Heuristic Evaluation Function; Alpha Beta Search, Alpha Beta Pruning.

**UNIT-III:**

Constraint Satisfaction Problem:

Different Types of Constraints, CSP, DSP, Forward Checking, Intelligent Backtracking, Logic, Propositional Calculus and First Order Calculus

**UNIT-IV:**

Knowledge Representation and Logic:

Propositional Logic, Interpret a Propositional Logic, Compound Proposition; Interface in Propositional Logic, First Order Logic;First Order Logic, Reasoning Using First Order Logic, Resolution in FOPL.

**UNIT-V:**

Rule Based System and Semantic Net:

Rule Based System, Semantic Net, Reasoning in Semantic Net, Frames.

**UNIT-VI:**

Planning Problems

Introduction to Planning Problems, Formulate Planning Problem, Casting Planning Problem, Search in Plan Space, Forward Search, Backward Search, Strips Planning, Partial Order Planning, Graph Plan Algorithm

**UNIT-VII**:

Probability and Fuzzy

Rule Based Expart System, Certainty Factor; Reasoning with Uncertainty, Bayes' Rule;

Fuzzy Reasoning, Its Application.

**UNIT-VIII:**

Learning:

Introduction to Learning, Definition of Machine Learning, Types of Learning and notations, applications of Machine Learning, inductive learning Hypothesis,

**UNIT-IX:**

Neural Networks:

Learning Using Neural Networks-Introduction, Linear threshold unit of perceptron, representation power of perceptron, how to train a perceptron, Single layer percptron network, multi-layer perceptron network, sigmoid unit;

**UNIT-X:**

Robotics

Introduction to Robotics, Robot Hardware, Robot perception, Planning a move ,Robotic Software Architecture .

**Text Book:**

1. Artificial Intelligence by E Rich and K Knight, McGraw-Hill.
2. Artificial Intelligence a Modern Approach-Stuart Russell, Peter Norvig, PHI

**Reference Books:**

1. Artificial Intelligence by E Rich and K Knight, McGraw-Hill.
2. Artificial Intelligence (3rd Ed) Russell Norvig, Pearson.
3. Introduction of Artificial Intelligence and expert systems by DW Patterson, PHI.
4. Artificial Intelligence and Soft Computing by A. Konar, CRC Press 2000.

| **COMPILER DESIGN** | **UCS06B14** |
|---|---|
| L T P<br>3 - 1 - 0 :4 Credits | Prerequisites: UCS04B06 |

**UNIT I: Introduction:**

Introduction to Compiler, Single and Multi Pass Compilers, Translators, Phases of Compilers, Compiler writing tools, Bootstrapping.

**UNIT II: Lexical Analysis:**
Role of Lexical Analyzer, Specification of tokens, Recognition of tokens, lexems and patterns, Regular expression, Finite automata from regular expression to finite automata, transition diagrams, Implementation of lexical analyzer, Tool for lexical analyzer – LEX, Error reporting.

**UNIT III: Syntax Analysis and Parsing Techniques:**
Context free grammars, ambiguity, precedence, Bottom-up parsing and top down parsing, Top down parsing: elimination of left recursion, recursive descent parsing, Predictive parsing; Bottom Up Parsing: Operator precedence parsing, LR parsers, Construction of SLR, canonical LR and LALR parsing tables, the parser generator – YACC, error recovery in top down and bottom up parsing.

**UNITIV : Syntax Directed Translation & Type Checking :**
Inherited attributes, dependency graph, Construction of syntax trees, bottom up and topdown evaluation of attributes, S-attributed and L-attributed definitions.
Type Checking: Static vs. Dynamic Checking, Type expression, Type Checking, Type Equivalence, Type Conversion.
Symbol Tables: Structure of Symbol Table, Simple Symbol Table (Linear Table, Ordered List, Tree, Hash Table), Scoped Symbol Table (Nested Lexical Scoping, One Table per Scope, One Table for all Scopes).

**UNIT V: Intermediate Code Generation:**
Intermediate Language, Intermediate representation Technique, Three-address code, quadruples and triples, Translation of assignment statements, Boolean expressions, Control Flow, Case Statement, and Function Call.

**UNIT VI:Runtime Environment:**
Storage organization, activation tree, activation record, allocation strategies, Parameter passing, dynamic storage allocation.

**Unit-VII :Code Generation& Code Optimization :**
Factors affecting code generation, Basic Block, Code generation for tree, Register Allocation and assignment, DAG representation, Code generation using dynamic programming.
Code Optimization: Need for optimization, Optimization of Basic Blocks, Loops in flow graph, Optimizing transformation ,Compile time evaluation, common sub-expression elimination, Dead code optimization, peep hole optimization, Local Optimization, Global Optimization,loops, global dataflow analysis,solution to iterative dataflow equations.

**Text Books:**
1. Compiler-Principles, Techniques and Tools by Alfred V.Aho, Ravi Sethi and J. D.Ullman, Addison Wesley.

**Reference Books:**
1. Compiler Design by SantanuChattopadhyay, PHI

| **COMPUTER NETWORKS** | **UCS06B15** |
|---|---|
| L T P<br>3 - 1 - 0 :4 Credits | Prerequisites: UCS03B01 |

**Course Objective:**

- Understand the principles and concepts on computer networks.
- Familiarize the student with the basic taxonomy and terminology of the computer networking area.
- Understand the state-of-the-art in network protocols, architectures and applications.
- Understand the factors influencing on the performance of computer networks, and the reasons for having variety of different types of networks.
- Understand the Internet structure, various protocols of the Internet and how these protocols address the standard problems of networking and the Internet.
- Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.
- Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.

**UNIT I**

**Introduction:**

Definition, History and development of computer networks, Goals, Applications and Classification of computer networks, Some well-known networks, Protocols and Standards.

**Network Models and Architecture:**

OSI Reference Model, Services and important functions of each layer, TCP/IP Model, Basic concepts of hubs, switches, gateways and routers, Circuit, Message and Packet switching.

**UNIT II**

**Brief Review of Physical and Data Link Layers:**

Guided and Unguided media, Line Discipline, Flow control, Capacity utilization, Sliding Window, Stop & wait protocols, Error detection mechanism, VRC,LRC,CRC, Automatic Repeat Request(ARQ)- Stop-and Wait , Go-back-n, Selective repeat.

**Medium Access Control:**

ALOHA, Slotted ALOHA, CSMA, CSMA/CD, Ethernet, Token Ring, CSMA/CA.

**UNIT III**

**Network Layer:**

Need for Network layer, Connection–oriented and connectionless services, Addressing: Internet address, Internet Protocol, IPv6, ARP, DHCP, ICMP, Classful addressing, subnetting, supernetting, Classless Addressing, Routing techniques –Static versus Dynamic Routing, Flooding, Routing algorithms: Distance vector and Link-state routing, Inter-domain routing.

**Transport layer:**

Basics of TCP and UDP, Connection establishment and termination, Congestion control algorithms, Flow control, Retransmission, TCP extensions, Introduction to quality of service.

**Application layer Protocols:**

Basics of Telnet, FTP, SMTP, POP, HTTP, WWW.

**UNIT IV**

**Wireless and Mobile Networking:**

IEEE 802.11, BLUETOOTH, Overview of Ad-hoc networks. Cellular networks – GSM, CDMA

**UNIT V**

**Frame Relay and ATM Networks:**

Overview of X.25, Frame Relay and ATM-evolution, ATM layers, sub layers and their functions, ATM switch architecture.

**Text Books**:-


1. Data Communication and Networking, 4th Edition, McGraw-Hill, Behrouz Forouzan.
2. A. S. Tanenbaum, "Computer Networks", 4th Ed., Pearson Education Asia (LPE), 2003.


**Reference Books:-**


1. W. Stallings, "Data and Computer Communications", 6th Ed., Pearson Education Asia (LPE), 2000.
2. F. Halsall, "Data Communications, Computer Networks and Open Systems", 4th Ed., Pearson Education Asia (LPE), 1996


| **MANAGEMENT AND MANAGERIAL ECONOMICS** | **UCS06C04** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: *None* |

**Purpose of the inclusion of the subject:** This subject will help the engineering students to understand the basic concepts of Management and Managerial Economics. It will also be providing the idea related to management and managerial techniques in engineering decision making. While working in a company, the engineer needs to monitor and control a large number of variables present in environment where business is taking place. The subject equips a graduate engineer to carry out all the responsibilities successfully.

**Courses objective:**

2. To make the Engineering student know about the basic concepts, functions, principles and techniques of management and their application, which complement the technical skills to execute their capabilities successfully.
3. To make the Engineering student know about the basic concepts of finance in carrying out any project

**Unit- 1**

**Basic Concepts and functions of management**: planning, nature, purpose and objective of planning; organizing: nature and purpose, authority and responsibility, staff bug; supply of human resources, performance appraisal. Controlling: system and process of controlling, control techniques.

**Unit 2**

**Human resource Management and Marketing Management**: nature and scope of human resource of planning, planning and development, recruitment and selection, career growth, grievances, motivation and its type, needs for motivation, reward and punishment, models of motivation. Leaders: kinds of leaders, leadership styles, roles and functions of leader; conflict management: kinds and causes of conflict, settlement of conflict, Group and team working, organizational design and development.

**Unit – 3**

**Financial Management:** Need of finance, kinds and sources of capital shares and debentures, fixed and working capital , capital structure of a firm, operating and financial leverage, EBIT and EPS analysis, financial ratio analysis : uses and natures, liquidity coverage ratios, practical problems.

**Unit – 4**

**Investment decisions and forecasting of working capital**: Kinds of capital Budgeting decisions, evaluation of proposals, capital discounting and non discounting based methods. Practical problems. Definition and importance of working capital. Working capital operating cycle, factors affecting Working capital, inventory management

**Unit – 5**

**Cost Analysis and Cost Control**: elements of cost, types of cost, direct and indirect, variable and fixed, labour cost, material cost, overhead cost, cost control techniques. Budget: meaning, kinds, budgetary controls, break even analysis, practical problems.

**Unit – 6**

**Perfect Competition-** Perfect Competition, Features; Short run and long run equilibrium of firm and industry, shut down point

**Unit – 7**

**Monopoly-** features, monopoly power, pricing under monopoly, price discrimination.

**Unit –** 8

**Oligopoly-** Features, kincked demand Curve, Cournot'sDuoploy Model Cartels, Price leadership.

**Unit –** 9

**Monopolistic Competition-** Features, Pricing under monopolistic competition, Product differentiation.

**Unit –** 10

**Macroeconomics-** Inflation; Function of Central & Commercial Banks

**Course outcome:**

1. Be able to understand the principles of management and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
2. Be able to make a plan how to organize, control and motivate people.
3. Be able to understand the Cost analysis in the context of short and long term decision making and the use of discounted cash flow analysis.
4. Be able to identify and explain economic concepts and theories related to the markets, industry and firm structures.
5. Be able to pursue the larger objectives of the firm besides profit maximization.

| **SOFTWARE ENGINEERING** | **UCS06B16** |
|---|---|
| L T P<br>3 -1 -0 : 4 Credits | Prerequisites: None |

**Course Objective:**
Software affects us to an ever-increasing extent, both within industry and in our daily lives. Software Engineering deals with the design and development of high-quality software systems and is thus an increasingly important area ofcomputer science. The six month course block in Software Engineering gives you knowledge and practical skills in the development of software systems of high quality, which is invaluable for software architects, project managers and technical specialists. The demand for knowledgeable experts in software engineering is steadily increasing, which makes you very competitive nationally as well as internationally, both in industry and in academic research.

**UNIT I**
**Introduction:** Evolving role of software, classification and characteristics of software, software applications, software crisis and myths, software vs. system engineering, different lifecycle models, and comparative study of various development models.

**UNIT II**
**Software development steps:** Feasibility study, functional and non-functional requirements. Requirement engineering process: specification, validation and management. Software design process: design principles, coupling vs cohesion, software architecture design methodologies, function oriented vs object oriented design, structured design methodology. Coding: coding principles and methodology, code verification and documentation.

**UNIT III**
**Software project management:** Principles of SPM, team Structure & scheduling, project planning, Total Quality Management (TQM), various cost estimation methods, COCOMO Model, WBS, configuration management, risk management, different project management tools.

**UNIT IV**

**Software testing and quality management:** Different types of testing, verification vs validation, system testing, debugging, black-box testing & white-box testing, control flow graphs – cyclomatic complexity. Software quality factors, quality assurance, quality standards: CMM, ISO, software reliability, software maintenanceand reengineering.

**UNIT V**
**Object oriented approach:** Conventional vs. OO approaches in design and coding, architectural patterns, UML and different diagrams to represent OO approach, object oriented testing.

**Text Books:**
1. Rajib Mall, “Fundamentals of Software Engineering ”, PHI.
2. Roger S.Pressman, “Software Engineering- A Practitioners approch”, McGrawHill;

**Reference Books:**
1. K.K. Aggarwal&Yogesh Singh, “Software Engineering”, Third Edition, New Age International Publishers
2. Waman S Jawadekar, “Software Engineering-Principles and Practice”, Mcgraw Hill

companies.

3. Deepak Jain “Software Engineering-Principles and Practices”, Oxford

| COMPILER DESIGN LABORATORY | UCS06P09 |
|---|---|
| L T P<br>0 - 0 - 3 : 2 Credits | Prerequisites: *None* |

**Unit I**:

Programmes on handling files, Programs on language, grammer, regular expression, NFA, DFA, strings.

**Unit II:**

Programs for lexical analyzer,

**Unit III:**

Programs on removing left recursion, finding FIRST, FOLLOWS

**Unit IV:**

Programs on LL (1) parser, LALR Parser, canonical parser etc

| COMPUTER NETWORK LABORATORY | UCS06P10 |
|---|---|
| L T P<br>0 - 0 - 3 : 2 Credits | Prerequisites: *None* |

**UNIT I:**

Study of TCP and UDP, Peer-to-Peer applications, Client-server programming, Looking up internet address, Implementation of ping programming, Socket program for UDP Echo Client and Echo Server.

**UNIT II:**

Java multicast programming, Client server Communication using object stream, Client server Communication using byte stream, Implementation of CRC, Message passing using Message Window and Group Window.

**UNIT III:**

Study and implementation of Stop & Wait protocol, Go Back N protocol, Selective Repeat protocol.

**UNIT IV:**

Study and implementation of CSMA-CA protocol, CSMA-CD protocol, Pure Aloha protocol, Slotted Aloha protocol, Token Bus protocol, Token Ring protocol.

**UNIT V:**

Study of network simulator NS2 and simulation using the NS2 package, Study the effect of different Routing protocols on network’s performance through simulation.

| SOFTWARE ENGINEERING LABORATORY | UCS06P11 |
|---|---|
| L T P<br>0 -0 -3 : 2 Credits | Prerequisites: *None* |

**Course Objective:**

Software Engineering Laboratory is functional for the purpose of providing Software Engineering tools for developing various software applications in a systematic way. It is useful for the study of various software development steps, different lifecycle models and managing a project in a proper way.

**Experiments to be Conducted:**

1. Generating SRS document from a given set of requirements for a software to be developed.
2. Make a comparative statement in between a number of Software Development Models with test scenarios.
3. Preparing SPMP document – Activity Network, Critical Path, Gantt chart.
4. Preparing Decision Tree and Decision Table for a given set of requirements for a software to be developed.
5. Function Oriented Design – DFD, Structured chart representation of some sample software to be developed.
6. Object Oriented Design – Studying UML with Rational Rose software and generating different types of UML diagrams and implement them with some programming language.
7. Generating test report.
8. Mini Project (group wise) to represent Software Engineering Methodologies.

# Departmental Elective Subjects in Sixth Semester

| COMPUTER AND NETWORK SECURITY | UCS06E04 |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: UCS05B12 |

Course Description

This course will cover basic principles of computer security and security engineering. To facilitate understanding, this course will consider security both from an attacker's perspective (threat modeling) and the defender's perspective (building and deploying secure systems). Specific topics will include operating system security, network security, web security, security economics and security psychology.

Course Outcomes

**On successful completion of the module, students will be able to:**

- Discuss the basic methodology in computer security and interpret relating security concepts and terminology.
- Recognise the nature and characteristics of various Network & Software security.
- Illustrate the potential vulnerability of networked applications and select and apply appropriate countermeasures.
- Demonstrate and articulate the ethics in cyber world and awareness about law.

**Course Content**

Unit 1: Introduction to Cryptography

Introduction & threat modelling,Fundamental Security Terminology - CIA Triad, Assets, Threats, Vulnerabilities, Attacks, Risks and Controls Basic security methodology. One-way functions, hash functions, Transport Layer Security, PKI, Messaging & Usability, Cryptocurrency &blockchains.

Unit 2: Network security

Networking basics.IP, TCP and DNS. Censorship and mass surveillance. Denial of service. Anonymity & Tor.

Unit 3: Software security

Access control & information flow. Systems security & isolation. Control flow hijacking.

Unit 4: Web security

Password storage. Online authentication. Spam and Abuse. Online crime. Browser security, XSS and XSRF. Web privacy.

Unit 5: Security & Society

This unit will cover Economics, Ethics & Law related with cyber security.

**Recommended Text Book:**

Security Engineering: A Guide to Building Dependable Distributed Systems by Ross J. Anderson, Wiley Publication.

**Reference Book :**


1. Pfleeger, C.P and PfleegerS.L (2015). "Security in Computing", 5th Edition, Prentice-Hall.
2. Computer Security, Gollmann, John Wiley & Sons
3. Christof Paar and Jan Pelzl, Understanding Cryptography, Springer.


| **DATA WAREHOUSING & DATA MINING** | **UCS06E05** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: UCS05B11 |

**Course Objective:**
This course shall cover the concept of data warehouse and reasons for building it. The later part shall cover data mining techniques based on real-life examples.

**UNIT I**
**Introduction to Data Warehousing:**
Data Management; Benefits of Data Warehousing; Features of a Data Warehouse; Operational Databases vs. Data Warehouses; The Information Flow Mechanism; Role of Metadata; Classification of Metadata; Data Warehouse Architecture; Different Types of Architecture; Data Marts, OLTP.

**UNIT II**
**Data Design and Data Representation:**
Data Pre-Processing, Data Integration, ,Principles of dimensional modeling, Data extraction, transformation and loading, Data Cleaning, OLAP Models,Data quality.

**UNIT III**
**Data Mining Techniques:**
Introduction to Data Mining, Data pre-processing, Mining frequent patterns
**Classification:**
Decision Tree-Based Algorithms, Bayes classification method, Rule based classification, Model evaluation techniques, Bayesian Belief Networks, Back propagation, Support Vector Machines
**Clustering:**
Similarity and Distance Measures, Distance Based Clustering, Hierarchical Algorithms, Partitional Algorithms, Density Based Clustering.

**UNIT IV**

**Advanced Techniques:**

Introduction to Web Mining, Social Media Mining.

**Text Books:**

1. Data Warehousing: Fundamentals for IT Professionals by PaulrajPonniah; Wiley India
2. Data Mining: Concepts and Techniques by J. Han and M. Kamber; Morgan Kaufman.
3. Social Media Mining :An Introduction by Reza Zafarani, Mohammad Ali Abbasi and Huan Liu; Cambridge University Press

**Reference Books:**

1. The Kimball Group Reader, Re-mastered Collection by Ralph Kimball and Margy Ross, Wiley Publications
2. Data Mining practical machine learning tools & technology by Ian H. Witten &Eibe Frank and Mark A. Hall;Morgan Kaufmann Publishers
3. Data Mining Introductory and Advanced Topics by M.H. Dunham; Pearson Education.

| **MOBILE COMPUTING** | **UCS06E06** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: None |

**Course Objective:**

The course shall cover the concepts and principles of mobile computing. It distinguishes between types of Mobility and provides a computer systems perspective on the converging areas of wireless networking, embedded systems, and software. The goal is to develop skills of finding solutions and building software for mobile computing applications.

**UNIT I**

**Introduction:**

Issues and Challenges in mobile computing, Coping with uncertainties, Resource poorness, bandwidth etc., Cellular architecture, Co-channel interference, Frequency reuse, Capacity increase by cell splitting, Evolution of mobile system: CDMA, FDMA, TDMA.

**Introduction to Personal Communications Services (PCS)**:

PCS Architecture, Networks signalling.

**UNIT II**

**Mobility Management:**

Cellular architecture, Co-channel interference, Adjacent channel interference, Mobility-handoff, types of handoffs, Location management, HLR-VLR scheme, Hierarchical scheme, Predictive location management schemes, Mobile IP, Cellular IP, DHCP.

**Mobile Transport Layer:**

Indirect TCP, Snoop TCP, Mobile TCP

**Mobile Ad Hoc Network and Routing Protocols:**
Hidden and exposed terminal problems, Routing protocols: Destination sequenced distance vector algorithm, Cluster based gateway switch routing, Dynamic source routing, Ad hoc on-demand routing, Location aided routing, Zonal routing algorithm.

**UNIT III**
**Global System for Mobile Communication (GSM) Overview**:
GSM Architecture, Mobility management, Network signaling.

**General Packet Radio Services (GPRS):**
GPRS Architecture, GPRS Network Nodes.

**UNIT IV**
**Mobile Data Communication**:
WLANs (Wireless LANs), Bluetooth and IrDA technologies and standards.

**Wireless Application Protocol (WAP):**
The Mobile Internet standard, WAP Gateway and Protocols.

**UNIT V**
**Third Generation (3G) Mobile Services**:
Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G.

**Wireless Local Loop (WLL)**:
Introduction to WLL Architecture, Wireless Local Loop Technologies.

**UNIT Vi**
Different mobile-phone based platform architectures and applications.

**Text Book:**

1. J. Schiller, “Mobile Communications”, Pearson Education.

**Reference Book:**

1. Martyn Mallick, “Mobile and Wireless Design Essentials”, Wiley Publishing, 2003.
2. Yi-Bing Lin &Imrich Chlamtac, “Wireless and Mobile Networks Architectures”, John Wiley & Sons, 2001.
3. Raj Pandya, “Mobile and Personal Communication systems and services”, Prentice Hall of India, 2001.
4. “Handbook of Wireless Networks and Mobile Computing ” Stojmenovic&Cacute, 1st Ed. Wiley, 2002.

# Seventh Semester

| MACHINE LEARNING | UCS06B17 |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: UCS06B13,<br>UCS03C01 |

**Course Objective:**
The objective is to familiarize the students with some basic concepts and techniques of Machine Learning and also to develop skills of using recent machine learning software for solving practical problems Students should also to gain experience of doing independent study and research. The emphasis will be thus on machine learning algorithms and applications, with some broad explanation of the underlying principles.

**Unit-1:**
Introductory Topics; Linear Regression and Feature Selection; Linear Classification;

**Unit-2:**
Support Vector Machines and Artificial Neural Networks; Bayesian Learning and Decision Trees;

**Unit-3:**
Evaluation Measures; Hypothesis Testing; Ensemble Methods; Clustering; Graphical Models;

**Unit-4:**
Learning Theory and Expectation Maximization; Introduction to Reinforcement Learning

**Text Books:**
1. Machine Learning A Probabilistic Perspective By Kevin P. Murphy
2. An Introduction to Statistical Learning with Applications in R Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani

**Reference Books :**
1. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
2. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2008.
3. Christopher Bishop. Pattern Recognition and Machine Learning.
4. Machine Learning, Tom Mitchell, McGraw Hill, 1997.

# Departmental Elective Subjects in Seventh Semester

| BIG DATA ANALYTICS | UCS07E07 |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites:UCS05B11 |

**Course Objective:**

This course shall cover the concept of data warehouse and reasons for building it. The later part shall cover data mining techniques based on real-life examples.

**UNIT I**
Overview of Big Data, Stages of analytical evolution, State of the Practice in Analytics

**UNIT II**
The Data Scientist, Big Data Analytics in Industry Verticals, Data Analytics Lifecycle, Operationalizing Basic Data Analytic Methods Using R

**UNIT III**
Advanced Analytics - Analytics for Unstructured Data - Map Reduce and Hadoop, The Hadoop Ecosystem, In-database Analytics

**UNIT IV**
Data Visualization Techniques, Stream Computing Challenges, Systems architecture, Main memory data management techniques, energy-efficient data processing, Benchmarking, Security and Privacy, Failover and reliability.

**Text Books:**


1. Bill Franks, Taming The Big Data Tidal Wave, 1st Edition, Wiley, 2012.
2. Frank J. Ohlhorst, Big Data Analytics,1st Edition, Wiley, 2012.


| **CLOUD COMPUTING** | **UCS07E08** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: None |

**Objective:**
Study different Cloud computing architectures and services.
Get familiar with cloud applications and programming in cloud platform.

**Unit I**

Introduction to Cloud Computing -advantages, challenges, and risks.
Enabling Technologies and System Models for Cloud Computing.

**Unit II**
Distributed System Models
Parallel Computing
Virtualization

**Unit III**
Cloud Computing Architectures
Service-Oriented Architectures

**Unit IV**
Cloud OS

Cloud Programming

**Unit V**
Cloud Platforms in Industry
**Unit VI**
Cloud Applications

**Text Books:**

1. Mastering Cloud Computing – RajkumarBuyya, Christian Vecchiola& S. ThamaraiSelvi; McGraw-Hill.
2. Cloud Computing: Concepts Technology and Architecture – Thomas Erl; Pearson Education

**Reference Books:**

1. Cloud Computing : A Practical Approach - Anthony T. Velte Toby J. Velte, Robert Elsenpeter; The McGraw - Hill.
2. Distributed and Cloud Computing-Kai Hwang, Jack Dongarra& Geoffrey C. Fox; Morgan Kaufmann.
3. Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more - Dr. Kris Jamsa; Jones & Bartlett Learning (2013)

| **INFORMATION RETRIEVAL** | **UCS07E09** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: UCS03B02, UCS04B07 |

**Course Objective:**

- Introduce students to the basic concepts and techniques of Information Retrieval, Web Search, Data Mining, and Machine Learning for extracting knowledge from the web.
- Develop skills of using recent data mining software for solving practical problems of Web Mining.
- Gain experience of doing independent study and research.
- In addition to foundations, and practical experience with search engines, the class will also introduce the student to the state-of-the-art in search engine research, future trends and state-of-the-art practice.

**UNIT I**
**Introduction:** The nature of unstructured and semi-structured text. Inverted index and Boolean queries.
**Preprocessing:** Tokenization, stemming, stop words, phrase identification, indexing. Index compression: lexicon compression and postings lists compression. Gap encoding, gamma codes, Zipf's Law. Postings size estimation,dynamic indexing, positional indexes, n-gram indexes, real-world issues.

**UNIT II**
**Retrieval Models:** Boolean, vector space, probabilistic and language modelling, learning-to-rank,latent semantic indexing. Vector space scoring, cosine measure, Efficiency considerations, Document length normalization, Relevance feedback and query expansion.

**Performance Evaluation**: Evaluating search engines, precision, recall, F-measure, Mean Average Precision, Mean Reciprocal Rank. Creating test collections: kappa measure, inter-judge agreement.

**UNIT III**

**Classification and Clustering:** Introduction to text classification, Naive Bayes models, Spam filtering, Vector space classification using hyper planes, centroids, k-Nearest-Neighbours,Support vector machine classifiers, Kernel functions, Boosting.

Clustering versus classification, Partitioning methods, k-means clustering, Mixture of Gaussians model, Hierarchical agglomerative clustering, Clustering terms using documents,Summarization, Topic detection and tracking, cross language information retrieval

**UNIT IV**

**Web search:** Hypertext, web crawling, search engines, ranking, link analysis, PageRank. Recommender Systems - Collaborative Filtering and Content-Based Recommendation ofDocuments and Products Information Extraction and Integration - Extracting Data from Text – XML

- Semantic Web - Collecting and Integrating Specialized Information on the Web.

**Text Book:**

1. Introduction to Information Retrieval by Christopher D. Manning, PrabhakarRaghavan, and HinrichSchuetze, Cambridge University Press, 2008.

**Reference Books:**

1. Search Engines: Information Retrieval in Practice by Bruce Croft, Donald Metzler, and Trevor Strohman, Pearson Education, 2009.
2. Modern Information Retrieval by Baeza-Yates Ricardo and BerthierRibeiro-Neto.2nd edition, Addison-Wesley, 2011.
3. Information Retrieval: Implementing and Evaluating Search Engines by Stefan Buttcher, Charlie Clarke, Gordon Cormack, MIT Press, 2010

| **PATTERN RECOGNITION** | **UCS07E10** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: None |

**Course Objectives:**

Pattern Recognition (PR) techniques are widely used for medical and biological applications since a long time. The objective of this new elective course is first to make student familiar with general approaches such as Bayes Classification, Nearest Neighbor Rule, Neural Networks and later to concentrate on more often used modern classification techniques such as Support Vector Machines and Multiclassifiers for solving Bio-Medical problems. The students will also learn through reading and discussing different application papers.

**UNIT I**

**Introduction and mathematical preliminaries**

What is Pattern recognition; Applications and Examples, Clustering vs. Classification; Supervised vs. unsupervised, Relevant basics of Linear Algebra, vector spaces, Probability Theory basics, Basics of Estimation theory, Decision Boundaries, Decision region / Metric spaces/ distances

**UNIT II**

**Classification**

Bayes decision rule, Error probability, Normal Distribution, Linear Discriminant Function (equal covariance matrices), Non-linear Decision Boundaries (unequal covariance matrices), Mahalanobis Distance, K-NN Classifier, Fisher's LDA, Single Layer Perceptron, Multi-layer Perceptron, Training set, test set; standardization and normalization

**UNIT III**

**Clustering**

Basics of Clustering; similarity / dissimilarity measures; clustering criteria. Different distance functions and similarity measures, Minimum within cluster distance criterion, K-means algorithm; Single linkage and complete linkage algorithms, MST, K-medoids, DBSCAN, Data sets - Visualization; Unique Clustering; No existence of clusters

**UNIT IV**

**Feature selection**

Problem statement and Uses; Algorithms - Branch and bound algorithm, sequential forward / backward selection algorithms, (l,r) algorithm; Probabilistic separability based criterion functions, interclass distance based criterion functions

**UNIT V**

**Feature Extraction**

PCA + Kernel PCA

**Recent advances in Pattern Recognition**

Structural PR, SVMs, FCM, Soft-computing and Neuro-fuzzy techniques, and real-life examples

**Text Books:**


1. R.O. Duda, P.E. Hart, and D.G. Stork, 'Pattern Classification' New York: John Wiley,2001
2. Digital Image Processing and Pattern Recognition- Malay k Pakhira –PHI


**Reference Books:**


1. Statistical pattern Recognition by K. Fukunaga; Academic Press, 2000.
2. Pattern Recognition by S.Theodoridis and K.Koutroumbas, 4th Ed., Academic Press, 2009.


| **SOFT COMPUTING** | **UCS07E11** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: UCS06B13 |

**UNIT-1**

Introduction to Fuzzy sets, Fuzzy t- and s- norms, projection, cylindrical extension, Fuzzy relations, Implication relations, Fuzzy relational equations, Possibilistic reasoning, Fuzzy pattern recognition, Introduction to Fuzzy control and Fuzzy databases.

**UNIT-2**

Biological vs. artificial neurons, McCulloch and Pitts Model, Perceptron as linear classifier, Supervised learning: Perceptron learning algorithm, Steepest descent learning and backpropagation algorithm, Radial basis function neural net. Unsupervised learning: Hopfield neural net, Self-organizing feature map neural net, Competitive neural learning, Reinforcement learning: Q-learning and temporal difference Q-learning, Support vector machine (SVM), Kernelized SVM, Learning vector quantization.

**UNIT-3**

Genetic Algorithm: Binary and real codes, Genetic programming, Particle swarm optimization, Differential Evolution, Bacterial Foraging

**UNIT-4**

Hybridization of neuro-fuzzy, neuro-GA, neuro-swarm, neuro-evolution algorithms.Applications in Pattern Recognition, Robotics, and Image Processing.

**Text Books:**

1. Computational Intelligence: Principles, Techniques, and Applications by A. Konar, Springer 2005
2. Computational Intelligence by A. P. Engelbrecht

| **UNIX SYSTEM PROGRAMMING** | **UCS07E12** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: UCS05B12, |

**Course objectives:** This course will enable students to

- Understand the UNIX Architecture, File systems and use of basic Commands.
- Use of editors and Networking commands.
- Understand Shell Programming and to write shell scripts.
- Understand and analyze UNIX System calls, Process Creation, Control & Relationship

**UNIT – I**

Introduction, Brief history. Unix Components/Architecture. Features of Unix.TheUNIXEnvironment and UNIX Structure, Posix and Single Unix specification.The login prompt.
General features of Unix commands/ command structure. Command arguments andoptions.Understanding of some basic commands such as echo, printf, ls, who, date,passwd, cal, Combining commands.Meaning of Internal and external commands. The typecommand: knowing the type of a command and locating it. The man command knowingmore about Unix commands and using Unix online manual pages.The man with keywordoption and whatis. The more command and using it with other commands. Knowing theuser terminal, displaying its characteristics and setting characteristics. Managing the nonuniformbehaviour of terminals and keyboards. The root login.

Becoming the super user: sucommand. The /etc/passwd and /etc/shadow files. Commands to add, modify and deleteusers.

**UNIT – II**

Unix files. Naming files. Basic file types/categories.Organization of files. Hidden files.Standard directories. Parent child relationship.The home directory and the HOMEvariable. Reaching required files- the PATH variable, manipulating the PATH, Relativeand absolute pathnames. Directory commands – pwd, cd, mkdir, rmdir commands. The dot(.) and double dots (..) notations to represent present and parent directories and their usagein relative path names. File related commands – cat, mv, rm, cp, wc and od commands.File attributes and permissions and knowing them. The ls command with options.Changing file permissions: the relative and absolute permissions changing methods.Recursively changing file permissions. Directory permissions.

**UNIT – III**

The vi editor. Basics. The .exrc file. Different ways of invoking and quitting vi. Differentmodes of vi. Input mode commands. Command mode commands. The ex mode commands.
Illustrative examples Navigation commands. Repeat command. Pattern searching. Thesearch and replace command. The set, map and abbr commands. Simple examples usingthese commands.
The shells interpretive cycle. Wild cards and file name generation. Removing the specialmeanings of wild cards. Three standard files and redirection. Connecting commands: Pipe. Splitting the output: tee. Command substitution. Basic and Extended regular expressions.Thegrep, egrep.Typical examples involving different regular expressions.

**UNIT – IV**

Shell programming. Ordinary and environment variables.The .profile. Read and readonlycommands.Command line arguments.exit and exit status of a command. Logical operators for conditional execution.The test command and its shortcut.The if, while, for and casecontrol statements. The set and shift commands and handling positional parameters. Thehere( << ) document and trap command. Simple shell program examples. File inodesandtheinode structure. File links – hard and soft links. Filters. Head and tail commands.Cutand paste commands.The sort command and its usage with different options.The umaskand default file permissions. Two special files /dev/null and /dev/tty.

**UNIT – V**

Meaning of a process.Mechanism of process creation.Parent and child process. The pscommand with its options. Executing a command at a specified point of time: at command.
Executing a command periodically: cron command and the crontab file.. Signals. The niceandnohup commands. Background processes. The bg and fg command. The kill command.
The find command with illustrative example.
Structure of a perl script. Running a perl script. Variables and operators. String handlingfunctions. Default variables - $_ and $. – representing the current line and current linenumber. The range operator.Chop() and chomp() functions. Lists and arrays. The @-variable. The splice operator, push(),

pop(), split() and join(). File handles and handling file– using open(), close() and die () functions.. Associative arrays – keys and value functions.
Overview of decision making loop control structures – the foreach. Regular expressions –simple and multiple search patterns.The match and substitute operators. Defining andusing subroutines.

**Text Books:**

1. Sumitabha Das., Unix Concepts and Applications., 4th Edition., Tata McGraw Hill
**2.** Behrouz A. Forouzan, Richard F. Gilberg : UNIX and Shell Programming- Cengage Learning – India Edition. 2009.

**Reference Books:**

**1.** M.G. Venkatesh Murthy: UNIX & Shell Programming**,** Pearson Education.
**2.** Richard Blum , Christine Bresnahan : Linux Command Line and Shell Scripting Bible, 2ndEdition , Wiley,2014.

# Departmental Elective Subjects in Eighth Semester

| **DEEP LEARNING** | **UCS08E13** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: None |

**Course Objective:**

The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolutional neural networks. The course also requires students to implement programming assignments related to these topics.

**UNIT I**

**Introduction**: Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm..

**UNIT II**

**Feedforward Networks:** Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.
**Better Training of Neural Networks:** Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

**UNIT III**

**Deep Neural Networks:** Difficulty of training deep neural networks, Greedy layerwise training.
Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs, Convolutional Neural Networks: LeNet, AlexNet
Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

**UNIT IV**

**Recent trends:** VariationalAutoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning

**Applications:** Vision, NLP, Speech

**Text Book:**

1.Introduction to Information Retrieval by Christopher D. Manning, PrabhakarRaghavan, and HinrichSchuetze, Cambridge University Press, 2008.

**Reference Books:**

1.Search Engines: Information Retrieval in Practice by Bruce Croft, Donald Metzler, and Trevor Strohman, Pearson Education, 2009.

2.Modern Information Retrieval by Baeza-Yates Ricardo and BerthierRibeiro-Neto.2nd edition, Addison-Wesley, 2011.

3.Information Retrieval: Implementing and Evaluating Search Engines by Stefan Buttcher, Charlie Clarke, Gordon Cormack, MIT Press, 2010

| **EMBEDDED AND REAL TIME SYSTEM** | **UCS08E14** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: UCS04B08 |

**Course Objective:**

1. Introduction of the real-time systems.
2. Computing required for the real-time embedded systems.
3. Communication required for the real-time embedded systems.
4. Present an overview of the real-time embedded systems in practice.

**UNIT I**

**INTRODUCTION TO EMBEDDED SYSTEMS:**

Architecture of Embedded Systems - Hardware Architecture, Software Architecture, Communication Software, Development/Testing Tools. ASIC Design, PLA-PLD-CPLDFPGA evolution,

**UNIT II**

**EMBEDDED SYSTEM MODELING:**

State chart, petri net, task graphs, UML, data flow graphs

**UNIT III**

**PROGRAMMING EMBEDDED SYSTEMS:**

The Process of Embedded System Development - Design Tradeoffs, Hardware Software codesign, Implementation, Integration and Testing. Hardware Platforms. Communication Interfaces.

**UNIT IV**

**EMBEDDED SYSTEM VALIDATION AND VERIFICATION**

**EMBEDDED/REAL-TIME OPERATING SYSTEMS:**

Representative Embedded Systems, Suitability and Characteristics of operating systems for RT applications.Programming in RT-Linux. RT Rule based Expert System. Embedded Database Application. Mobile Java .

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**UNIT V**

**APPLICATIONS:**

Embedded Software Development on 8051 Micro-controller Platform DSP-based Embedded Systems - Implementation of Embedded Systems with VHDL, FPGA and CPLD. Embedded Systems Applications using Strong ARM Platform

**Text Book**:

1. Embedded/Real-time Systems: Concepts, Design and Programmingby Dr. K.V.K.K. Prasad, Dreamtech press.

**Reference Book** :

1. Programming for Embedded Systems by Dreamtech Software team, Willey – Dreamtech
2. Real time systems by Jane Liu, Prentice Hall
3. Real-Time Systems: Scheduling, Analysis, and Verification by Prof. Albert M. K. Cheng, John Wiley and Sons
4. Embedded Systems: Principles, Techniques, and Applications by A. Konar, Springer 2011

| **HUMAN COMPUTER INTERACTION** | **UCS08E15** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: None |

**Course Objective:**

Human-computer interaction (HCI) has become an area of great interest and concern. HCI is concerned with the joint performance of tasks by humans and machines. It stresses the importance of good interfaces and the relationship of interface design to effective human interaction with computers. It focuses more on application (and less on theory) of user-centered design principles, guidelines, and evaluation. This course provides the concepts of HCI and user interfaces, focusing on user interface design, evaluation, and technologies. This is a non-programming intensive course.

Among the topics studied are the design and evaluation of effective user interaction designs, including principles and guidelines for designing interactive systems. Additionally, much emphasis is given to the development process for user interaction designs as an integral, but different, part of interactive software development. User interaction development activities include requirements and task analysis, usability specifications, design, prototyping, and evaluation. It is a goal of this course to help students realize that user interface development is an ongoing process throughout the full product life cycle.

Learning Outcomes

On completion of this course according to course goals, the student should be able to:
understand the basics of human and computational abilities and limitations.
understand basic theories, tools and techniques in HCI.
understand the fundamental aspects of designing and evaluating interfaces.
practice a variety of simple methods for evaluating the quality of a user interface.
apply appropriate HCI techniques to design systems that are usable by people.

**UNIT I**

INTRODUCTION

The Human – Input-output channels.Human Memory, thinking, emotions, psychology & design of interactive systems. Computer text entry devices, positioning, pointing &drawing , display devices for Virtual reality, interaction models, Frameworks & HCI, Ergonomics, Interaction styles WIMP Interfaces – context, paradigms for Interaction.

**UNIT II**

DESIGN PROCESS – SCREEN DESIGN

Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions. Screen Designing : Design goals– Screen planning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow. Visually pleasing composition , amount of information, focus and emphasis, presentation information simply and meaningfully, information retrieval on web, statistical graphics , Technological consideration in interface design .

**UNIT III**

WINDOWS AND MULTIMEDIA

Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls; Components– text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

**UNIT IV**

SOFTWARE TOOLS AND DEVICES

Software tools – Specification methods, interface –Building Tools , Interaction Devices – Keyboard and function keys pointing devices – speech recognition digitization and generation – image and video displays and drivers.

**UNIT V**

UBIQUITOUS COMPUTING, HYPERTEXT, WWW

Ubiquitous computing application research – virtual & augmented reality – information & data visualization, understanding hypertext – finding things – Web Technology & issues – Static Web content – Dynamic Web content; Groupware systems – Computer mediated communication – DSS – Frameworks for groupware.

**Text Book:**

1. Dix A. et al., Human-Computer Interaction. Harlow, England: Prentice Hall, ISBN-10: 0130461091

**Reference Books:**

1. Wilbert O Galitz, “The essential guide to user interface design”, Wiley
2. Ben Shneidermann , Catherine Plaisant, “Designing the user interface, Strategies for effective Human Computer Interaction”, Pearson Education.
3. . Alan Dix, Janet Finlay, GreGoryd, Abowd, Russell Beale, ”Human – Computer Interaction”, Pearson Education.

| NATURAL LANGUAGE PROCESSING | UCS08E16 |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: UCS06B13,<br>UCS03C01 |

**Course Objective:**
This course provides an introduction to computational linguistics, from morphology (word formation) and syntax (sentence structure) to semantics (meaning), and natural language processing applications such as parsing, machine translation, generation and dialog systems. At the end of this course, students should have a good understanding of the research questions and methods used in different areas of natural language processing. Students should also be able to use this knowledge to implement simple natural language processing algorithms and applications.

**UNIT-I**
**Sound :** Biology of Speech Processing; Place and Manner of Articulation; Word Boundary Detection; Argmax based computations; HMM and Speech Recognition.

**UNIT-II**
**Words and Word Forms :** Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields.

**UNIT-III**
**Structures :** Theories of Parsing, Parsing Algorithms; Robust and Scalable Parsing on Noisy Text as in Web documents; Hybrid of Rule Based and Probabilistic Parsing; Scope Ambiguity and Attachment Ambiguity resolution.

**UNIT-IV**
**Meaning:** Lexical Knowledge Networks, Wordnet Theory; Indian Language Wordnets and Multilingual Dictionaries; Semantic Roles; Word Sense Disambiguation; WSD and Multilinguality; Metaphors; Coreferences.

**UNIT-V**
**Web 2.0 Applications:** Sentiment Analysis; Text Entailment; Robust and Scalable Machine Translation; Question Answering in Multilingual Setting; Cross Lingual Information Retrieval (CLIR).

**Text Books:**
1. Speech and Language Processing (2nd ed.) Dan Jurafsky and James H. Martin

**Reference Books:**
1.Foundations of Statistical Natural Language Processingby Manning, Christopher and Heinrich, Schutze , MIT Press.
2. Statistical Language Learning by Charniack, Eugene, MIT Press, 1993.
3. The Handbook of Computational Linguistics and Natural Language Processing, Alexander Clark, Chris Fox, Shalom Lappin.

| PRINCIPLES OF PROGRAMMING LANGUAGE | UCS08E17 |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: UCS03B02,<br>UCS04B07, UCS04B06 |

**UNIT I**

Imperative Programming Paradigm: Syntax, Semantics and Pragmatics. Basic Constructs, Data abstraction.

**UNIT II**

Procedural abstraction: Names, bindings, scope, parameter passing methods, interface.

**UNIT III**

Functional Programming Languages: implementation, case study.

**UNIT IV**

Logic programming Languages: implementation, case study.

Text Books:


1) Ravi Sethi Programming Languages: Concepts and Constructs. Addison Wesley 1996
2) Benjamin C Pierce. Types and programming Languages, MIT Press, 2002
3) Michael L Scott, Programming Language Pragmatics. Elsevier. 2004.


| WEB TECHNOLOGY | UCS08E18 |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: None |

**Course objective**:

Design and implement dynamic websites with good aesthetic sense of designing and latest technical tools. Have a Good grounding of Web Application Terminologies, Internet Tools, E – Commerce and other web services. Get introduced in the area of Online Game programming.

**UNIT I**

**Internet Principles and Components:**

History of the Internet and World Wide Web, HTML, protocols - HTTP, SMTP, POP3, MIME, IMAP.Domain Name Server, Web Browsers and Web Servers, Dynamic HTML.,

**UNIT II**

**Client Side and Server Side Programming:** Introduction to JAVA Scripts and VB Scripts, Object Based Scripting for the web Server Pages, Session and Application management, Session tracking and cookies, Access a database from web page, Developing N-tier web application.

**UNIT III**

**XML and ActiveX:** Anatomy of xml document - XML markup-working with elements and attributes creating valid documents-xml objects and DOM. ActiveX controls: OLE and ActiveX -ActiveX Documents, Server side Active-X Components, ActiveX DLL and ActiveX Exe.

**UNIT IV**

**Multimedia and Web Application:** Multimedia in web design, Audio and video speech synthesis and recognition, Electronic Commerce, E-Business Model – E-Marketing, Online Payments and Security – N-tier Architecture. Search and Design: Working of search engines -optimization-Search interface.

**UNIT V**

**Web Services:** Introduction to Web Services, UDDI, SOAP, WSDL, Web Service Architecture, Developing and deploying web services. Ajax – Improving web page performance using Ajax, Programming in Ajax.

**Text Books:**

1. Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Pearson Education.

**References:**

1. Web Technologies, by Uttam K. Roy, Oxford Higher Education.

| **WIRELESS SENSOR NETWORK** | **UCS08E19** |
|---|---|
| L T P<br>3 - 0 - 0 : 3 Credits | Prerequisites: UCS06B15 |

**Course Objective:**

The objective of this course is to make the students

1. To Understand the basic WSN technologies, applications for emerging and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology
2. Understand the medium access control protocols and address physical layer issues
3. Learn key routing protocols for sensor networks and main design issues
4. Learn transport layer protocols for sensor networks, and design requirements
5. Understand the Sensor management, sensor network middleware, operating systems.

6. Get in-depth hands-on experience in designing and developing a real operational embedded network system

**Unit I**

**Wireless Sensor Network Concept**

Introduction, Hardware Configuration, Applications, Introduction to TinyOS and nesC, TinyOS Event Driven Architecture & Component Based Object Model, Concurrency Model of nesC (commands, events and tasks), Mate - A Tiny Virtual Machine for Sensor Networks, TOSSIM Simulator.

**Unit II**

**Deployment &Configuration :**Localization and calibration, Coverage and connectivity

**Unit III**

**Wireless Communications**

Link quality, shadowing and fading effects, Radio Model

**Unit IV**

**Medium Access**

Scheduling sleep cycles, Time Synchronization, SMAC , BMAC, multi-channel MAC, IEEE 802.15.4 standard

**Unit V**

**Data Gathering**

Tree construction algorithms and analysis, Asymptotic capacity, Lifetime optimization formulations

**Unit VI**

**Routing and Querying**

Publish/Subscribe mechanisms, Geographic routing, Energy Aware routing, Attribute based routing, Hierarchical routing, Storage and retrieval

**Unit VII**

**Collaborative Signal Processing and Distributed Computation**

Detection, estimation, classification problems, Energy-efficient distributed algorithms,

**Unit VIII**

**Security**

Privacy issues, Attacks and countermeasures, TinySec - Link Layer Security Architecture for WSN.

**Unit IX**

**Case Studies:** A coverage to deployed systems like CitySense, etc.

**Textbooks:**


1. F. Zhao and L. Guibas, Wireless Sensor Networks, Morgan Kaufmann, San Francisco, 2004.
2. Mobile, Wireless, and Sensor Networks: Technology, Applications, and Future Directions by Rajeev Shorey, A. Ananda, MunChoon Chan, and Wei Tsang Ooi, IEEE Press, & A John Wiley & Sons, Inc., Publication, 2006
3. Handbook of Algorithms for Wireless Networking and Mobile Computing by AzzedineBoukerche, Chapman & Hall/CRC Press, 2006


**Reference Books:**

1. Handbook of Sensor Networks: Compact Wireless and Wired sensing systems by Mohammad Ilyas and ImadMahgoub, CRC Press, 2005.
2. Wireless Sensor Network Designs by Anna Hac, John Wiley & Sons Ltd., 2003.
3. Wireless Sensor Networks : A systems perspective by NirupamaBulusu and Sanjay Jha, Artech House, August 2005.
4. Wireless Sensor Networks : Architecture and Protocols by Jr., Edgar H. Callaway, Auerbach, 2003.

5. Wireless Sensor Networks by C.S. Raghavendra, Krishna M. Sivalingam and TaiebZnati, Springer, 2005.

# Open Elective Subject in Eighth Semester

| **APPLICATION OF MACHINE LEARNING IN TIME SERIES ANALYSIS** | **UCS08E20** |
|---|---|
| **L T P**<br>**3 – 0 – 0 : 3 Credits** | **Prerequisites: None** |

**Section- A : Conventional Time-Series**

**UNIT - I**

1. Stochastic process and its main characteristics
Stochastic process. Time series as a discrete stochastic process.Stationarity. Main characteristics of stochastic processes (means, autocovariation and autocorrelation functions).Stationary stochastic processes.Stationarity as the main characteristic of stochastic component of time series.

2. Autoregressive-moving average models ARMA (p,q)
Moving average models MA(q). Condition of invertability. Autoregressive models AR(p). Yull-Worker equations. Stationarity conditions. Autoregressive-moving average models ARMA (p,q).

**UNIT - II**

3. Coefficient estimation in ARMA (p,q) processes. Box-Jenkins' approach
Coefficients estimation in autoregressive models.Coefficient estimation in ARMA (p) processes. Quality of adjustment of time series models.AIC information criterion.BIC information criterion."Portmonto"-statistics.Box-Jenkins methodology to identification of stationary time series models.

4. Forecasting in the framework of Box-Jenkins model
Forecasting, trend and seasonality in Box-Jenkins model.

**Section- B : Non-stationarity in Time-Series and Dealing with uncertainty in forecasting**

**UNIT - III**

5. Non-stationary in time series. Time series with non-stationary variance. Non-stationary mean.
Hindrances in Economic Time-Series Prediction ,Machine Learning Approach to Time-Series Prediction, Scope of Machine Learning in Time-Series Prediction, Sources of Uncertainty in a Time-Series, Scope of Uncertainty Management by Fuzzy Sets, Fuzzy Time-Series, Partitioning of Fuzzy Time-Series, Fuzzification of a Time-Series, Time-Series Prediction Using Fuzzy Reasoning, Single and Multi-Factored Time-Series Prediction.

**UNIT - IV**

6. Mini Project for prediction of Economic Time series using machine learning.

Text Book:

1. Time Series Analysis And Forecasting by Example, SorenBisgaard and Murat Kulachi, Wiley Publication.
2. Mathematic for Economic Analysis, Knut Sydsaeter and Peter J. Hammond, Pearson Publication.
3. Computational Intelligence Principal Techniques and Application, AmitKonar, Springer Publication.
4. Time Series Prediction and Applications, AmitKonar and Diptendu Bhattacharya, Springer Publication.

Reference Book:

5. Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, J.-S.R. Jang, C.-T. Sun and E. Mizutani, Pearson Publication.

Maximum 30 capacity,
Eligible: All B Tech : CSE, EE, ECE, ME, EIE, PE, CE, Bio Engg. Chemical Engg. andMsc: Maths, Physics.