# Detailed Syllabus for 2- year MCA Program

***Department of Computer Science and Engineering, Jadavpur University***

## ***SUBJECTS FOR BRIDGE COURSE***

Note that students with B.Sc./ B. Com./ B.A. degree (Non-Computer Science/Non-IT) would have to satisfactorily complete the **Four-weeks Bridge Course** (B-1 and B-II) before the commencement of the first semester of the 2-year MCA program.

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|---|---|
| Course code | CSE/MCA /T/B11 |
| Category | Bridge Course |
| Course title | Fundamentals of Computer Science |
| Scheme and Credits | L–T–P: Credits: 0 |
| Semester | |
| Pre-requisites (if any) | |

## Syllabus

**( Bridge Course: B-I)**

*Evolution of Computers and Computer Organization:*

Stored Program Concept, Von Neumann Architecture; Computer Hardware Generations; Brief overview of organization of modern computers; Basic description of input devices, output devices, storage devices – Primary and Secondary memory, Communication bus – Address bus, Data bus, Control bus; Data and Information, Data Processing. [4L]

*Data Representation:*

Number System – Decimal, Binary, Octal and Hexadecimal (Whole numbers and fractions); Addition and subtraction of numbers in different number systems; Different methods of negative number representation – signed magnitude, one's complement, two's complement, subtraction using complements. [6L]

*Definition of Software:*

Concept of programming languages –high level, low level programming languages and assembly languages; Types of software – system software, application software, translators (compiler, interpreter, assembler), operating system, utility software.

Introduction to problem solving – Basic concepts of an algorithm, program design methods, flowcharts. [2L]

*Introduction to C Programming:*

Introduction to C programming; Variables, Data Types, Operator and Expression: Identifier and Keyword, Constant, Integer, Floating Point, Character, String, Enumeration, Data Types in C, Data Declaration & Definition, Operators – Arithmetic, Relational, Logical, Increment & Decrement, Bit wise, Assignment, Conditional; Precedence & Associability of Operators.

[2L]

Console I/O: Character input & Output, String Input & Output, Formatted Input / Output (scanf/printf). [2L]

Control Statement: selection statements, nested if, if-else-if, the ? alternative, conditional expression, switch, nested switch, Iteration Statements, for loop, while loop, do-while loop, goto & label, break & continue, exit() function. [4L]

**Books:**

1. FUNDAMENTALS OF COMPUTERS by E Balagurusamy , McGraw Hill Education
2. Programming with C by Byron Gottfried, McGraw Hill Education

| | |
|---|---|
| Course code | CSE/MCA/T/B12 |
| Category | Bridge Course |
| Course title | Basic Electronics |
| Scheme and Credits | L–T–P: Credits: 0 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

**(Bridge Course: B-II)**

DC circuits: Mesh analysis, Superposition theorem, Thevenin's and Norton's theorems, Maximum Power Transfer theorem [2L]

Circuit Transients: RC, RL, RLC circuits. [2L]

Semiconductor fundamentals: Band structure of solids, Intrinsic and extrinsic semiconductor, generation and recombination of carriers, carrier diffusion. [2L]

p-n junction Diodes: Energy band diagram of p-n junction in equilibrium, under forward and reverse bias, I-V characteristics, breakdown mechanisms, Zener diode, LED. [4L]

Diode Circuits: Half-wave rectifier, Full-wave rectifier, Zener voltage regulator. [2L]

Transistor: Structure and operation of BJT. [2L]

Transistor Circuits: CE, CB, CC configurations, Input – output characteristics, R-C coupled amplifiers, Oscillators. [6L]

**Books:**

1. Electronic Circuits: Discrete and Integrated by D. L. Schilling and C. Belove, McGraw-Hill, 1989. Electronics
2. Electronics: Fundamentals and Applications by D. Chattopadhyay and P. C. Rakshit, New Age International, 10th Edition, 2010
3. Electric Circuits (fourth edition) by Mahmood Nahvi and Joseph A. Edminister, Schaum's Series

**FIRST YEAR FIRST SEMESTER**

| | |
|---|---|
| Course code | CSE/MCA/T/111A |
| Category | Theoretical Course |
| Course title | Programming Fundamentals and Object Oriented Concepts |
| Scheme and Credits | L–T–P: 4; Credits: 4 |
| Semester | I |
| Pre-requisites (if any) | |

# Syllabus

## Procedural Programming Using C:

*Arrays:* 1-D and 2-D arrays [3L]

*Functions and Pointers:* function prototypes, nested function calls, Concepts of ***Recursion***, concepts of pointers, Parameter Passing techniques - call by value and call by address, passing arrays to function, void pointer, static vs. Dynamic memory allocation, array of pointers, string handling using pointers, pointer to a function, function returning pointer. [9L]

*Structure:* nested structure, array of structures, pointer to structure, self – referential structure [2L]

*IO Handling:* File pointer, File operations, text mode files, binary mode files [3L]

Pre-processing directives and macro [1L]

## Object Oriented Concepts and C++:

Introduction to object oriented programming concept [2L]

Overview of Procedural Feature: Concept of Reference variable, Default Parameters to Function, Function overloading, Inline function, Macro [2L]

Fundamental Object Oriented Features:
Structure and Class and Object, Abstraction/ Encapsulation, Access Specifier [3L]

Static Members, Friend Function, Constructor and Destructor, Operator Overloading , Inheritance [6L]
Abstract Class, Run time polymorphism, Virtual Base Class, case studies for class design [4L]

File Handling, Case Studies for class design [4L]

Exception Handling [2L]

Class Template and Function Template [2L]

Introduction to Namespace [1L]

Introduction to STL, Case studies for class design [4L]

**Books.**

1. *Programming with C* by Byron Gottfried
2. *The C Programming Language*, Second Edition , by Brian W. Kernighan and Dennis Ritchie
3. *Let Us C* by Yashavant Kanetkar, 17th Edition
4. *Programming -- Principles and Practice Using C++*, Addison-Wesley, ISBN 978-0321-992789, by Bjarne Stroustrup
5. *Object-Oriented Programming with C++* by E. Balagurusamy , 8th Edition.
6. *C++ Primer* by Barbara E. Moo, Josée Lajoie, and Stanley B. Lippman

| | |
|---|---|
| Course code | CSE/MCA/Math/T/112A |
| Category | Mathematical Foundations |
| Course title | |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | I |
| Pre-requisites (if any) | |

## Syllabus

*Statistical Methods:*
Objectives of a sample survey, Sample estimate of the attribute of a population, Selection of a sample without bias, Simple random sampling – with and without replacement, Sampling Distributions, Central Limit Theorems, Confidence interval, Hypothesis Testing, Chi-square tests and other testing methods. [10 L]

*Linear Algebra:*
Matrices and Determinants, Characteristic polynomials, Eigen values, Vector spaces, Concept of Inner Product and Metric, Linear Transformations. [6L]

*Abstract Algebra:*
Binary Operations, Groupoid, Semi-group and Monoid, Group and Subgroup, Cosets, Lagrange's theorem, Cyclic group, Order of a group, Generators, Normal subgroup, Quotient group, Homomorphism, Isomorphism, Permutation group, Direct product, Rings and sub-rings, Ideals and quotient rings, Integral domains and Fields. [12L]

*Introduction to Number Theory:* Divisibility, GCD, Prime Numbers, Infinitude of Primes, Fundamental Theorem of Arithmetic, Congruences, Fermat's Little Theorem, Euler's Formula, Chinese Remainder Theorem. [6L]

*Induction and Recursion* : Mathematical Induction, Strong Induction and Well-Ordering, Recursive Definitions and Structural Induction [6L]

**Books:**

1. Feller*: An Introduction to Probability Theory and Its Applications.*
2. N. G. Das: *Statistical Methods.*
3. S. K. Mapa: *Higher Algebra – Abstract and Linear.*
4. C. L. Liu: *Elements of Discrete Mathematics*.
5. Kenneth Rosen: *Discrete Mathematics and Its Applications.*
6. Hardy et. al.: *An Introduction to the Theory of Numbers.*

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|---|---|
| Course code | CSE/MCA/T/113A |
| Category | Management Information Systems |
| Course title | |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

An overview of MIS, Structure of a MIS – Hardware, Software and Communication technology for information systems [2L]

Concepts of information, Information systems requirements – strategies for the determination of Information requirements, Storage and retrieval of data, transaction processing, office automation and information processing, Functional Information system – Marketing, HR, Finance [6L]

System concepts – system concepts applied to management information systems, concepts of planning and control, Organizational structure and management concepts, input/output design, concept of CASE tools, Software project management system – Basics, software effort estimation, quality control, role of human involvement [10L]

Decision support systems – Concepts of decision making, Behavioral models of the decision maker/decision making, Decision making process - phases in the decision making process, intelligence and design phases, support systems for planning, control and decision making, support systems for management of knowledge work, Decision support tools [10L]

Techniques and methodologies for supporting MIS development - Data base requirements, data warehousing and business intelligence, data mining, user interface requirements, developing and implementing application systems, Quality assurance and evaluation of Information systems, Organizational and social implications, Implementation of MIS [12L]

**Books:**

1. Gordon B. Davis, Margrethe H. Olson , "*Management Information Systems – Conceptual foundations, Structure and Development* ", 1985, 2nd edition Mc-Graw Hill
2. James A. Senn , "*Analysis &Design of Information System*", Second edition, McGraw Hill.
3. K. C. Laudon and J. P. Laudon, "*Essentials of Management Information Systems*", Pearson Prentice-Hall, 2012 ISBN: 978-0132668552

| | |
|---|---|
| Course code | CSE/MCA/T/114A |
| Category | Digital Systems |
| Course title | |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

Difference between Analog and Digital Systems. [1L]

*Number Systems:* Binary number systems, Conversion of binary numbers to decimal numbers and vice-versa, Binary addition, Representation of negative numbers, Binary subtraction, Binary multiplication and division, Octal and hexadecimal numbers, conversion from binary to octal or hexadecimal and vice-versa. [6L]

*Binary codes:* Binary Coded Decimal (8421 BCD, Excess-3 BCD) , Addition of BCD numbers, Gray code, Error detecting code, Seven-segment display code, other Alphanumeric codes (ASCII, EBCDIC, ISCII, UNICODE). [6L]

*Boolean algebra and Logic Gates*: Truth Table, AND, OR , NOT and Exclusive-OR operations, Venn Diagram, De Morgan's Theorem, Universal logic operations, Writing Boolean functions from truth table, AND, OR, NOT, NAND, NOR, Exclusive-OR, Exclusive-NOR.
[4L]

*Minimization of Boolean functions:* Karnaugh-Veitch Map method, Quine–McCluskey method.
[4L]

*Combinational digital circuits:* Encoder, Decoder, Multiplexer, Demultiplexer, Magnitude comparator, Parity generator, Parity checker, Half-adder, Full-adder, Sequential adder, Parallel adder, Carry-Look-Ahead adder [6L]

*Sequential digital circuits:* Flip-flops, Registers, Up-down counters, asynchronous and synchronous counters, design methodology of sequential circuits. [8L]

*Logic Families:* Bipolar Logic Families (RTL, DTL, HTL, TTL, ECL), MOS families (MOSFET, CMOS, BiCMOS). [5L]

**Books:**


1. *Digital Design:* M. Morris Mano and Michael D. Ciletti, Pearson Education
2. *Digital Circuits and Design :* S. Salivahanan and S. Arivazhagan, Vikas Publication
3. *Engineering Digital Design*, R. F. Tinder, Academic Press, Harcourt India Pvt. Ltd.
4. *Introduction to Logic design*, A. B. Marcovitz, Tata –McGraw-Hill Edition.
5. *Computer Systems and Data Analysis*, D. K. Basu, M. Nasipuri and M. Kundu, Narosa, New Delhi.
6. B. Vranesic, " *Fundamentals of Digital Logic with VHDL Design*", Tata-Mc-Graw-Hill Edition.
7. A. P. Malvino *"Digital Principles and Applications"*, McGraw Hill International Editions (Fourth Edition).

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|---|---|
| Course code | CSE/MCA/T/115A |
| Category | Graph theory and Combinatorics |
| Course title | |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

*Introduction to Graph Theory :* [3L]
Definitions and Examples, Subgraphs, Complements, Graph Isomorphism, Degree, Directed and undirected graphs, weighted and unweighted graphs.

*Cycles, Planarity and Coloring :* [8L]
Walk, Trail, Path, Cycle, Euler Trails and Circuits, Planar Graphs, Hamilton Paths and Cycles, Vertex coloring, Edge coloring, Chromatic Polynomials.

*Trees :* [4L]
Definitions, Properties and Examples, Rooted Trees, Trees and Sorting, Binary Trees, Weighted Trees and Prefix Codes

*Optimization in Graphs :* [7L]
Shortest Path Algorithms, Minimal Spanning Trees – the algorithms of Kruskal and Prim, Transport Networks – Max-flow Min-cut Theorem, Matching Theory.

*Principle of Inclusion and Exclusion:* [6L]
The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing is in its Right Place, Rook Polynomials.

*Generating Functions:* [6L]
Definition and Examples – application of calculus, Partitions of Integers, The Exponential Generating Function, The Summation Operator.

*Recurrence Relations :* [6L]
First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients, The Non-homogeneous Recurrence Relation, Solving Recurrences by Generating Functions, Fibonacci Numbers and Golden Ratio.

Books:
1. F. Harary*: Graph Theory*
2. N. Deo: *Graph Theory with Applications to Engineering and Computer Science*
3. A. Tucker: *Applied Combinatorics*

**FIRST YEAR SECOND SEMESTER**

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|---|---|
| Course code | CSE/MCA/T/121A |
| Category | Data Structures and Algorithms |
| Course title | |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

Introduction, elementary data structures and their applications. **[1L]**

**Lists**: ordered lists, representation of arrays, linked lists: singly, doubly and circular linked lists, stacks, queues, dequeues, multiples stacks and queues, generalized lists, Applications: polynomial arithmetic, infix, postfix and prefix arithmetic expression conversion and evaluations. **[8L]**

**Trees**: General and binary trees, traversals, threaded binary tree, Binary Search Trees, AVL trees, B-Tree: B+ tree. **[6L]**

**Searching & Sorting:** Linear Search, Hashing, Internal and External sort, Insertion sort, Bubble sort, Selection sort [**4L**]

**Complexity Analysis:** Complexity measures, Worst, Best and Average Case, Upper and Lower bounds, Order Notations. **[2L]**

**Divide and Conquer Technique:** Definition, Binary Search, Merge Sort, Quick Sort, Multiplication of Large Integers. **[4L]**

**Greedy Algorithms:** Definition, Minimum spanning tree, Dijkstra's Algorithm for the shortest path, Fractional Knapsack Problem, Scheduling problems **[6L]**

**Dynamic Programming:** Definition, Making change problem, 0-1 Knapsack Problem, Floyd's algorithm for shortest paths, Chained Matrix Multiplication **[6L]**

**Introduction to NP-completeness** **[3L]**
Space and Time Complexity, Classes of Problems, Easy and Hard Problems, Concept of Reduction, The classes P, NP, NP-hard and NP-complete, Examples of NP-complete problems.

**Suggested Readings:**


1. Aaron M. Tenenbaum, YedidyahLangsam, Moshe J. Augenstein, "Data Structures in C", Pearson Education India
2. R.L. Kruse, B.P. Leary, C.L. Tondo, "Data structure and program design in C," PHI
3. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data structures," Galgotia publications.
4. T Cormen, C Leiserson, R Rivest, C. Stein, "Introduction to Algorithms," MIT Press
5. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms," University Press

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|---|---|
| Course code | CSE/MCA/T/122A |
| Category | Advanced Programming **(JAVA and Python)** |
| Course title | |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

**Part A-*Java Programming***

Introduction to Java: Properties of Java, JVM. [1L]

Object-Oriented Programming Concepts: [7L]

- Classes, Objects, Methods, Constructors etc.
- Inheritance, Ploymorphism
- Packages, interfaces
- Wrapper Classes

Exception handling [2L]

Concurrency-- Threads and Synchronization [3L]

File Handling [2L]

Graphical User Interfaces (GUIs). [4L]

- Standard GUI components (buttons, text fields, radio button, check box, list etc.)
- Event handling

Collection Classes [3L]

***Part B- Python Programming***

*VARIABLES, OPERATORS AND CONDITIONALS* ***2L***

Introduction to Python Programming – Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements- Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs

*LOOPS AND FUNCTIONS* ***2L***

Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

*INTRODUCTION TO DATA STRUCTURES* ***4L***

List – Adding Items to a List – Finding and Updating an Item – Nested Lists – Cloning Lists – Looping Through a List – Sorting a List – List Concatenation – List Slices – List Methods – List Loop – Mutability – Aliasing – Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value, Nested Tuples, Basic Tuple Operations – Sets, Dictionary operations, Built-in Dictionary Functions & Methods

*STRINGS OPERATIONS:* ***3L***

Introduction, Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built – In String Functions – Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting, Sorting, Looping, Nested Dictionaries Built – in Dictionary Function – Finding Key And Value in a Dictionary

*PYTHON - MODULES* ***2L***

Modules: Introduction – Module Loading and Execution – Packages – Making Your Own Module – The Python Standard Libraries. *import* Statement, e *from...import* Statement, *PYTHONPATH* Variable. Namespaces and Scoping, dir( ) Function, *globals()* and *locals()* Functions. *reload()* Function, Packages in Python

*FILE HANDLING, EXCEPTION HANDLING AND SYSTEM LEVEL COMMANDS* ***2L***

Files: Introduction – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions - Scripts: modules to access OS internals - examples - os- pid - psutil - .shutil - glob – sys.

*PYTHON OBJECT ORIENTED PROGRAMMING* *5L*

Creating a class, Instantiating objects, Accessing Attributes, Adding attributes to a class, Built-In Class Attributes, Defining methods in a class, Passing arguments to methods, Destroying Objects (Garbage Collection), Class Inheritance, Overriding Methods, Base Overloading Methods, Overloading Operators, Data Hiding

*PYTHON REGULAR EXPRESSION* ***2L***

*match* Function, *search* Function, Search and Replace, Regular Expression Modifiers, Regular Expression Patterns

*PYTHON FOR DATA ANALYSIS* ***3L***

Basic and advanced NumPy (Numerical Python) features
Tools to load, clean, transform, merge, and reshape data
Data analysis tools in the pandas library
static or interactive visualizations with matplotlib

**Books:**

1. Herbert Schildt, Java: The Complete Reference, Latest Edition
2. Bruce Eckel , Thinking in Java
2. Reema Thareja, Python Programming: Using Problem Solving Approach
3. Martin C. Brown, Python: The Complete Reference

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|---|---|
| Course code | CSE/MCA/T/123A |
| Category | Computer Organization and Architecture |
| Course title | |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

## Syllabus

1. Introduction to basic structures and operational concepts, Instruction formats, Instruction execution, sequencing, Addressing modes, Stacks, Queues, Subroutines [Example instruction set may be used: INTEL/ARM/MOTOROLA/others] **[7L]**

2. Control unit – Concepts, Fetching and storing word from/in main memory, Register transfers, Operations, execution of a complete instruction Hardwired control, Microprogrammed control, Concept of horizontal and vertical microprogramming, Nanoprogramming, Concepts of pipelining **[8L]**

3. Fixed point Arithmetic - Arithmetic and logical operations of signed numbers and their implementation, Concepts of floating point numbers and operations, Bit-slice processors and Emulation **[5L]**

4. Memory – Basic concepts, RAM, ROM – different types, Characteristics, ache memories, Performance (memory interleaving, hit rate etc.), Memory hierarchy - virtual memory – address translation, Secondary memories **[8L]**

5. Input/output organization: memory mapped, standard (isolated) and linear selection techniques of I/O addressing. Data transfer through programmed I/O, interrupt and DMA I/O processors. Data transfer over synchronous and asynchronous buses; discussions on some standard interface buses. **[8L]**

6. Brief introduction to RISC processors and parallel processing techniques. **[4L]**

**Suggested Readings:**

1. Computer Organization – C. Hamacher, Z. Vranesik, S. Zaky, McGraw Hill
2. Computer Architecture and Organization – John P. Hayes, McGraw Hill

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|---|---|
| Course code | CSE/MCA/T/124A |
| Category | Operating Systems |
| Course title | |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

## Syllabus

1. Introduction to Operating Systems [**1L]**

2. Concept of batch-processing, multi-programming, time sharing, real time operations [**2L]**

3. Process Management: Concept of process, state diagram, process control block; scheduling of processes – criteria, types of scheduling, non-preemptive and preemptive scheduling algorithms like: FCFS, Shortest Job First/Next (SJF/N), Shortest Remaining Time Next (SRTN), Round Robin (RR), Highest Response ratio Next (HRN), Priority based scheduling, different Multilevel queue scheduling etc.; [**5L]**

4. Threads – concept, process vs thread, kernel and user threads, multithreading models [**2L]**

5. Inter-process Communication (IPC) – Shared memory, message, FIFO, concept of semaphore, critical region, monitor [**2L]**

6. Process Synchronization: concepts, race condition, critical section problem and its solutions; synchronization tools- semaphore, monitor etc., discussion of synchronization problems like producer-consumer, readers-writers, dining philosophers, sleeping-barber etc. Deadlock – conditions, resource allocation graph, prevention techniques, avoidance technique – Banker's algorithm and related algorithms. [**6L]**

7. Memory management: Address space and address translation; static partitioning, dynamic partitioning, different types of fragmentation, paging, segmentation, swapping, virtual memory, demand paging, page size, page table, page replacement algorithms – FIFO, LRU, Optimal page replacement, Variants of LRU, etc; thrashing, working set strategy **[6L]**

8. File Management: File and operations on it, file organization and access; file allocation; directory structures, file sharing, file protection [**4L]**

9. Device management: Magnetic disks, disk scheduling- criteria, algorithms – FCFS, SSTF, SCAN, C-SCAN, LOOK, etc, disk management – formatting, boot block, disk free space management techniques, concept of RAID etc. [**3L]**

10. Protection and Security: Concepts of domain, Access matrix and its implementation, access control, Security of systems- concepts, threats- Trojan horse, virus, worms etc, introduction to cryptography as security tool, user authentication [**5L]**

11. Case Studies [**4L]**

**Suggested Readings:**

1. Operating Systems Concepts – A. Silberschatz, P. Galvin and G. Gagne. Wiley India
2. Operating Systems Concepts - Gary Nutt, N. Chaki and S. Neogy, Pearson Education
3. Operating Systems – W. Stallings, Pearson Education
4. Operating Systems: A Concept-based Approach – D. M. Dhamdhere, Tata McGraw-Hill

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|---|---|
| Course code | CSE/MCA/T/125A |
| Category | Database Management Systems |
| Course title | |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

## Syllabus

**Introduction:** Advantages of DBMS, Various levels of Data Definition and abstraction, Data Independence **[2 L]**

Concepts of Different Database Models, Functional Components of DBMS and Overall Structure of DBMS **[2 L]**

**Relational Model:** Relation, Attribute, Key, Foreign Key and other Relational Constraints **[2 L]**

**Database Design:** ER Diagram, Mapping and Participation Constraints, Weak Entity Set, Aggregation, Extended ER diagram, Design of Database Tables from ER/EER Diagram **[4 L]**

**Languages:** Relation Algebra, Relational Calculus **[3 L]**
Structured Query Language **[3 L]**

**Functional Dependency:** Concepts of Functional Dependency, Normalization, Multivalued Dependency **[5 L]**

**Database Storage:** Fixed/Variable Length Record, Ordered/Unordered file and Operations on them **[1L]**

**Indexing:** Primary/Clustering/Secondary/Multilevel Index, B/B+ Tree based Indexing, Hashing **[3L]**

**Query Optimization:** Search Strategies, Expression level Optimization, Join strategies **[2L]**

**Database Security** **[1 L]**

**Case Study:** Introduction to Oracle Architecture, PL/SQL, Trigger **[3L]**

**Transaction and Recovery:** Concept of Transaction and its States, Log based Recovery, Checkpoint **[3 L]**

**Concurrency Control:** Lock based Protocol, Time Stamp based Protocol, Recoverable Schedule etc. **[3 L]**

**Advanced Concepts:** Object-oriented database concepts and other query languages **[3L]**

**Suggested Readings:**

1. Fundamentals of Database Systems by E. Navathe
2. Database System Concepts by Korth and Silberschatz
3. Commercial Application Development Using Oracle Developer - 2000 by I. Bayross

**SECOND YEAR FIRST SEMESTER**

| | |
|---|---|
| Course code | CSE/MCA/T/211A |
| Category | Software Engineering |
| Course title | |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

1.Introduction and Brief Overview – Basic methods and principles used by engineering, including fundamentals of technical communication, measurement, analysis and design. Some aspects of the engineering profession, including standards, safety and intellectual property are also covered. [2L]

2. Software Model Driven Development Process - Analysis, Design, Testing( traditional practice diagrams such as DFDs and ERDs etc and Object-Oriented Software Engineering – Concept )- Case study with complete examples. [5L]

3. Requirements Engineering – Definition, Analysis, Development, Management; Standards/Guidelines (IEEE-Analysis, Specification, management) and CASE Tools - Case study with complete examples. [3L]

4. Effort and Cost Estimation Techniques - using COCOMO, COCOMO-II (using Lines of code, Object points, Function points) - Case study with complete examples. [4L]

5. Software Architecture - Architectural styles, architectural patterns, analysis of architectures, formal descriptions of software architectures, architectural description languages and tools, scalability and

interoperability issues, Web Engineering Architectures - case studies with example.

[3L]

6. Software Quality metrics – Product Revision (Maintainability, Flexibility, Test ability); Product Transition(Reusability, Interoperability, Portability); Product Operations(Reliability, Usability, Correctness, Integrity, Efficiency)- Measure Reliability; Availability; Reusability; Measure Software Complexity; - Case study with complete examples. [10L]

7. Software Evaluation Metrics (Supervised and Unsupervised techniques) – Methods of evaluating clustering- Assessing Clustering tendency, Determination number of clusters, Measuring Clustering quality; Methods for estimating a classifier's accuracy: Holdout method, Random subsampling, Cross validation, Bootstrap. Classifier Evaluation Metrics: Accuracy, Error Rate, Sensitivity and Specificity / Precision and Recall, and F-measures - Case study with complete examples. [10L]

8. Software Testing Technique and Strategies – Black Box, White Box, Integrity testing (top down, bottom up, mixed); test case design; System testing (Recovery, Security, Stress, Performance, Regression, Smoke, Verification, Validation, Acceptance etc..) - case study with example.

[3L]

**Suggested Readings:**

1. Fundamentals of Software Engineering – C. Ghezzi, M. Jazayeri, D. Mandrioli
2. Software Engineering – Sommerville, Pearson
3. Software Engineering – Martin L. Shooman, TMH
4. Software Engineering, A practitioner's approach – Roger Pressman
5. Software Engineering – Rajib Mall

| | |
|---|---|
| Course code | CSE/MCA/T/212A |
| Category | Automata and Language Processors |
| Course title | |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

## Syllabus

**Finite Automata and Regular Languages : [6L]**

DFA, NFA, Recognition of a language by an automaton, Equivalence of DFA and NFA, Minimization of FA, Equivalence of FAs, Pumping Lemma for Regular Languages, Closure Properties of Regular Sets.

**Context-free Languages and Push-Down Automata: [6L]**

Non-regular languages, CFLs, Closure properties of CFLs. Representative grammars, Context-free grammars, Parse trees, derivations and sentential forms, Ambiguity, Push-Down Automata, Pumping Lemma for CFL.

**Turing Machines: [3L]**

Turing Machines, Halting Problem, Recursive and Recursively enumerable Language.

**System software:** functions of an Assembler, features, design of one pass and two pass assemblers; basic Concepts of Linkers and Loaders, Boot Loaders, Dynamic Linking **[3L]**

Concept of Editor and text editor, Interpreters, Simulator **[2L]**

Introduction to Compiler, Different phases and passes of compiler **[1L]**

**Lexical Analysis:** Role of Lexical Analyzer, Input Buffering, Specification of Tokens, State-machine driven lexical analysers and their implementations. **[4L]**

**Syntax Analysis:** Role of the parser, Top-down parsing, LL(1)grammars, Predictive Parsing, Bottom-up parsing, Shift-reduce Parsing, LR(0) grammars, LR parsing algorithms **[6L]**

**Syntax Directed Translation:** Syntax directed definitions, Construction of syntax trees, Bottom-up evaluation of S-attributed definitions, L-attributed definitions **[2L]**

**Runtime Environments:** Source Language issues, Storage Organization, Storage Allocation strategies, Access to non-local names, Parameter passing mechanism **[2L]**

**Intermediate Code Generation:** Intermediate languages, Graphical representation, Three address code, Implementation of three address statements (Quadruples, Triples, Indirect triples) **[2L]**

**Code Optimization and generation:** Introduction, Basic blocks and flow graphs, Transformation of basic blocks, DAG representation of basic blocks, Principal sources of optimization, Loops in the flow graph, Peephole optimization. Issues in the design of code generator, Register allocation and assignment **[3L]**

**Suggested Readings:**


1. J. E. Hopcroft and J. D. Ullman: Introduction to Automata Theory, Languages and Computation.
2. H. R. Lewis and C. H. Papadimitriou: Elements of the Theory of Computation.
3. Alfred Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman, "Compilers Principles, Techniques and Tools," Pearson Education Asia (2nd Ed. - 2009).
4. Leland L. Beck**,** "System Software: An Introduction to Systems Programming," 3/E, Addison-Wesley, 1997.
5. Allen I. Holub "Compiler Design in C," Prentice Hall of India, 2003.
6. C. N. Fischer and R. J. LeBlanc, "Crafting a Compiler with C," Pearson Education.
7. J.P. Bennet, "Introduction to Compiler Techniques," Second Edition, Tata McGraw-Hill, 2003.
8. Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C," PHI, 2001.
9. Kenneth C. Louden, "Compiler Construction: Principles and Practice," Thomson Learning.
10. Systems Programming and Operating Systems – D. M. Dhamdhere, TMH
11. John J. Donovan, "Systems Programming," 3rd edition, 1997, Addison Wesley.

| | |
|---|---|
| Course code | CSE/MCA/T/213A |
| Category | |
| Course title | Data Communication and Computer Networks |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

**Introduction:** Uses of Computer Networks, Types of Computer Networks, OSI Reference Model, TCP/IP model **[1L]**

**Physical Layer:** Data and signal fundamentals, Transmission impairments, Attenuation, Distortion, Noise, Data rate limits for noisy and noiseless channels, Digital Transmission, line coding schemes, Block coding schemes, Scrambling techniques, Analog to digital encoding, Analog Transmission, Transmission Media - Guided (wired) media – Twisted pair cable, Coaxial cable and Fibre optic cable, Unguided (wireless) media, Concept of multiplexing, Frequency division multiplexing, Time division multiplexing, Concept of spreading spectrum, Frequency hopping spread spectrum and Direct sequence spread spectrum. **[10L]**

**Data Link Layer:** Link Layer Addressing, ARP, Error detection and Correction Techniques, Flow and Error Control, Data Link Layer Protocols, MAC Protocols, Point to Point Protocol, Wired LANs– Ethernet, IEEE 802.3, Hub, Switches, Introduction to Wireless LANs, IEEE 802.11, MAC sublayer, Bluetooth. **[10L]**

**Network Layer:** Introduction, Performance metrics, IP Addressing, Subnetting, Routing Algorithms (Link State, Distance Vector, Hierarchical), Routing protocols in the Internet (RIP, OSPF, BGP), Broadcast and Multicast Routing Algorithms, Routers, ICMP, Introduction to IPv6. **[10L]**

**Transport Layer:** Introduction to Transport Layer Services, Transport Layer Protocols, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Socket. **[5L]**

**Application Layer:** SSH, Domain Name Space (DNS), Electronic Mail (SMTP, MIME, IMAP, POP3), File Transfer Protocol **[4L]**

**Suggested Readings:**


1. Computer Networking: A Top-Down Approach Featuring the Internet, by James F. Kurose and KeithW. Ross, 6th Edition, Pearson Education, 2017
2. Data communication and Networking, by Behrouz A. Forouzan, 5th Edition, Tata McGraw-Hill, 2017
3. Computer Networks, by Andrew S. Tanenbaum, 5th Edition, Prentice Hall India, 2013
4. Computer Networks: A Systems Approach, by Larry L. Peterson and Peter S. Davie, 5th Edition, Morgan Kauffman Publishers, 2011
5. Data and Computer Communication, by William Stallings, 10th Edition, Pearson Education, 2017

| | |
|---|---|
| Course code | CSE/MCA/T/214 |
| Category | Elective |
| Course title | Elective-1 |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

**Note that students have to choose one subject from this elective basket. The detailed syllabus for each subject belonging to the elective-I basket is attached below.**

| | |
|---|---|
| Course code | CSE/MCA/T/215 |
| Category | Elective |
| Course title | Elective-1I |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

**Note that students have to choose one subject from this elective basket. The detailed syllabus for each subject belonging to the elective-II basket is attached below.**

| | |
|---|---|
| Course code | CSE/MCA/T/216 |
| Category | Elective |
| Course title | Elective-III |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

**Note that students have to choose one subject from this elective basket. The detailed syllabus for each subject belonging to the elective-III basket is attached below.**

# LIST OF ELECTIVES

## (Note that students have to choose one subject from each of the following elective baskets)

## Subjects in the Elective-1 basket

| | |
|---|---|
| Course code | CSE/MCA/T/214A |
| Category | Elective-1 |
| Course title | Artificial Intelligence and Applications |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

## Syllabus

Introduction [2L]

Intelligent Agents [2L]

Solving problems by Searching – Uninformed (BFS, DFS, DLS, ID, IB, Bi-directional Search, Island-Driven Search), Informed/Heuristic (Greedy, A*, IDA*) [5L]

Advanced intelligent search techniques – Uniform Cost Search, Hill Climbing, Simulated Annealing, Genetic Algorithm, Tabu Search [8L]

Adversarial search - Game Playing [2L]

Knowledge and Reasoning - Predicate calculus in Artificial intelligence, Resolution Refutation Systems, Structured Knowledge Representation Techniques [6L]

Reasoning under Uncertainty – Non Monotonic Reasoning Systems, Assumption based Truth Maintenance System, Probabilistic Reasoning, Fuzzy Reasoning [4L]

Machine Learning - Decision Trees, Artificial Neural Networks [5L]

Planning – Classical, Algorithm for Planning as State-space Search, Planning Graph [2L]

Some Applications of Artificial Intelligence [4L]

**Suggested Readings:**


1. N. J. Nilsson. Artificial Intelligence : A New Synthesis, Elsevier India, 2010
2. N. J. Nilsson. Principles of Artificial Intelligence, Narosa Publishing House, 2002
3. N. J. Nilsson. Problem-Solving Methods in Artificial Intelligence, New York: McGraw-Hill, 1971.
4. S. Russel, P. Norvig. Artificial Intelligence and Modern Approach, Pearson Education, 2003
5. G. F. Lugar, Artificial Intelligence, Pearson Education, 2001
6. M. Ginsberg, Essentials of Artificial Intelligence, Morgan Kaufman Publishers, 1993
7. Elaine Rich, Kevin Knight. Artificial Intelligence

| | |
|---|---|
| Course code | CSE/MCA/T/214B |
| Category | Elective-1 |
| Course title | Machine Learning |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

What is machine learning? Why machine learning? Applications of machine Learning, types of machine Learning. [1L]

Machine leaning system design, Concept Learning, learning hypothesis space, learning as search, inductive bias-restriction bias and preference bias [4L]

Data representation- Features/attributes, Types of features, Training and test data design, output vector representation [2L]

Decision tree learning, noise and overfitting, Gini index [4L]

Instance based learning, Curse of dimensionality [2L]

Probabilistic learning model and Bayesian learning [4L]

Linear regression, Logistic Regression, Regularized Logistic Regression, Support Vector Machine (SVM), Learning multiple classes [6L]

Performance measures for Machine learning algorithms: Evaluation metrics, Bootstrapping & Cross Validation [2L]

Artificial Neural networks: Perceptron Learning, Delta Rule, multilayer neural networks, Backpropagation algorithm, Momentum, L1/L2 Regularization [4L]

Introduction to deep learning [3L]

Unsupervised Learning: Partitional and hierarchical clustering, Gaussian mixture model. [5L]

Ensemble Learning [3L]

| | |
|---|---|
| Course code | CSE/MCA/T/214C |
| Category | Elective-1 |
| Course title | Pattern Recognition |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

Basic concepts of Pattern Recognition, Pattern Preprocessing [2L]

Feature Extraction, Dimensionality Reduction Techniques, Feature Selection [4L]

Decision Functions [2L]

Bayesian decision theory, Parametric Estimation: Maximum likelihood estimation and Bayesian estimation [6L]

Non parametric Estimation: Parzen windows, Nearest Neighbor estimation [4L]

Pattern Classification: Linear classifiers, Perceptron, Non-linear classifiers: MLP, Non-linear SVM [6L]

Unsupervised learning and Clustering: Partitioning methods, Density-based methods, MST- based methods; Soft Computing based methods, Hierarchical Clustering, Cluster Validity Indices. [12L]

Syntactic Pattern Recognition: Concepts and applications [4L]

**Suggested Readings:**

1. Pattern Recognition Principles, Tou and Gonzalez, Addison-Wesley
2. Pattern Classification, Duda, Hart and Stork, Wiley
3. Pattern Recognition and Machine Learning, Christopher Bishop, Springer
4. Introduction to Statistical Pattern Recognition, Fukunaga, Academic Press

| | |
|---|---|
| Course code | CSE/MCA/T/214D |
| Category | Elective-1 |
| Course title | Introduction to Data Science |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

1. Definition of Data, type of data, data collection, Date Cleaning, data preprocessing, ETL techniques, data storage, data warehousing, data wrangling, Knowledge discovery, data mining, data science project life cycle, Data summaries and descriptive statistics : Measures of i) Frequency, Count, Percent, ii) Central Tendency like Mean, Median, and Mode, iii) Dispersion or Variation like Range, Variance, Standard Deviation, iv) Position like Percentile Ranks and Quartile Ranks. 6L

2. Basic of Linear Algebra, Basic probability- Joint Probability, Conditional Probability, Bayes Theorem 2L

3. Probability distributions, Regression models 3L

4. Hypothesis testing, ANOVA, t-test, Wilcoxon signed-rank test, Spearman's rank-order correlation, error, sampling, normalization 3L

5. Feature extraction and Feature Selection, dimensionality reduction - Principal Component Analysis 3L

6. Fundamentals of Graphs and Charts, Data visualization 3L

7. Introduction to machine learning , supervised, unsupervised learning, ROC, AUC, Classification: KNN, Decision Tree, Random Forest, Bayes Classifier, Support Vector Machine 5L

8. Clustering: KMeans, FCM, DBScan, Expectation-Maximization, Agglomerative Hierarchical Clustering 4L

9. Database Management System, SQL, Introduction to Big Data and Its management – Basics of Hadoop, MapReduce, NoSQL, Spark 5L

10. Basics of Deep Learning, Convolutional Neural Network, Recurrent Neural Network 2L

11. Case study on real-life applications of Data Science in any area like bioinformatics, image processing and computer vision, natural language processing, social networking etc. 4L

**Reference Books:**


1. Cady, Field. The data science handbook. John Wiley & Sons, 2017.
2. Pierson, Lillian. Data science for dummies. John Wiley & Sons, 2015.
3. Peter Bruce and Andrew Bruce, Practical Statistics for Data Science, O'Reilly, 2017.
4. Moreira, João, Andre Carvalho, and Tomás Horvath. A general introduction to data analytics. John Wiley & Sons, 2018.
5. Machine Learning, Tom Mitchell, McGraw Hill, 1997.
6. Introduction to Machine Learning, third edition. Ethem Alpaydin. The MIT Press. September 2014: ISBN: 978-0-262-028189
7. Braun W J, Murdoch D J (2007): A First Course in Statistical Programming with R. Cambridge University Press. New York.
8. Cory Lesmeister, Mastering Machine Learning with R.
9. Python Data Science Handbook, Jake VanderPlas, 2016, O'Reilly Media, Inc., ISBN: 9781491912058
10. Practical Statistics for Data Scientists by Peter Bruce, Andrew Bruce & Peter Gedeck, O 'Reilly, ISBN: 149207294X
11. Data Science from Scratch Paperback, Joel Grus, O′Reilly, ISBN-10 : 149190142X2015.
12. Hands-On Machine Learning with Scikit-Learn, Keras and Tensor Flow: Concepts, Tools and Techniques to Build Intelligent Systems, Aurelien Geron, Shroff/O'Reilly; 2019, ISBN-10: 9352139054

| | |
|---|---|
| Course code | CSE/MCA/T/214E |
| Category | Elective-1 |
| Course title | Optimization Techniques |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

**Introduction** **[2L]**
Historical development, Engineering application of optimization, Formulation of design problems as mathematical programming problems, classification of optimization problems.

**Linear Programming** **[8L]**
Graphical method, Simplex method, Revised simplex method, Duality in linear programming, Sensitivity analysis, other algorithms for solving LP problems.

**Application of Linear Programming II** **[6L]**
Transportation Problem, Assignment Problem and other applications, Integer Programming.

**Non-Linear Programming** **[14L]**
Unconstrained optimization techniques, Convex/Concave function and Global Optimality, Gradient Descent methods, Constrained optimization, Convex Separable Quadratic Programming, Direct and indirect methods, Optimization with calculus, Lagrangian Multiplier methods and Kharush-Khun-Tucker optimality conditions.

**Dynamic Programming** **[3L]**
Introduction, Sequential optimization, computational procedure, curse of dimensionality.

**Advanced Optimization Technique** **[4L]**
Genetic Algorithms, Simulated Annealing etc.

**Game Theory** **[3L]**
Introduction, Maxmin-Minimax Principle, Games with or without saddle points.

**Suggested Readings:**
1. H. A. Taha, Operations research
2. S. Fang et al, Linear optimizations and Extensions
3. G. Hadley, Linear programming, Narosa Publishing House, New Delhi, 1990.
4. K. Deb, Optimization for Engineering Design – Algorithms and Examples.
5. R. Rardin, Optimization in Operation research, Pearson
6. J. K. Sharma, Operations Research: Theory and Application 6/e, Laxmi Publications

| | |
|---|---|
| Course code | CSE/MCA/T/214F |
| Category | Elective-1 |
| Course title | Soft Computing |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

1. Introduction to Soft Computing, Components of Soft Computing, Importance of Soft Computing, Applications. [2L]

2. Fuzzy Set Theory - Definition, Different types of fuzzy set membership functions. Fuzzy set theoretic operations, Fuzzy rules and fuzzy reasoning, Fuzzy inference systems. [8L]

3. Rough set theory. [2L]

4. Probabilistic Reasoning. [4L]

5. Genetic Algorithms, Simulated Annealing, applications. [6L]
6. Neural Networks- Artificial neural networks models, Supervised Learning, Unsupervised Learning, Applications. [10L]

7. Hybrid Systems and applications [8L]

**Suggested Readings:**
1. Neuro Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence - Jang, Sun and Mizutani, Printice Hall.
2. Soft Computing : Integrating Evolutionary, Neural, and Fuzzy Systems, by Tettamanzi, Andrea, Tomassini, and Marco. (2001), Springer.

# Subjects in the Elective-II basket

| | |
|---|---|
| Course code | CSE/MCA/T/215A |
| Category | Elective-II |
| Course title | Distributed computing |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

**Introduction to distributed environment:** Goals, hardware & software concepts, Overview of high performance computing, Parallel computing, Collaborative computing, architecture, middleware, Strengths and weaknesses of distributed computing. **[6L]**

**Communication:** Message-oriented communication, stream oriented communication, MPI, Socket, Web Socket, Remote procedure call (RPC), Remote method Invocation (RMI). **[5L]**

**Client Server model:** Architecture, multi-tier design, applications (e.g., email, chat) **[4L]**

**P2P:** Architecture, design, applications (e.g., Napster). **[4L]**

**Cluster Computing:** Hardware and software, Architecture, middleware, cluster computing environments, cluster resource management. **[4L]**

**Grid Computing:** Architecture, middleware, resource management, application, case study (e.g., Globus Toolkit). **[4L]**

**Cloud Computing:** Architecture, types of cloud services (IaaS, PaaS, SaaS, XaaS), Parallel processing in the cloud, Distributed storage systems, Virtualization. **[6L]**

**Overview of Big Data:** Characteristics of Big Data and Dimensions of Scalability **[1L]**

**Distributed File System:** Design principles, Overview of Replication and Fault Tolerance **[2L]**

**Hadoop:** core components, architecture, Hadoop Distributed File System (HDFS) **[2L]**

**MapReduce:** Programming model, applications **[2L]**

**Suggested Readings:**


1. Distributed Computing: Principles and Applications, M. L. Liu, Pearson/AddisonWesley.
2. Cloud Computing Principles and Paradigms - Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley
3. Hadoop: The Definitive Guide Book by Tom White, O'Reilly
4. Map Reduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop by Donald Miner, O'Reilly


| | |
|---|---|
| Course code | CSE/MCA/T/215B |
| Category | Elective-II |
| Course title | Internet of Things (IOT) |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

## Syllabus

**Introduction:** Background of foundation technologies, architectural principles. **[4L]**

**IoT Stack:** Raw data- physical device level, data transformation- sensor middleware level, Data aggregation- virtual sensor level, data management and control – Semantic Level, data representation- application level, data visualization- business level. **[2L]**

**IoT Communication Protocols:** Physical and MAC layers, IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN; Network Layer – IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT, 6LoWPAN, Routing over Low Power and Lossy Networks; **[6L]**

**IoT Communication Technologies:** RFID, NFC, ZigBee, Bluetooth, Challenges and requirements **[4L]**

**Application Layer Protocols:** COAP, XMPP, AMQP, MQTT, WebRTC, WebSocket **[4L]**

**Building IoT Applications:** Arduino, Raspberry Pi, real-world application scenarios **[4L]**

**Cloud Computing:** Cloud storage, computational infrastructure, Distributed frameworks and programming paradigms, e.g., Hadoop ecosystem **[4L]**

**Integrating IoT and Cloud:** Sensor-Cloud Architectures and Approaches; Issues related to the integration, what to offload and what not to. **[4L]**

**Analyzing IoT data:** Overview of data analytics and visualization for IoT applications – Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning **[4L]**

**Privacy Issues:** Issues regarding data sharing **[2L]**

**Case Studies/Industrial Applications–** Smart and Connected Cities, Smart Traffic Control, Smart Healthcare **[2L]**

**References:**


1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by David Hanes, Gonzalo Salgueiro, Rob Barton, June 2017, Publisher(s): Cisco Press, ISBN: 9780134307091
2. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.
3. Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.
4. Charles Bell, "Beginning Sensor Networks with Arduino and Raspberry Pi", Apress, 2013.


| | |
|---|---|
| Course code | CSE/MCA/T/215C |
| Category | Elective-II |
| Course title | Network Security |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

1. Introduction: Security Goals, Threats, Vulnerabilities and Attacks, Types of Attacks, Security Services and Mechanisms [2L]

2. Cryptographic Tools: Symmetric Key Cryptography, Block Ciphers, Stream Ciphers, DES, IDEA, AES, Asymmetric Key Cryptography, RSA, ElGamal Cryptosystems, Elliptic Curve Cryptosystems, Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signatures, Key Management, Kerberos [4L ]

3. Security at Network Layer: IP Security Overview, IP Security Architecture, Security Association, Authentication Header, Encapsulated Security Payload, Internet Key Exchange, ISAKMP [3L]

4. Security at Transport Layer: SSL Architecture, Four SSL Protocols, SSL Message Format, Transport Layer Security, HTTPS, SSH [3L]

5. Security at Application Layer: Email Security, PGP, S/MIME [3L]

6. Firewalls and Intrusion Prevention Systems: Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall Location and Configuration, Intrusion Prevention Systems [3L]

7. Intrusion Detection Systems: Intruders, Intrusion Detection, Host Based Intrusion Detection, Network Based Intrusion Detection, Distributed Intrusion Detection, Intrusion Detection Exchange Format, Honeypots [3L]

8. Denial of Service Attacks: Denial of Service Attacks, Flooding Attacks, Distributed Denial of Service Attacks, Reflector and Amplifier Attacks, Defences against Denial of Service Attacks, Responding to a Denial of Service Attack [4L]

9. Malicious Software: Types of Malicious Software, Viruses, Virus Countermeasures, Worms, Bots, Botnets, Rootkits [4L]

10. Software Security: Buffer Overflow Attacks, Defence against Buffer Overflows, Handling Program Inputs, Writing Safe Program Codes, Interaction with Operating System and Other Software [3L]

11. Wireless Network Security: Authentication and Authorization in Wireless LANs, Data Protection in Wireless LANs, Security in MANET [8L]

**Suggested readings:**

1. Computer Security: Principles and Practices, by William Stallings and Larry Brown, First Edition, 2008, Pearson Education

2. Network Security: Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Second Edition, 2003, Prentice Hall India

3. Cryptography and Network Security, by William Stallings, Fifth Edition, , Prentice Hall, 2010

4. Cryptography and Network Security by Behrouz A. Forouzan and Debdeep Mukhopadhyay, Second Edition, 2010, Tata McGraw Hill

5. Network Security Essentials: Applications and Standards, by William Stallings, Edition, , Pearson Education

6. Security in Computing, by Charles P. Pfleeger, Shari Lawrence Pfleeger, 4th Edition, 2007, Prentice Hall

7. Security in Wireless LANs and MANs by Thomas Hardjono and Lakshminath R. Dondeti, Artech House, 2005

| | |
|---|---|
| Course code | CSE/MCA/T/215D |
| Category | Elective-II |
| Course title | Web Technologies |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

Introduction to web technology [2L]

Scripting language (JavaScript) and HTML5. [4L]

XML Processing Technologies for Data Representation; DOM, SAX for XML. [2L]

Server side programming (Servlet, Spring framework, etc.) [10L]

Web Clients: Browsers, cookies, spiders, search engines [2L]

Multimedia Streaming Protocols [8L]

Web Servers Web Caching and Content Distribution [2L]

HTTP, Websocket [6L]

Web Security [2L]

Web Protocols: TCP, IP, SMTP, POP3, FTP [2L]

**Suggested Readings:**

1. Head First Servlets and JSP by Bryan Basham, Kathy Sierra, Bert Bates, O'Reilly Media publications
2. Internet and World Wide Web: How to Program - 4th Edition by P. J. Deitel and H. M. Deitel, Pearson Publications
3. Java Web Services by David A Chappell, Tyler Jewell, O'Reilly Publications
4. Spring Boot in Action by CRAIG WALLS, Manning Publications

| | |
|---|---|
| Course code | CSE/MCA/T/215E |
| Category | Elective-II |
| Course title | Software Project Management |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

1. Introduction to Project management [3L]

a. Project Management Basics b. Role of a Project Manager c. Project Resources d. Phases of Software Project

2. Introduction to PERT/CPM [5L]

a. Work Breakdown Structure b. Network diagramming c. Critical Path d. PERT Probability e. Crashing f. Resource Leveling

3. Software Effort Estimation [4L]

a. Estimations Basics b. LOC Method c. Function Points d. Activity Based Estimation e. COCOMO f. Uncertainty in estimation

4. Project Planning [5L]

a. Management b. Risk c. Quality Assurance d. Schedule

5. Configuration Management [4L]

a. Configuration Management Basics b. Environment for Configuration Control c. Configuration Control vs. Version Control d. Code Management e. Change Management f. Information Management

6. Quality Assurance in Projects [4L]

a. Quality Basics b. Quality Assurance Activities in Projects c. Quality Control Activities in d. Introduction to ISO 9000, SEI – CMM Maturity Levels, Six Sigma

7. Productivity Aspects [2L]

a. Productivity Basics b. Productivity Measurement & Metrics

8. Human Factors and Leadership [4L]

a. Communication b. Leadership c. Team Dynamics

9. Progress Tracking & Control [3L]

a. Progress Assessment & Reporting b. Scope Management c. Risk Mitigation

10. Project Closeout [3L]

a. Project post-mortem b. Collection of re-usable Components c. Practices adopted in the project d. Project-End Audit

11. Organizational Support for Effective Project Management [3L]

a. Recognition as a Specialist Discipline b. Organize Knowledge Repository c. Processes, Standards & Guidelines d. Training

**Suggested Readings:**

1. Gilb, T., “Principles of Software Engineering Management”, Addison Weskey. Reading. M. A 1988.
2. Putnam. L.H., Myers. W., “Industrial Sire: Software - Effective Management using Measurement”, IEEE C.S. Press. 1997.

| | |
|---|---|
| Course code | CSE/MCA/T/215F |
| Category | Elective-II |
| Course title | Microprocessors and Embedded systems |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

## Syllabus

Introduction to microprocessor [2L]

Basic features of 8085 microprocessors and its addressing modes, 8085 microprocessor architecture.

Memory and I/O interfacing [4L]

Address decoding, Address aliasing, Memory read and write operations, Timing diagrams, Memory mapped I/O and I/O mapped I/O.

Programming of 8085 [6L]
Instruction Set, Assembly Language Programming and Illustrative examples.

8085 Interrupt Structure [2L]

Data Transfer Techniques [2L]
Synchronous and Asynchronous modes of data transfer, Interrupt driven I/O, DMA.

Peripheral Devices [6L]
8255 programmable peripheral interface, 8254 programmable counter, 8251 UART programmable communication interface, 8257 DMA Controller. 8259 Interrupt controller,8279 Keyboard & display interface.

Introduction to micro-controllers [8L]
8051 as an example. Micro-controller architecture, bi-directional data ports, internal ROM and RAM, counters/timer s, oscillator and clock, serial communication.8051-register set, memory organization-internal & external, program memory & data memory, bit addressable memory, and special function registers, Introduction to instruction set of 8051 and assembly language programming.

Introduction to Embedded Systems [2L]
An overview to embedded systems, Optimization of design metrics.

Embedded Processor Technology [2L]
General purpose processors, Single purpose processors, Application specific processors.

IC Technology [2L]
VLSI, ASIC, PLD

Design Methodology [4L]
Partitioning of Hardware-Software, Hardware- Software co-design approach.

**Suggested Readings:**


1. R. Gaonkar, “Microprocessor Architecture, Programming and Applications”, 5th Ed., Pearson International, 2001.
2. K. Ayala, “The 8051 Microcontroller – Architecture, Programming and Applications”, 2nd Ed., Pearson International,1996.
3. Liu and Gibson, “Microcomputer Systems: The 8086/8088 Family”, 2nd Ed., Prentice-Hall India (EEE), 1986.
4. J. Uffenberk, “Microcomputers and microprocessors”, 3rd Ed., Pearson Education, Asia (LPE), 2002.
5. C. Gilmore, “Microprocessors Principles and Applications”, 2nd Ed., McGraw-Hill International, 1995.
6. D. Hall, “Microprocessors and Interfacing”, 2nd Ed., Tata-McGraw-Hill, 1999.
7. Treibel and Singh, “The 8088 and 8086 Microprocessors”, 4th Ed., Prentice-Hall India (EEE), 1991.
8. Mazidi, “The 8051 Microcontrollers & Embedded Systems”, Pearson Education Asia (LPE)
9. M. Predko, “Programming and Customizing 8051 Microcontroller”, TMH
10. F.Vahid, T. Givargis, Embedded System Design - A unified Hardware/ Software Introduction, Willey Student Edition India, 2006
11. J. H. Jenkins, "Designing with FPGAs, and CPLDs", Prentice Hall, NJ.
12. Embedded System Design by S. Chattopadhyay, PHI

# Subjects in the Elective-III basket

| | |
|---|---|
| Course code | CSE/MCA/T/216A |
| Category | Elective-III |
| Course title | Computer Graphics |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

## Syllabus

**Introduction** **[2L]**
Basics of computer graphics, its applications, overview of graphical input-output devices.

**Rasterization Algorithms:** **[8L]**
*Scan conversion of Straight lines*: DDA algorithm, Bresenham's algorithm, Midpoint algorithm
*Scan conversion of Circles:* Polynomial method, DDA algorithm, Bresenham's algorithm, Midpoint algorithm.
*Scan conversion of Ellipses:* DDA algorithm, Midpoint algorithm

**Generations of solid areas**: **[4L]**
Scan line algorithms, Seed-fill algorithms.

**Geometric Transformations:** **[8L]**
*2-D Transformations:* Scaling, Rotation, Translation, Reflection, Shear, Homogenous co-ordinate system, Rotation about an arbitrary point, reflection in an arbitrary straight line.
*3-D Transformations:* Scaling, Rotation, Translation, Reflection, Rotation about an arbitrary straight line, reflection in an arbitrary plane, Parallel projections, Perspective projections.

**Display files and Segments:** **[2L]**

**2-D viewing and Clipping:** **[6L]**
Cohen- Sutherland Algorithm, Mid-point subdivision algorithm, Sutherland-Hodgman Polygon Clipping.

**Curves and Surfaces:** **[4L]**
Functional and parametric representations of curves and surfaces, Effect of control points on the shape of a curve, Bezier curves and surfaces, B-Spline curves and surfaces.

**Hidden surface removal:** **[2L]**
Z-buffer algorithm, Warnock's algorithm.

**Illumination model, colour, shading.** **[4L]**

**Suggested Readings:**


1. Procedural Elements of Computer Graphics: D. E. Rogers, McGraw Hill.
2. Mathematical Elements of Computer Graphics: D. E. Rogers, McGraw Hill.
3. Computer Graphics: Hearn and Baker, Prentice Hall India.
4. Computer Graphics, principles & practices: J.D. Foley, A. van Dam, S.K. Feiner and

J.F. Huges, Addison Wesley.
5. Computer Graphics, a programming approach: S. Harrington, TMH publication.
6. Computer Graphics: A. N. Sinha, A. D. Udai, TMH, New Delhi, 2008.
7. Computer Graphics, Multimedia and Animation: M. K. Pakhira, PHI Pvt. Ltd., 2008.

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|---|---|
| Course code | CSE/MCA/T/216B |
| Category | Elective-III |
| Course title | Computer Vision |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

## Syllabus

**Introduction to Computer Vision.** **[1L]**

**Fundamentals of Digital Image Processing**: **[4L]**
Image acquisition, Image representation, Basic Image transforms, image file formats (BMP, TIFF, GIF, PNG, etc.)

**Image Enhancement:** **[8L]**
Contrast stretching, Histogram Equalization, Binarization
*Filtering in Spatial domain:* Mean filter, Order Statistics filters.
*Filtering in Frequency domain:* Butterworth filter, Gaussian filter.

**Image Restoration**: **[2L]**
Image degradation models, Weiner filter.

**Image Segmentation:** **[4L]**
Edge detection: Gradient operators, Compass operator, Laplacian operators. LoG operator, Canny edge detector.

**Region Segmentation:** **[2L]**
Region growing, region splitting and merging.

**Shape detection:** **[3L]**
Least Mean Square error line fitting, Eigenvector line fitting, Straight line Hough Transform, Generalized Hough Transform, describing boundary by chain encoding.

**Image textures:** **[2L]**
Run Length Coding, Gray-level co-occurrence matrix, Local Binary Patterns.

**Morphological Operators:** **[4L]**
Dilation, Erosion, Opening, Closing, Hit-and-Miss transforms, Applications.

**Image Compression.** **[4L]**
*Spatial Domain methods:* Run Length encoding, Block based encoding, Contour encoding.
*Frequency Domain methods:* DCT, FFT, K-L transform, JPEG.

**Image Understanding:** **[6L]**
Feature extraction techniques, Statistical Decision making techniques, Nearest Neighbour Clustering, maxi-min Clustering, Discriminant functions, Artificial Neural Networks.

**Suggested Readings:**


1. R.C. Gonzalez and R. E. Woods, "Digital Image Processing", Pearson Education.
2. E. Gose, R. Johnsonbaugh, S. Jost, "Pattern Recognition and Image Analysis", Prentice Hall India.
3. B. Chanda and D. Dutta Majumder, "Digital Image Processing and Analysis", PHI.
4. Anil K. Jain, "Fundamentals of Digital Image Processing", PHI.
5. M. Sonka, V. Hlavac, R. Boyle, "Image Processing, Analysis and Machine Vision", Thomson Learning, 1999.
6. Malay K. Pakhira, Digital Image Processing and pattern recognition, PHI, 2011


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|---|---|
| Course code | CSE/MCA/T/216C |
| Category | Elective-III |
| Course title | Bioinformatics |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

## Syllabus

1. Introduction to Bioinformatics, Central dogma of Molecular Biology [2L]
2. Biological Databases- Concepts and Understanding [2L]
3. Sequence alignment: Pairwise sequence alignment, Global and local alignment, scoring, dynamic programming, multiple sequence alignment, tree alignment, Hidden Markov Models [6L]
4. Gene finding algorithms [2L]
5. Protein Sequences and Substitution matrices: Suffix tree construction and applications [2L]
6. Introduction to Gene Expression: Microarrays, their uses, idea about normalization, clustering [2L]
7. Functional enrichment analysis - Metabolic Pathway (KEGG), GO annotations [1L]
8. Phylogenetic Tree and Analysis [2L]
9. Introduction to Gene Regulation: Gene regulation, binding sites, transcriptional networks, gene's circuitry [6L]
10. Network of Interactions: Regulatory networks, Biomolecular Networks [2L]
11. Signals in Sequences: Weight matrices, dependencies, transcriptionfactor binding sites [2L]
12. Introduction to Proteomics: Protein structure, protein interactions [2L]
13. Protein Structure Prediction: Attempts to predict secondary and tertiary structure of amino acid sequences [4L]
14. Post Translational Modifications in Proteins [2L]
15. Drug docking and designing [3L]

**Books:**


1. Dan E Krane, Michael L Raymer, Fundamental Concepts of Bioinformatics, Pearson.
2. Richard Durbin, Sean R Eddy, Anders Krogh, Graeme Mitchison. Biological Sequence Analysis, Cambridge, 1998
3. Roderic D M Page, Edward C Holmes. Molecular Evolution: A phylogenetic Approach, Blackwell

Sciences Inc 1999
4. David W Mount. Bioinformatics: Sequence and Genome Analysis, CBS Publishers and Distributors (Pvt.) Ltd., 2005
5. Pierre Baldi, Soren Brunak. Bioinformatics: The Machine Learning Approach, MIT Press, 2001
6. Paul G. Higgs and Teresa K. Attwood. Bioinformatics and Molecular Evolution, Blackwell Publishing, 2005.
7. Auther M. Lesk, Introction to Bioinformatics, Oxford University Press, 2008.

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|---|---|
| Course code | CSE/MCA/T/216D |
| Category | Elective-III |
| Course title | Information Retrieval |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

## Syllabus

Introduction, Taxonomy of information retrieval models, Document retrieval and ranking, A formal characterization of IR models, Boolean Retrieval Model 2L

Basic Tokenization, Indexing and Normalization
Word tokenization, Text Normalization, Stop-word removal, Word Stemming(Porter Algorithm), Case folding, Lemmatization, Inverted indices 2L

Skip pointers, Phrase queries 2L

**Tolerant Retrieval**
Wild card queries, Permuterm index, Bigram index, Spelling correction, Edit distance, Jaccard coefficient, Soundex 4L

**Scoring, Term Weighting and the Vector Space Model** 4L

**Evaluation of IR Models**
Precision, Recall, F-measure, E-measure, Normalized recall, Evaluation problems 2L

**Latent Semantic Indexing**
Eigen vectors, Singular value decomposition, Low rank approximation, Problems with Lexical Semantics 4L

Index Construction and Index Compression 2L

**Query Expansion and Relevance feedback**
Rocchio algorithm, Probabilistic relevance feedback, Query Expansion and its types, Query drift Clustering-Based Relevance Feedback 4L

**Query Augmentation**
Graph based augmentation, Query similarity based, Semantic query similarity based, Dealing with Zero-recall queries 2L

**Statistical Language Models for IR**

Basics of Statistical Language Models , Query-Likelihood Approaches , Smoothing Methods, Divergence Approaches, Topic Models 6L

**Search Engines**

Search engines (working principle), Spidering (Structure of a spider, Simple spidering algorithm, multithreaded spidering, Bot), Directed spidering(Topic directed, Link directed) ,Crawlers (Basic crawler architecture), Link analysis (e.g. hubs and authorities, Page ranking, Google Page Rank), shopping agents 6L

**Content Based Image Retrieval**

Introduction to content Based Image retrieval, Challenges in Image retrieval, Image representation, Indexing and retrieving images, Relevance feedback 6L

**Semantic Matching using Neural Networks 2L**

**Books:**

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008. http://nlp.stanford.edu/IR-book/information-retrieval-book.html

2. Cheng Xiang Zhai, Statistical Language Models for Information Retrieval, Morgan & Claypool Publishers, 2008. http://www.morganclaypool.com/doi/abs/10.2200/S00158ED1V01Y200811HLT• 001

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

4. Baeza-Yates Ricardo and Berthier Ribeiro-Neto, Modern Information Retrieval, 2nd edition, Addison-Wesley, 2011

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|---|---|
| Course code | CSE/MCA/T/216E |
| Category | Elective-III |
| Course title | Natural Language Processing |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

**Regular Expressions and Automata**: **[2L]**
Introduction to NLP, Regular Expression, Finite State Automata

**Tokenization** **[6L]**
Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition,Multi Word Expressions, Minimum Edit Distance, Spell Checking

**Morphology** **[2L]**
Morphology – Inflectional and Derivational Morphology, Morphological Parsing with Finite State Transducers, Porter Stemmer

**Language Modeling** [**4L**]
Introduction to N-grams, Chain Rule, Smoothing –Interpolation, Backoff, Web-Scale LMs, Add-One Smoothing, Good- , Kneser-Ney Smoothing, Evaluation and Perplexity.

**Hidden Markov Models and POS Tagging** [**4L**]
Markov Chain, Hidden Markov Models, Forward Algorithm, Viterbi Algorithm, Part ofSpeech Tagging

**Text Classification** [**4L]**
Text Classification, Naïve Bayes' Text Classification, Sentiment Analysis - Opinion Mining and Emotion Analysis, Resources and Techniques, Evaluation

**Computational Lexical Semantics** [**4L**]
Introduction to Lexical Semantics, Thesaurus and WordNet, Word Sense Disambiguation, Word Similarity – Path based, Information Content based, Resnik Similarity, Lin Similarity, Distributional Similarity, Pointwise Mutual Information, Word Sense Induction

**Information Retrieval** [**6L**]
Boolean Retrieval, Term-document incidence matrix, Inverted Index, Query processing with inverted index, Phrase Queries, Positional Index, Ranked Retrieval – Term Frequency, Inverse Document Frequency, tf-idf weighting, Vector Space Model, Relevance Feedback, Page Ranking, Evaluation

**Question Answering and Summarization** **[4L]**
Question Processing, Passage Retrieval, Answer Processing; Single and Multi Document Summarization, Evaluation

**Machine Translation** [**4L**]
Introduction, Different paradigms –Rule based, Example based, Statistical, Noisy channel model, EM algorithm, Decoding, Evaluation

**Suggested Readings:**
1. Speech and Language Processing, Jurafsky and Martin, Pearson Education
2. Foundation of Statistical Natural Language Processing, Manning and Schutze, MIT Press

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|---|---|
| Course code | CSE/MCA/T/216F |
| Category | Elective-III |
| Course title | Multimedia |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

**Introduction**
Multimedia and its Application, Different Media, Hypertext and Hypermedia, Issues in Multimedia System, Component of a Multimedia System **[2L]**

**Overview of Text and Graphics:**
Types of Text Data (Plain/Formatted/Hypertext), Unicode Scheme, Concept of Font, File Formats (txt, doc, rtf, ps, pdf, etc.), Vector and Raster Graphics **[2L]**

**Image:**

Image Digitization, Digital Image, Binary/Gray Scale/ Colour Image, Colour Models, File Formats, Overview of Contrast Intensification, noise removal, edge detection and segmentation **[5 L]**

Image Descriptors (Shape, Texture and Colour Features) **[3L]**

Lossless and Lossy Image Compression including JPEG **[3L]**

An overview of Content-Based Image Retrieval System **[3L]**

**Audio:**

Audio Digitization (Sampling and Quantization, Representation based on

PCM/DPCM/DM/ADM), File Formats **[2L]**

Time Domain Descriptors (ZCR, STE, etc.), Frequency Domain Descriptors (Spectral Centroid, Spectral Flux, Spectral Roll Off, etc.), and Perception-based Descriptors (Mel Scale, MFCC) **[3L]**

Psycho Acoustics and Audio Compression **[2L]**

An Overview of Audio Classification/Retrieval System **[2L]**

**Video:**

Structure of Video Data, File Formats **[1L]**

Video Compression **[2L**]

Motion Estimation **[1L]**

Structural Segmentation of Video Data **[3L]**

Overview of Video Summarization, Browsing and Retrieval System **[2L]**

**Animation:**

Keyframes & tweening, cel & path animation, principles and techniques of animation, Web animation, 3D animation principles, camera, special effects, transformations and editing, rendering algorithms, features of animation software, file formats. **[4L]**

**Suggested Readings:**

**1.** Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods
2. Digital Image Processing and Analysis by B. Chanda and D. Dutta Majumder
3. Principles of Multimedia by Ranjan Parekh
4. Multimedia –A Practical Approach by Sanhker, Jaico.
5. Multimedia Systems by Buford J. K., Pearson Education.
6. Multimedia and Imaging Databases by S. Khoshafian, A. Brad Baker, Morgan Kaufmann.
7. Multimedia Systems Design, Prabhat k. Andleigh & Kiran Thakkar, Prentice Hall PTR.
8. Digital Multimedia by Nigel Chapman & Jenny Chapman, John-Wiley.
9. Fundamentals of Computer Graphics and Multimedia by D.P. Mukherjee, PHI

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|---|---|
| Course code | CSE/MCA/T/216G |
| Category | Elective-III |
| Course title | Biometric Systems |
| Scheme and Credits | L–T–P: 3; Credits: 3 |
| Semester | |
| Pre-requisites (if any) | |

# Syllabus

1. Introduction to Biometric Systems: History, Definition, Characteristics, Systems model, Identification, Verification/Authentication, Applications. **[2L]**

2. Image processing and Pattern recognition Fundamentals: Introduction to biometric samples, Representation, Biometrics as pattern recognition systems, Preprocessing, Segmentation, Noise removal techniques, etc. **[4L]**

3. Biometric Traits: Fundamentals of acquisition sensors and techniques, Characteristics of Biometric traits: Face, Gait, Iris, Fingerprint, Signature, etc. **[2L]**

**4.** Biometric Systems Performance Terminology: Performance assessment terminology – Estimation of errors, FAR, FRR, ROC, Ranking; Testing methods used in biometrics, Graphical analysis of system performance. **[2L]**

5. Biometric Feature Extraction: Subspace-based approaches: Principal Component Analysis (PCA), Fisher's Linear Discriminant Analysis (FLDA), Independent Component Analysis (ICA), Variants of PCA, FLDA and ICA, Kernel version of subspace-based approaches; Geometric-feature-based approaches; Hybrid approaches. Invariant features, etc. **[10L]**

6. Biometric Classification & Recognition: Design of classifiers: Neural networks-based classifiers, Probabilistic classifiers, Neuro-Fuzzy classifiers; Template matching, etc. **[5L]**

7. Multi-biometric Systems: Introduction to multi-biometric systems, Types of multibiometric systems, levels of fusion in multi-biometric systems: Image fusion, Feature level fusion, Dimension reduction, Decision level fusion, Demster Shafer (DS) Theory, Multi-level fusion. **[5L]**

8. Video-based Person Identification: Acquisition, Generic systems model, Face detection and recognition from video, Tracking. **[4L]**

9. 3D face recognition systems: 3D face model – Reconstruction, feature extraction and recognition; Expression and Action recognition; Multi-view 3D reconstruction. **[4L]**

10. Biometric Standards & Privacy: Introduction to biometric standards, importance of biometric standards, privacy, Biometric attacks, interoperability of data, systems and applications. **[2L]**

**Suggested Readings:**


1. Introduction to Biometrics, A. K. Jain and A. Ross, Springer
2. Biometrics: Theory, Methods & Applications, N. V. Boulgouris, K. N. Plataniotis, E. Micheli Tzanakou, IEEE Press, 2009.
3. A. Ross, K. Nandakumar and A. K. Jain, "Handbook of Multibiometrics", Springer Publishers.
4. Guide to Biometrics, Ruud Bolle, J. Connell, S Pankanti, N Ratha, A Senior, Springer.
5. Biometric Technologies and Verification Systems, J R Vacca, Elsevier.
6. Biometric Systems: Technology, Design & Performance Evaluation, J. Wayman, A. K. Jain, D. Maltoni, D. Maio, Springer Verlag, 2004.
7. Handbook of Biometrics, Springer Verlag, 2008, A. K. Jain, P. Flynn and A. A. Ross.

**SECOND YEAR SECOND SEMESTER**

## CSE/MCA/S/221 Seminar

Topics for Seminar cover all areas of Computer Science & Engineering and related interdisciplinary fields.

## CSE/MCA/S/222 Project

Topics for Project cover all areas of Computer Science & Engineering and related interdisciplinary applications.