

*Academic Syllabus  
for  
M. Tech  
in  
Computer Science and Engineering*

Session 2016 - 17



Biju Patnaik University of Technology ( BPUT ), Orissa

[www.bput.ac.in](http://www.bput.ac.in)

**CREDIT DISTRIBUTION STRUCTURE FOR M. TECH ADMISSION BATCH 2017-18**

1ST SEMESTER				2ND SEMESTER			
CODE	SUBJECT	L-T-P	CREDIT	CODE	SUBJECT	L-T-P	CREDIT
	COMPUTATIONAL METHODS AND TECHNIQUES	3-1-0	4		SPECILIZATION CORE I	3-1-0	4
	INTERNET OF THINGS	3-1-0	4		SPECILIZATION CORE II	3-1-0	4
	BRANCH SPECILIZATION CORE I	3-1-0	4		ELECTIVE I (SPECILIZATION RELATED)	3-1-0	4
	BRANCH SPECILIZATION CORE II	3-1-0	4		ELECTIVE II (DEPATMENTAL REALTED)	3-1-0	4
	BRANCH SPECILIZATION CORE III	3-1-0	4		ELECTIVE III (FROM ANY DEPARTMENT)	3-1-0	4
<b>CREDITS (THEORY)</b>			<b>20</b>	<b>CREDITS (THEORY)</b>			<b>20</b>
<b>PRACTICALS/SESSIONALS</b>				<b>PRACTICALS/SESSIONALS</b>			
	LAB I	0-0-4	4		LAB II	0-0-4	4
	REPORT WRITTING & SEMINAR (ENTREPERNEURSHIP & START UP)	0-0-4	4		DESIGN PROJECT	0-0-4	4
<b>CREDITS (PRACTICALS/SESSIONALS)</b>			<b>8</b>	<b>CREDITS (PRACTICALS/SESSIONALS)</b>			<b>8</b>
<b>TOTAL SEMESTER CREDITS</b>			<b>28</b>	<b>TOTAL SEMESTER CREDITS</b>			<b>28</b>
<b>TOTAL CUMULATIVE CREDITS</b>			<b>28</b>	<b>TOTAL CUMULATIVE CREDITS</b>			<b>56</b>
<b>3RD SEMESTER</b>				<b>4TH SEMESTER</b>			
CODE	SUBJECT	L-T-P	CREDIT	CODE	SUBJECT	L-T-P	CREDIT
	RESEARCH METHODOLOGY	3-1-0	4				
	IPR (INTELLECTUAL PROPERTY RIGHTS)	3-1-0	4				
<b>CREDITS (THEORY)</b>			<b>8</b>				
<b>PRACTICALS/SESSIONALS</b>				<b>PRACTICALS/SESSIONALS</b>			
	PRE DESSERTATION WORK EVALUATION		9		DESSERTATION EVALUATION AND OPEN DEFENCE		17
<b>CREDITS (PRACTICALS/SESSIONALS)</b>			<b>9</b>	<b>CREDITS (PRACTICALS/SESSIONALS)</b>			<b>17</b>
<b>TOTAL SEMESTER CREDITS</b>			<b>17</b>	<b>TOTAL SEMESTER CREDITS</b>			<b>17</b>
<b>TOTAL CUMULATIVE CREDITS</b>			<b>73</b>	<b>TOTAL CUMULATIVE CREDITS</b>			<b>90</b>



*First Semester***COMPUTER SCIENCE AND ENGINEERING**

**Specialization:** **COMPUTER ENGINEERING**  
**COMPUTER SCIENCE AND ENGINEERING**  
**COMPUTER SCIENCE**  
**COMPUTER SCIENCE AND TECHNOLOGY**

First Semester							
Theory					Practical		
Course Name	Hours/ Week L / T	Credit Theory	University Marks	Internal Evaluation	Hours/ Week L/T	Credit Practical	Marks
Computational Methods and Techniques	4 - 0	4	100	50	-	-	-
Internet of Things (IOT)	4 - 0	4	100	50	-	-	-
Advanced Computer Architecture	4 - 0	4	100	50	-	-	-
Advanced Data Structure and Algorithm	4 - 0	4	100	50	-	-	-
Advanced Operating System	4 - 0	4	100	50	-	-	-
Lab - I					8	4	150
Total Marks : 900							
Total Credits: 22							



# COMPUTATIONAL METHODS AND TECHNIQUES

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## **MODULE-I:**

Neural Networks: Artificial Neural Network and Introduction, Learning Rules, Knowledge Representation and Acquisition, Different Methods of Learning, Algorithms of Neural Network: Feed-forward Error Back Propagation, Hopfield Model, Kohonen's Feature Map, K-Means Clustering, ART Networks, RBFN, Application of Neural Network to the relevant field.

## **MODULE-II:**

Fuzzy Logic: Basic Concepts of Fuzzy Logic, Fuzzy vs Crisp Set, Linguistic variables, Membership Functions, Operations of Fuzzy Sets, Fuzzy If-Then Rules, Variable Inference Techniques, Defuzzification, Basic Fuzzy Inference Algorithm, Fuzzy System Design, FKBC and PID Control, Antilock Breaking System(ABS), Industrial Applications.

## **MODULE-III:**

Optimization Fundamentals: Definition, Classification of Optimization Problems, Unconstrained and Constrained Optimization, Optimality Conditions, LINEAR Programming: Simplex Method, Duality, Sensitivity Methods, NON-LINEAR Programming: Newton's Method, GRG Method, Penalty Function Method, Augmented Lagrange Multiplier Method, Dynamic Programming and Integer Programming, Interior Point Methods, Karmakar's Algorithm, Dual Affine, Primal Affine.

## **MODULE-IV:**

**Genetic Algorithm:** GA and Genetic Engineering, Finite Element based Optimization, PSO, BFO, Hybridization of Optimization Technique, Application of Optimization Technique for Solving Projects (Project solutions). Implementation of Branch Relevant Industrial Applications by Matlab Code.

## **Books Recommended:**

1. Neural Networks- by Simon Haykin
2. Fuzzy Logic with Engineering Application- by ROSS J.T (Tata Mc)
3. Neural Networks and Fuzzy Logic – by Bart Kosko
4. An introduction Fuzzy Control – by D.Driankor, H. Hellendorn, M.Reinfrank (Narosa Pub)
5. Fuzzy Neural Control – by Junhong NIE & Derek Linkers (PHI)
6. Related IEEE/IEE Publications
7. Fuzzy System Design Principles, Building Fuzzy IF-THEN Rule Bases – by Riza C. Berikiu and Trubatch, IEEE Press
8. Ashok D. Begundu & Chandrapatla T.R "Optimization concept and application in engineering", Prentice Hall, 1999
9. Rao S.S "Engineering Optimization"
10. Gill, Murray and Wright, "Practical Optimization"
11. James A. Memoh. "Electric Power System Application Of Optimization".
12. Song Y., "Modern Optimization Techniques In Power System" Optimization Research; Prabhakar Pai, Oxford University Press.



# INTERNET ON THINGS (IoT)

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## MODULE I

### Introduction to Internet of Things

**Introduction**-Definition & Characteristics of IoT, **Physical Design of IoT**- Things in IoT, IoT Protocols, **Logical Design of IoT**- IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, **IoT Enabling Technologies**- Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, **IoT Levels & Deployment Templates.**

## MODULE II

### Domain Specific IoTs

**Home Automation:** Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, **Cities**-Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response, **Environment**-Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection , River Floods Detection , **Energy**- Smart Grids , Renewable Energy Systems , Prognostics , **Retail**-Inventory Management , Smart Payments , Smart Vending Machines , **Logistics**-Route Generation & Scheduling , Fleet Tracking , Shipment Monitoring , Remote Vehicle Diagnostics, **Agriculture**-Smart Irrigation ,Green House Control ,**Industry** -Machine Diagnosis & Prognosis Indoor Air Quality Monitoring ,**Health & Lifestyle** -Health & Fitness Monitoring, Wearable Electronics

**IoT and M2M Introduction, M2M-Difference between IoT and M2M, SDN and NFV for IoT-** Software Defined Networking, Network Function Virtualization

## MODULE III

### IoT Platforms Design Methodology

**IoT Design Methodology**-Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View

Specification, Operational View Specification, Device & Component Integration, Application Development,

### Case Study on IoT System for Weather Monitoring, Motivation for Using Python

**IoT Physical Devices & Endpoints** What is an IoT Device-Basic building blocks of an IoT Device,

**Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi**

**Interfaces** – Serial, SPI, I2C, **Programming**

**Raspberry Pi with Python**-Controlling LED with Raspberry Pi, interfacing an LED and Switch with Raspberry Pi, Interfacing a Light Sensor (LDR) with Raspberry Pi, **Other IoT Devices**- pcDuino, Beagle Bone Black, Cubieboard

## MODULE IV

**IoT & Beyond:** Use of Big Data and Visualization in IoT, Industry 4.0 Concepts. Overview of RFID, Low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and dataintensive IoT for continuous recognition applications. Overview of Android / IOS App Development tools & Internet Of Everything **Text Books:**

Internet of Things, A Hands on Approach, by Arshdeep Bahga & Vijay audiseti, University Press.

**Reference Books:** The Internet of Things, by Michael Millen, Pearson



# ADVANCED COMPUTER ARCHITECTURE

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## **Module - I**

Principles of Processor Performance, RISC and CISC Architectures, Pipelining fundamentals, Pipeline Hazards, Superscalar Architecture, Super Pipelined Architecture, VLIW Architecture.

## **Module - II**

Basic Multiprocessor Architecture: Flynn's Classification, UMA, NUMA, Distributed Memory Architecture, Array Processor, Vector Processors, Associative Processor, Systolic architecture. Interconnection Networks: Static Networks, Network Topologies, Dynamic Networks.

## **Module -III**

Hierarchical Memory Technology: Data and Instruction caches, Multi-level caches, Cache memory mapping policies, Cache Coherence, Cache Performance, Virtual memory, Page replacement techniques, Memory Inter leaving, Memory Management hardware.

## **Module - IV**

Data Flow Computer Architecture: Static Data flow computer, Dynamic Data flow computer, Cluster computers, Distributed computing, Cloud computing.

## **Reference Books:**

1. David A. Patterson and John L. Hennessy, Computer Organization and Design, Elsevier.
2. John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann
3. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw- Hill.
4. K. Hwang and F. A. Briggs, Computer Architecture and Parallel Processing, McGraw Hill.
5. Computer Architecture: Parhami, Oxford University Press



# ADAVANCED DATA STRUCTURE AND ALGORITHM

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## **MODULE-I:**

Heap Structure: Min-Max heap, Leftist heaps, Binomial heaps, Fibonacci heaps, Skew heaps, Lazy binomial heaps, Deap Data structure.

## **MODULE-II:**

Search and Multimedia Structure: Binary Search Tree, AVL Tree, 2-3 Tree, B-Tree, B+ Tree, Red-Black Tree, Segment Tree, k-d Tree, Point Quad Trees, R-Tree, TV-Tree.

## **MODULE-III:**

Asymptotic Notations, Dynamic Programming (LCS, Floyd-Warshall Algorithm, Matrix Chain Multiplication), Greedy Algorithm (Single Source Shortest Path, Knapsack problem, Minimum Cost Spanning Trees), Geometric Algorithm (Convex hulls, Segment Intersections, Closest Pair), Internet Algorithm (Tries, Ukonnen's Algorithm, Text pattern matching), Numerical Algorithm (Integer, Matrix and Polynomial multiplication, Extended Euclid's algorithm)

## **MODULE-IV:**

Polynomial Time, Polynomial-Time Verification, NP Completeness & reducibility, NP Completeness proofs, Cook's theorem

## **Reference Books:**

1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, "Introduction to Algorithms", PHI.
2. E. Horowitz, S. Sahani and Dinesh Mehta, Fundamentals of Data Structures in C++, 2<sup>nd</sup> Ed, University Press.
3. Mark Allen Weiss, "Data Structures & Algorithm Analysis in C/C++", Pearson Edu. India.
4. Adam Drozdex, Data Structures and algorithms in C++, Thomason learning.



## ADVANCED OPERATING SYSTEM

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

### **MODULE-I:**

System Architecture Types, Distributed Operating Systems, Issues in Distributed Operating Systems, Lamport's Logical Clocks, Vector Clocks, Causal Ordering of Messages, Global State, Chandy-Lamport's Global State Recording Algorithm,

### **MODULE-II:**

Cuts of a Distributed Computation, Termination Detection, Mutual Exclusion Algorithms, Performance Measures, Non-Token-Based Algorithms, Ricart-Agrawala Algorithm, Maekawa Algorithm, Token-Based Algorithms, Suzuki-Kasami Algorithm, Raymond Tree based Algorithm, Comparative Performance Analysis.

### **MODULE-III:**

Deadlock Handling Strategies, Centralized Deadlock-Detection Algorithms, Distributed Deadlock Detection Algorithms, Hierarchical Deadlock Detection Algorithms, Agreement Protocols.

### **MODULE-IV:**

Distributed File Systems, Distributed Shared Memory, Distributed Scheduling, Fault Tolerance, Multiprocessor Operating Systems.

### **Reference Books:**

1. M. Singhal and N. G. Sivaratri, "Advanced concepts in Operating Systems", Tata McGraw Hill.
2. Coulouris, "Distributed Systems: Concepts and Design", Pearson Education.
3. P. K. Sinha "Distributed Operating Systems Concepts and Design" PHI.



*Second Semester*

Second Semester							
Course Name	Theory				Practical		
	Hours/ Week L / T	Credit Theory	University Marks	Internal Evaluation	Hours/ Week L/T	Credit Practical	Marks
<b>Specialization Core-1</b> Computer Graphics	4-0	4	100	50	-	-	-
<b>Specialization Core-2</b> Software Engineering	4-0	4	100	50	-	-	-
<b>Elective I (Specialization related)</b> 1. Distributed Database System. 2. J2EE. 3. Information Extraction and Retrieval. 4. Fast Machine Learning.	4-0	4	100	50	-	-	-
<b>Elective II (Departmental related)</b> 1. Data Ware Housing & Data Mining 2. Cloud Computing 3. Cryptography. 4. Graph Theory.	4-0	4	100	50	-	-	-
<b>Elective III (from any department)</b> 1. Mobile Computing. 2. Wireless Sensor Network. 3. Big Data Analytic 4. Bio Informatics. 5. Digital Image Processing	4-0	4	100	50	-	-	-
<b>Lab-2 (Specialization lab to be decided by the department)</b>					4	4	150
<b>Seminar/Project</b>					4	4	150
<b>Total</b>							



# COMPUTER GRAPHICS

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## MODULE-I

Introduction: Display of entities, geometric computation and representation, graphics environments; Working principles of display devices: Refreshing Raster scan devices, vector devices, cathode ray tube terminals, plotters; Display of colors: Look-up tables, display of gray shades, half toning; Display and drawing of graphics primitives: Point, line, polygon, circle, curves, and texts;

## MODULE-II

Coordinate conventions: World coordinates, device coordinates, normalized device coordinates, view-port and window, zooming and panning by changing coordinate reference frames; Computations on polygons: Point inclusion problems, polygon filling, polygon intersections, clipping, polygonization of a point set, convex hull computation, triangularization of polygons;

## MODULE-III

Transformations in 2D and 3D: Translation, Rotation, Scaling, Reflection; Projection: Perspective and parallel projections, isometric projection, Transformation matrices; Volume and surface representation: Polygonal meshes, parametric curves and surfaces, Cubic and Bi-cubic Splines, Voxels, Octree and Medial axis representation, Sweep representation, surfaces and volumes by rotation of curves and surfaces, Fractal modeling;

## MODULE-IV

Hidden surface and Line Elimination: Elimination of back surfaces, Painters' algorithms,

Binary space partitioning tree; Rendering and visualization: Shading model, constant, Goraud and Phong shading, Ray tracing algorithm, Radiosity computation; Computer animation: Fundamental concepts.

### Books:

1. Foley, "Computer Graphics: Principles and practice", 2nd Edition.
2. Mel Slater, "Computer Graphics and Virtual Environments 1/e", Pearson Education.
3. D.F.Rogers, "Procedural elements for Computer Graphics", Mc. Graw Hill, 1985.
4. K. A. Plastock and Borden Kelly: Schaum's Outline of Computer Graphics, 1986.
5. Newman and Sproull : Principles of interactive Computer Graphics, Mc. Graw Hill, International Students Edition, Kogakusha, 1981.
6. S. Harrington: Computer Graphics A Programming Approach, Mc. Graw Hill, 1986.



## SOFTWARE ENGINEERING & DEVELOPMENT METHODOLOGIES

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

### MODULE-I

Evaluation of Software Design Technique: Adhoc Base, Control Base, Data Structure, Data Flow, Objective Oriented. Process Model: SDLC, Component Base Software Developer Model, Unified Model, Fountain Model, 4P Approach: People, Process, Project, Product. Software Metrics: Process Metrics: LOC, COCOMO, PF, OO Process Metric, Use Case Process Metric.

### MODULE-II

Product Metrics: FP, Architectural Design Metrics, Metrics for OO Design, Class Oriented Metric, Coupling Metric, Cohesion Metric. Metrics for Testing. Project Metrics: Web Engg. Object Technology: Object, Classes, Message, Class Hierarchy, Inheritance, Abstract, Encapsulation, Polymorphisms. Relationship: IsA, Has A, UsesA. Object Oriented Modeling:

### MODULE-III

Booch Notation, Rumbaugh Object Modeling Technique, Jacobson Model: Use Case,

Abstract Use Case, Actor, Abstract actor. Use case Model: Domain Object Model, Analysis Object Model, Design Model, Testing Model, Implementation Model

UML Diagram: Class Diagram, Object Diagram, Sequence Diagram, Collaboration Diagram, Activity Diagram, State Chart Diagram, Component Diagram, Deployment Diagram

### MODULE-IV

Object Oriented Analysis: Class: Interface Class, Control Class, Entity Class. Developing Use

Case: Use case Element, Description, Case Study (i.e ATM), Class Classification Approach, Noun Phase Approach, Classical Approach, Function Point Approach, Structural Approach, CRC Card.

Object Oriented Design: Component Level Design, Cohesive, Coupling

Object Oriented Testing: System Testing: Requirement Specification, Integration Testing:

Sequence Testing, Inheritance Testing, Polymorphism Testing, Encapsulation Testing Unit Testing: Class Testing, Method Testing

### Text Book:

1. Software Engineering by Pressman McGraw Hill



# DISTRIBUTED DATABASE SYSTEM

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## **MODULE-I**

Features of distributed databases, features of centralized databases, level of distributed transparency – Reference Architecture, types of Data Fragmentation, distribution Transparency, Access primitives, Integrity constraints.

## **MODULE-II**

Distributed Database design – A frame work, the design of database fragmentation, the allocation of fragments. Translation of global queries into fragment queries, query optimization.  
Distributed Transaction Management – A framework, transaction atomicity, 2-phase commit, concurrency control: foundations, distributed deadlocks, timestamps.

## **MODULE-III**

Reliability: Basic concepts, commit protocols, consistent view of Network, Detection and Resolution of Inconsistencies, check points and cold restart.

Commercial Systems: Tranclem's ENCOMPASS

## **MODULE-IV**

Distributed database systems, IBM's Inter system communication, feature of distributed ingres and Oracle.

Heterogeneous databases: General problems – brief study of multibase.

### **Text Book:**

1. Ceri S. Pelagatti. G, Distributed Database systems Principles and Systems, McGraw Hill.



## J2EE

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

### MODULE-I:

Enterprise Java Programming: Overview, Java EE 6 API, Web Applications, Java Servlet

Technology: - Lifecycle of a Servlet, Servlet API, Servlet Packages, Types of servlets, Database Access, Stateless and Stateful protocols, Session Tracking. JSP Technology: - Architecture & Anatomy of JSP Page, JSP life cycle, JSP with MVC Architecture, Dynamic webpage Creation, Scripting Elements, Session Tracking, Database access, JSTL, JavaServer Faces (JSF) Technology, Facelets, Ajax.

### MODULE-II:

Web Services: JAX P: SAX, DOM, JAX B: XJC, Marshaling, Unmarshaling, WSDL, JAX-WS: Apache axis 2 implementation contract first, contract last, Building consumer, RPC encoded, RPC literal, Document /Encoded, Document /Literal, Document /Wrapped, SOAP. JAX-RS

### MODULE-III:

Advanced Technologies – Frameworks:

**Struts:** Introduction, Features and Architecture, The MVC Design Pattern,

**Hibernate:** Introduction to O-R Mapping, Hibernate Basics, Hibernate Architecture, Hibernate Configurations, POJO (Plain Old Java Classes) classes and O/R Mapping, Hibernate Query Language.

### MODULE-IV:

**Spring:** IOC, dependency Injection, Constructor injection, setter injection, type, index, name attributes, Collection injection, Bean inheritance, IDRef, Bean aliasing, Bean scopes, Automating,

Nested bean factories, dependency Check, dependency On, Aware interface, static factory method, Instance factory method, Factory Bean, Method replacement, look up method injection, Properties editors, Internationalizations (I18N), Bean POST Processor, Bean factory POST Processor, Event Factory vs Application Context, Spring AOP, Spring Integration with Hibernate, Spring integration with Struts, Introduction to design pattern.

### Books:

1. Eric Jendrock, D. Carson, I. Evans, D. Gollapudi, K. Haase, C. Srivastha, "The Java EE6 Tutorial", Volume-1, Fourth Edition, 2010, Pearson India, New Delhi. Chapters: 1, 3, 4, 5, 7, 9 to 12, 14 to 16, 17, 19, 23, 26, 27, 28.
2. Ralph Moseley, "Developing Web Applications", 2008, Wiley India, New Delhi.
3. Kongent S., "Java Server Programming (JEE 6) Black Book, Platinum Edition", 2008, Dreamtech / Wiley India Pvt. Ltd.
4. David Geary, Cay S. Horstmann, "Core JavaServer Faces", Second Edition, 2007, Pearson Education, Inc. New Delhi.
5. Java 7 JAX-WS Web Services by Deepak Vohra
6. Building a Restful Web Service with Spring by LudovicDewailly
7. Spring in Action by Craig Walls
8. Hibernate in Action by Christian Bauer Gavin King



# INFORMATION EXTRACTION AND RETRIEVAL

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## MODULE-I:

Introduction to Information Retrieval

The nature of unstructured and semi-structured text. Inverted index and Boolean queries.

Text Indexing, Storage and Compression

Text encoding: tokenization, stemming, stop words, phrases, index optimization. Index compression: lexicon compression and postings lists compression. Gap encoding, gamma codes, Zipf's Law. Index construction. Postings size estimation, merge sort, dynamic indexing, positional indexes, n-gram indexes, real-world issues.

## MODULE-II:

Retrieval Models Boolean, vector space, TFIDF, Okapi, probabilistic, language modeling, latent semantic indexing. Vector space scoring. The cosine measure. Efficiency considerations. Document length normalization. Relevance feedback and query expansion. Rocchio. Performance Evaluation Evaluating search engines. User happiness, precision, recall, F-measure. Creating test collections: kappa measure, interjudge agreement.

## MODULE-III:

Text Categorization and Filtering

Introduction to text classification. Naive Bayes models. Spam filtering. Vector space classification using hyperplanes; centroids; k Nearest Neighbors. Support vector machine classifiers. Kernel functions. Boosting.

Text Clustering Clustering versus classification. Partitioning methods. k-means clustering. Mixture of Gaussians model. Hierarchical agglomerative clustering. Clustering terms using documents.

## MODULE-IV:

Advanced Topics Summarization, Topic detection and tracking, Personalization, Question answering, Cross language information retrieval Web Information Retrieval Hypertext, web crawling, search engines, ranking, link analysis, PageRank, HITS. Retrieving Structured Documents XML retrieval, semantic web

### Textbooks:

1. Introduction to Information Retrieval Manning, Raghavan and Schütze, Cambridge University Press, draft.
2. Modern Information Retrieval Baeza-Yates and Ribeiro-Neto, Addison Wesley, 1999. A comprehensive survey by Ed Greengrass Mining the Web, Soumen Charabarti, Morgan Kaufmann, 2002.



# FAST MACHINE LEARNING

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## **MODULE-I:**

Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation.

Linear regression, Decision trees, over fitting.

## **MODULE-II:**

Instance based learning, Feature reduction, Collaborative filtering based recommendation. Probability and Bayes learning.

## **MODULE-III:**

Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.

Neural network: Perceptron, multilayer network, back propagation, introduction to deep neural network.

## **MODULE-IV:**

Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.

Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model

## **BOOKS:**

1. Machine Learning. Tom Mitchell. First Edition,
2. Introduction to Machine Learning Edition 2, by EthemAlpaydin McGraw- Hill, 1997



# DATA WARE HOUSING & DATA MINING

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## **MODULE-I**

Introduction to Data Mining, Paradigm, Computing Paradigm, Business Paradigm, Business Problem Definition, Operational & informational Data stores, Data Warehouse Definition & characteristics, Data Warehouse Architecture, Client /Server Computing Model & Data Warehouse, Overviews of Client/server Architecture, Server specialization in client/server computing Environment, Server Function, Server H/W Architecture RISC versus CISC, Multiprocessor System, SMP implementation, Parallel Processors and Cluster Systems,

## **MODULE-II**

Distributed Memory Architecture, Cluster System, Advances in Multiprocessing Architecture, Server Operating System, Operating System Implementation

Data Warehousing Component, Overall Architecture, Data Warehouse Database Sourcing, Acquisition, Cleanup & transformation Tools, Metadata, Access Tools, Data Marts, Data

Warehouse Administration and Management, Information Delivery System, Business & Data Warehouse,

## **MODULE-III**

Business Consideration: Return & Investment, Design Consideration, Implementation

Consideration, Benefits of Data Warehousing, Mapping the Data Warehouse to Multi

Processor Architecture, Database architecture for Parallel Processing, Shared Memory

Architecture, Shared Disk Architecture, Shared Nothing Architecture, Combined Architecture

## **MODULE-IV**

Introduction to Data Mining, Measuring Data Mining effectiveness: Accuracy, speed & Cost,

Embedding Data Mining into your Business Process, Discovery verses Prediction, Comparing the Technology, Business Score Card, Application Score Card, Algorithm Score card, Decision Tree, CART, CHAID, Growing the Tree, When does the Tree stop growing, Strength & Weakness, Algorithm Score Card, Neural Network, Different types of neural N/W, Kohonen feature maps, Nearest Neighbor and Clustering, Business Score Card Where to use clustering & nearest neighbor prediction, Clustering for clarity, Clustering for out layer analysis, Nearest Neighbor for prediction, Application Score Card

### **Text Books:**

1. Data Warehousing, Data Mining & OLAP by Alex & Stephen, McGraw Hill.



# EMBEDDED SYSTEM

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## MODULE - I (12 HOURS)

**Introduction:** Features of Embedded systems, Design matrices, Embedded system design flow, SOC and VLSI circuit.

ARM: An advanced Micro Controller, Brief history, ARM pipeline, Instruction Set

Architecture ISA: Registers, Data Processing Instructions, Data Transfer Instructions, Multiplications instructions, Software interrupt, Conditional execution, branch instruction, Swap instruction, THUMB instructions. FPGA

## MODULE - II (12 HOURS)

Devices and device drivers, I/O devices, Serial peripheral interfaces, IIC, RS232C, RS422, RS485, Universal serial bus, USB Interface, USB Connector IrDA, CAN, Bluetooth, ISA, PCI, PCI - X and advance busses, Device drivers.

**Real time operating system:** Hard real time, firm real time, soft real time, Task periodicity: periodic task, sporadic task, aperiodic task, task scheduling, scheduling algorithms: clock driven scheduling, event driven scheduling.

## MODULE - III (08 HOURS)

**Software and programming concept:** Processor selection for an embedded system, State chart, SDL, PetriNets, Unified Modeling Language (UML).

Low power embedded system design: Dynamic power dissipation, Static power dissipation, Power reduction techniques, system level power management.

## MODULE - IV (08 HOURS)

**Hardware and software partitioning:** K-L partitioning, Partitioning using genetic algorithm, particle swarm optimization, Functional partitioning and optimization: functional partitioning, high level optimizations. Hardware software co-simulations

### Text Books:

1. "Embedded System Design " by SantanuChattopadhyay, PHI
2. "Embedded system architecture, programming and design" By Raj Kamal, TMH

### Reference Books:

1. "Hardware software co-design of Embedded systems" By Ralf Niemann, Kulwer Academic.
2. "Embedded real time system programming" By Sriram V Iyer, Pankaj Gupta, TMH.



# CRYPTOGRAPHY

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## MODULE-I

**Introduction to Cryptography:** Basics of Symmetric Key Cryptography, Basics of Assymmetric, Key Cryptography, Hardness of Functions, Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption.

## MODULE-II

**Goldreich-Levin Theorem:** Relation between Hardcore Predicates and Trap-door permutations

**Formal Notions of Attacks:** Attacks under Message Indistinguishability: Chosen Plaintext

Attack(IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and INDCCA2), Attacks under

**Message Non-malleability:** NM-CPA and NM-CCA2, Interrelations among the attack model

**Random Oracles:** Provable Security and asymmetric cryptography, hash functions One-way functions: Weak and Strong one way functions

## MODULE-III

**Pseudo-random Generators (PRG):** Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF)

**Building a Pseudorandom Permutation:** The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction Left or Right Security (LOR)

## MODULE-IV

**Message Authentication Codes (MACs):** Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC

**Public Key Signature Schemes:** Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing

**Assumptions for Public Key Signature Schemes:** One way functions Imply Secure One-time

Signatures Shamir's Secret Sharing Scheme Formally Analyzing Cryptographic Protocols Zero Knowledge Proofs and Protocols

## REFERENCE BOOKS:

1. Y. Daniel Liang: Introduction to JAVA Programming, 6 Edition, Pearson, 2007.
2. Chris Bates: Web Programming Building Internet Applications, 3 Edition, Wiley India, 2006.
3. XueBai et al: The Web Warrior Guide to Web Programming, Thomson, 2003.
4. Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.



# GRAPH THEORY

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## MODULE-I

Basic Concepts: Graphs and digraphs, incidence and adjacency matrices, isomorphism, the automorphism group; Trees: Equivalent definitions of trees and forests, Cayley's formula, the Matrix-Tree theorem, minimum spanning trees; Connectivity: Cut vertices, cut edges, bonds, the cycle space and the bond space, blocks, Menger's theorem; Paths and Cycles: Euler tours, Hamilton paths and cycles, theorems of Dirac, Ore, Bondy and Chvatal, girth, circumference, the Chinese Postman Problem, the Travelling Salesman problem, diameter and maximum degree, shortest paths;

## MODULE-II

Matchings: Berge's Theorem, perfect matchings, Hall's theorem, Tutte's theorem, Konig's theorem, Petersen's theorem, algorithms for matching and weighted matching (in both bipartite and general graphs), factors of graphs (decompositions of the complete graph), Tutte's f-factor theorem;

## MODULE-III

Extremal problems: Independent sets and covering numbers, Turan's theorem, Ramsey theorems; Colorings: Brooks theorem, the greedy algorithm, the Welsh-Powell bound, critical graphs, chromatic polynomials, girth and chromatic number, Vizing's theorem; Graphs on surfaces: Planar graphs, duality, Euler's formula, Kuratowski's theorem, toroidal graphs, 2-cell embeddings, graphs on other surfaces; Directed graphs: Tournaments, directed paths and cycles, connectivity and strongly connected digraphs, branchings;

## MODULE-IV

Networks and flows: Flow cuts, Max flow min cut theorems, perfect square; Selected topics: Dominating sets, the reconstruction problem, intersection graphs, perfect graphs, random graphs.

## Text Books:

1. T. H. Cormen, C. E. Leiserson and R. L. Rivest, Introduction to Algorithms, Prentice Hall of India, 3rd ed, 2006.
2. N. Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India, 2004.

## Reference Books:

1. D. B. West, Introduction to Graph Theory, 2nd Ed, Prentice Hall of India, 2007.
2. R. Diestel, Advanced Graph Theory, Springer Verlag Heidelberg, New York, 2005.
3. M. T. Goodrich and R. Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, Wiley, 1st ed, 2001.



# MOBILE COMPUTING

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## **MODULE-I**

Overview of wireless technologies. Wireless multiple access protocols. Cellular systems: Channel allocation. Location management.

## **MODULE-II**

Wireless LANs: Medium access, Mobile IP routing. TCP over wireless. Mobile ad hoc networking.

## **MODULE-III**

Energy efficiency. Impact of mobility on algorithms and applications.

## **MODULE-IV**

Disconnected operation of mobile hosts. Data broadcasting. Mobile agents.

## **References:**

1. J. H. Schiller. Mobile Communications. Addison Wesley, 2000.
2. A. Mehrotra. GSM System Engineering. Artech House, 1997.
3. Charles Perkins. Mobile IP. Addison Wesley, 1999.
4. Charles Perkins (ed.) Adhoc Networks. Addison Wesley, 2000 Relevant RFCs, internet drafts and research papers.



# WIRELESS SENSOR NETWORK

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## MODULE-I

Introduction: the vision, Networked wireless sensor devices, Applications, Key design challenges.

Network deployment: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Coverage metrics, Mobile deployment.

## MODULE-II

Localization: issues & approaches, Coarse-grained & Fine-grained node localization, Network-wide localization, Theoretical analysis of localization techniques.

Synchronization: Issues & Traditional approaches, Fine-grained clock synchronization, and Coarse-grained data synchronization.

## MODULE-III

Wireless characteristics: Basics, Wireless link quality, Radio energy considerations, SINR capture model for interference.

Medium-access and sleep scheduling: Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contentionfree protocols.

Sleep-based topology control: Constructing topologies for connectivity, constructing topologies for coverage, Set K-cover algorithms.

## MODULE-IV

Routing: Metric-based approaches, Routing with diversity, Multi-path routing, Lifetime maximizing energy-aware routing techniques, Geographic routing, Routing to mobile sinks. Data-centric networking: Data-centric routing, Data-gathering with compression, Querying, Data-centric storage and retrieval, The database perspective on sensor networks. Reliability and congestion control: Basic mechanisms and tunable parameters, Reliability guarantees, Congestion Control, Real-time scheduling.

## Books:

1. Wireless Sensor Networks: Technology, Protocols, and Applications: KazemSohraby, Daniel Minoli, TaiebZnati , Wiley Inter Science.
2. Wireless Sensor Networks: Architectures and Protocols: Edgar H. Callaway, Jr. Auerbach Publications, CRC Press.
3. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, TaiebZnati , Springer.
4. Networking Wireless Sensors: BhaskarKrismachari, Cambridge University Press
5. Distributed Sensor Networks: A Multiagent Perspective, Victor Lesser, Charles L. Ortiz, and MilindTambe , Kluwer Publications.
6. Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas , Morgan Kaufmann Series in Networking 2004.



# COMPUTATIONAL FINANCE

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## MODULE-I

Introduction to Computational Methods in Finance

1-Quick Review of Matrices and Functions (2 Hours, IM ) Terminology and definitions — vectors, matrices. Functions of a single variable; differentiability; convexity, concavity; determining minimum or maximum. Functions of several variables; partial differentiation; gradient; Hessian; Taylor expansion; Newton's method. Partial differential equations; finite difference method.

2. Probability and Optimisation (2 Hours, IM) Random variables, probability; distribution, moments. Optimisation. Linear and quadratic programming; feasible set; Lagrangean function; optimality conditions.

## MODULE-II

Portfolio Theory and Risk Management

3-Introduction to Investment Theory (2 Hours, NG)

basic terminology and definitions — investment, financial markets, cash flows, risk aversion, pricing, hedging fundamental theorems and principals, interest rate theory — present value, future value

4-Bonds, Stocks and Their Valuation (2 Hours, NG) Valuation of bonds, bond prices, yield to maturity, duration, convexity, term structure, spot and forward rates Valuation of common stocks, stock prices, stock returns and dividend yields.

5-Single-period Markowitz Model (2 Hours, BR) asset return, portfolio return and uncertainty maximum expected value minimum risk — variance, downside risk and may be credit risk, value at risk, Markowitz model- Various versions with different constraints. The efficient frontier.

## MODULE-III

6-The Asset Pricing Models: Capital asset pricing model Factor models-single and multiple factor models. Simple and multiple linear and non linear regression. Derivative Securities:

7-Introduction to Derivatives Financial derivatives-futures, swaps, option contracts (Vanilla, Exotic) Time values of derivatives-arbitrage and risk-neutral valuation.

8-Introduction to Option Theory Models of asset dynamics-binomial lattice, stochastic process, Brownian motion.

## MODULE-IV

9-Option Pricing Models Black-Scholes equation and its applications to valuations. Binomial pricing models. 10-Hedging and Risk Management: Financial risk management. Dynamic and static hedging strategies, bucket hedging Measuring risk-risk sensitivities (greeks), value-at-risk, scenario analysis.

Managing risk for vanilla and exotic options.

### Reference Books:

1. J.Hull, Options, Futures and Other Derivative Securities, Prentice Hall, 2000.
2. Duffie, Dynamic Asset Pricing Theory, Princeton University Press, 1996.
3. D.G. Luenberg, Investment Science, 1998.
4. P. Wilmott, Derivatives: The theory and Practice of Financial Engineering, 1998.
5. P. Wilmott, Option Pricing: Mathematical Models and computation, 1993.
6. S. Pliska, Discrete Time Models in Finance, 1998.
7. E.J. , Elton, M.J. Gruber, Modern Portfolio Theory and Investment Analysis, 1995



# BIO INFORMATICS

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## MODULE-I

Sequence-alignment methodologies: Sequence databases; Similarity matrices; Pairwise alignment: Features of dynamic Programming, alignment by Bayesian Statistical Methods, multiple sequence alignment: local multiple sequence alignment: MEME, PSSM, HMM (algorithms and applications) Progressive methods for global multiple sequence alignment: CLUSTALW, PILEUP, T-COFFEE; Statistical significance of alignment results;

## MODULE-II

Pattern analysis in sequences and Phylogenetic tree construction methods: Motif representation, Markov models; .Distance Based methods: clustering based

methods,optimality based methods: Fitch -Margoliash and Minimum evolution methods, Neighbor joining and related neighbor methods Character Based methods: Maximum parsimony methods, Maximum likely hood method, genetic algorithm, Phylogenetic tree evaluation: Boot strap analysis; dendrogram and applications .

## MODULE-III

Structure-Prediction of Biomolecules with applications in Bioinformatics: Structure classification of proteins (SCOP, CATH); Secondary structure prediction of various protein categories (e.g.transmembrane proteins and helical proteins), RNA secondary structure prediction methods.

## MODULE-IV

Patterns, motifs and Profiles in sequences: Derivation and search methods; Derived Databases of patterns, motifs and profiles e.g.ProSITE, Blocks, Prints-S, Pfam; Overview of tertiary structure prediction methods; algorithms for modeling protein folding; algorithms for 3D structure prediction with representative examples Protein structure prediction by comparative modelling approaches (homology modeling and fold recognition); ab initio structure prediction methods.



# DIGITAL IMAGE PROCESSING

**Internal Assessment: 50**

**Full Marks: 100**

**Theory Credit: 04**

## MODULE-I

Digital Image Fundamentals, Image Transforms: Fourier, Hadamard, Walsh, Discrete cosine and Hotelling Transforms; Image Enhancement: Histogram modification, Histogram equalisation, Smoothing, Filtering, Sharpening, Homomorphic filtering. ;

## MODULE-II

Image restoration, Segmentation: Pixel classification, Bi-level thresholding, Multi-level thresholding, P-tile method, Adaptive thresholding, Spectral & spatial classification, Edge detection, Hough transform, Region growing.

## MODULE-III

Matching and Registration: Image modeling, Stereo mapping, Landmark matching, Rectification in geometric transformations, Match measurement, matching of binary pattern, Distortion tolerant matching; Digital geometry and its applications: Neighborhood, Path, Connectedness, Holes and Surroundness, Borders, Distances, Medial Axis Transform (MAT), Shrinking and Expanding, Thinning.

## MODULE-IV

Introduction to Mathematical morphology and its application, Morphological Operations, Dilation, Erosion, Opening, Closing, Smoothing, Extraction of connected components, Thinning.

### Text Books:

1. R.C. Gonzalez, R.E. Woods, Digital Image Processing, Pearson Prentice Hall, 2007.
2. B. Chanda, D.D. Majumder, Digital Image Processing and Analysis, Prentice Hall, 2007.

### Reference Books:

1. W.K. Pratt, Digital Image Processing (Fourth Edition), John Wiley & Sons, Inc., 2007
2. A.K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1988.



## *Third Semester*

# INTELLECTUAL PROPERTY RIGHTS

### **UNIT 1 - INTRODUCTION**

Intellectual property: meaning, nature and significance, need for intellectual property Right (IPR), IPR in India – Genesis and development, IPR in abroad, Examples:-Biotechnology Research and Intellectual Property Rights Management.

What is a patent, What can be protected by a patent, Why should I apply for a patent? Patent Law, Patentability requirements, Non-Patentable subject matters, Layout of the Patents. Procedure for domestic and international filing of applications, Restoration, Surrender and Revocations of Patents, Rights of Patentee and Working of Patent, Licensing and Enforcing Intellectual Property.

### **UNIT 2 – COPYRIGHTS**

Copyright: meaning, scope; What is covered by copyright? How long does copyright last? Why protect copyright? Related rights, Rights covered by copyright. Ownership: Duration, Division, Transfer and Termination of Transfers.

### **UNIT 3 – INFRINGEMENT AND REMEDIES**

Literal and non-literal infringement, Role of claims, Doctrines on infringement: Equivalent doctrine, Pith and Marrow doctrine, Comparative test. Defenses: Gillette Defense, General grounds, Patents granted with conditions, Parallel import. Remedies: Civil, Administrative.

### **UNIT 4 – STATE LAW: TRADE SECRET, CONTRACT, MISAPPROPRIATION, RIGHT OF PUBLICITY**

Trademarks, Trade Secret - Overview, Requirements, Misappropriation of Trade Secret, Departing Employees, Remedies, Criminal Liability, Misappropriation, Clickwrap Agreements, Idea Submissions; Right of Publicity, Federal Preemption, Review.

#### **Books:**

1. W. R. Cornish and D. Llewellyn, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Rights, Sweet & Maxwell.
2. Lionel Bently and Brad Sherman, Intellectual Property Law, Oxford University Press.
3. P. Narayanan, Intellectual Property Law, Eastern Law House
4. B. L. Wadehra, Law Relating to Intellectual Property, Universal Law Publishing Co.
5. V. K. Ahuja, Law Relating to Intellectual Property Rights, LexisNexis.
6. Ajit Parulekar and Sarita D'Souza, Indian Patents Law – Legal & Business Implications; Macmillan India Ltd, 2006
7. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010.



## Reference

1. The Copyright Act, 1957
  2. The Patent Act, 1970
  3. The Trade Marks Act, 1999
  4. The Designs Act, 2000
  5. The Geographical Indication of Goods Act, 1999
  6. The Protection of Plant Varieties and Farmers' Rights Act, 2001
- The Semiconductor Integrated Circuits Layout Design Act, 2000

# RESEARCH METHODOLOGY

## MODULE I:

Introduction to RM: Meaning and significance of research. Importance of scientific research in decision making. Types of research and research process. Identification of research problem and formulation of hypothesis. Research Designs.

## MODULE II:

Measurement and Data Collection. Primary data, Secondary data, Design of questionnaire; Sampling fundamentals and sample designs. Measurement and Scaling Techniques, Data Processing.

## MODULE III:

Data Analysis – I: Hypothesis testing; Z-test, t-test, F-test, Chi-square test. Analysis of variance. Non-parametric Test – Sign Test, Run test, Krushall – Wallis test

## MODULE IV:

Data Analysis – II: Factor analysis, Multiple Regressions Analysis. Discriminant Analysis, Use of SPS Package.

## Reference Books

1. Research Methodology, Chawla and Sondhi, Vikas
2. Research Methodology, Paneersevam, PHI

