

## **PG SYLLABUS**

### **(INFORMATION TECHNOLOGY)**

<b>SEMESTER</b>	<b>PAPER</b>	<b>PAPER CODE</b>	<b>FULL MARKS</b>	<b>CREDITS</b>	<b>REMARKS</b>
FIRST	ADVANCED COMPUTER ARCHITECTURE	MIT-1.1.1	100	6	COMPULSORY
	COMPUTER GRAPHICS	MIT-1.1.2	100	6	COMPULSORY
	MOBILE COMMUNICATIONS	MIT-1.1.3	100	6	COMPULSORY
	PROBABILITY AND STOCHASTIC PROCESS	MIT-1.1.4	100	6	COMPULSORY
	GREEN IT	MIT-1.1.5	100	6	COMPULSORY
SECOND	ARTIFICIAL INTELLIGENCE	MIT-1.2.1	100	6	COMPULSORY
	DATA MINING AND DATA WAREHOUSING	MIT-1.2.2	100	6	COMPULSORY
	DESIGN AND ANALYSIS OF ALGORITHMS	MIT-1.2.3	100	6	COMPULSORY
	WIRELESS SENSOR NETWORKS	MIT-1.2.4	100	6	COMPULSORY
	ADVANCE DATA STRUCTURE AND ALGORITHM	MIT-1.2.5	100	6	COMPULSORY
THIRD	SOFTWARE EVOLUTION	MIT-2.3.1	100	6	COMPULSORY
	CRYPTOGRAPHY AND NETWORK SECURITY	MIT-2.3.2	100	6	COMPULSORY
	IT INFRASTRUCTURE DESIGN	MIT-2.3.3	100	6	COMPULSORY
	INTERNET OF THINGS	MIT-2.3.4	100	6	COMPULSORY
	ADVANCE OPEARTING SYSTEM	MIT-2.3.5	100	6	COMPULSORY
FOURTH	CLOUD COMPUTING	MIT- 2.4.1 A	100	6	CHOOSE ANY ONE OF THE TWO COURSES
	BIOINFORMATICS	MIT- 2.4.1 B		6	
	DIGITAL IMAGE PROCESSING	MIT- 2.4.2 A	100	6	CHOOSE ANY ONE OF THE TWO COURSES
	EMBEDDED SYSTEMS	MIT- 2.4.2 B		6	

	SOFTWARE PROJECT MANAGEMENT	MIT- 2.4.3	100	6	COMPULSORY
	PROJECT	MIT-2.4.4	300	6	COMPULSORY

# **FIRST SEMESTER**

## **Advanced Computer Architecture (MIT-1.1.1)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

Digital Electronics: Boolean algebra, Combinational circuits, Karnaugh map, Flip-flops, Sequential circuits. RISC processors, RISC vs CISC, Classification of Instruction set Architecture, Performance measurement, Basic parallel processing techniques: Instruction level, Thread level and Process level. Classification of parallel architecture.

### **UNIT II**

Pipeline: Arithmetic pipeline, Instruction pipeline. Hazards in a pipeline: Structural, data and control hazard, Overview of hazard resolution techniques. Dynamic instruction scheduling, Branch prediction techniques, Instruction-level parallelism using software approaches, Superscalar techniques.

### **UNIT III**

Basic concept of hierarchical memory organization, Main memories, Cache memory design and implementation, Cache coherence problem and synchronization mechanisms, Virtual memory design and implementation, Secondary memory technology, RAID.

### **UNIT IV**

Bus structures and standards, Synchronous and asynchronous buses, Types and uses of storage devices, Interfacing I/O to the rest of the system, Reliability and availability, I/O system design, Platform architecture.

### **UNIT V**

Centralized vs. distributed shared memory, Interconnection topologies, Multiprocessor architecture, Symmetric multiprocessors, Cache coherence problem, Synchronization, Memory consistency, Multicore architecture. Distributed computers, Clusters, Grid, Mainframe computers.

Text Book:-

1. Computer Organisation and Design: The Hardware/Software Interface by David A. Patterson and John L. Hennessy. 5<sup>th</sup> Edition, Morgan Kaufmann, 2013.
2. Computer System Architecture by M. Mano, 3<sup>rd</sup> Edition, Pearson Education, 2007.
3. Computer Architecture: A Quantitative Approach by J. Hennessey and D. Patterson, 5<sup>th</sup> Edition, Morgan Kaufman.
4. Advanced Computer Architecture: A design Space Approach by D. Sima, Addison-Wesley, 1987.

## **Computer Graphics (MIT-1.1.2)**

**Full marks – 100 (Mid Semester: 20; End Semester:  
50(Theory)+30(Practical))**

### **UNIT I**

**A survey of computer graphics:** Computer Aided Design, Presentation Graphics, Computer Art, Entertainment, Education Training, Visualization, Image Processing, Graphical User Interface. **Overview of graphics system:** Video Display Devices, Raster Scan Systems, Random Scan Systems, Input Devices, Hard-copy Devices, Graphics Software. **Output primitives:** Points and lines, DDA and Bresenham's Line Drawing Algorithm, Midpoint circle algorithm, Filled area primitives. **Attributes of output primitives:** Line attributes, Curve attributes, Colour and grayscale levels, Area-fill attributes, Character attributes, Bundled attributes.

### **UNIT II**

**Two dimensional geometric transformations:** Basic Transformation (Translation, Rotation, Scaling), Matrix representation and homogenous coordination, Composite Transformation, Reflection, Shear. **Two dimensional viewing:** The viewing Pipe-line, Viewing Coordinate Reference frame, Window-to-viewport coordinate transformation. **Clipping:** Line Clipping (Cohen Sutherland Algorithm), Polygon clipping (Sutherland-Hodgemen Algorithm)

### **UNIT III**

**Three dimensional object representation:** Polygon Surfaces, Quadratic surfaces, Spline Representations, Beizer Curves and surfaces, B-Spline Curves and surfaces

### **UNIT IV**

**Three dimensional geometric and modeling transformations:** Translation, Rotation, Scaling, Reflections, Shears, Composite Transformation. **Three dimensional viewing:** Viewing pipeline, Viewing coordinates, Projections (Parallel and Perspective).

### **UNIT V**

**Visible-surface detection methods: Classification of** visible-surface detection algorithms, back-face detection, Depth-Buffer method, A-Buffer method, Scan-line method, Depth-sorting method. **Illumination Models:** Basic illumination models, Displaying light intensities, Halftone Patterns and Dithering Technique, Polygon Rendering Methods,(Gouraud and phong shading)

Text Book :-

1. Computer Graphics C Version, by D. Heam and M. P. Baker, 2<sup>nd</sup> Edition, Pearson Education, 2002.

## **Practical**

Background concept of enabling graphics mode in C and usage of various graphic functions available in graphics.h, Simple animation programs using graphics library, Implementation of DDA and Bresenham's line drawing, Mid point circle algorithms in C, Writing program in C to implementation translation, rotation, scaling, line clipping, polygon clipping.

## **Mobile Communications (MIT-1.1.3)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

Introduction to Wireless Networks: Evolution of Wireless Networks, Applications, Challenges, Overview of various Wireless Networks.

Wireless transmission: Frequencies for radio transmission, signals, antennas, Signal propagation.

Multiplexing (Space Division Multiplexing, Frequency Division Multiplexing, Time Division Multiplexing, Code Division Multiplexing, Orthogonal Frequency Division Multiplexing), Modulation (Amplitude shift keying, Frequency shift keying, Phase shift keying), spread spectrum (Direct Sequence Spread Spectrum, Frequency Hopping Spread Spectrum).

### **UNIT II**

Motivation for a specialized MAC: Hidden and exposed terminal, Near and far terminals.

SDMA, FDMA, TDMA: Fixed TDM, Classical Aloha, Slotted Aloha, Carrier sense multiple access, Demand assigned multiple access, PRMA packet reservation multiple access, Reservation TDMA, Multiple access with collision avoidance, Polling, Inhibit sense multiple access, CDMA: Spread Aloha multiple access

### **UNIT III**

GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, New data services,

Mobile IP : Goals, assumptions and requirements, Entities and terminology, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimizations, Reverse tunneling, IPv6, IP micro-mobility support

### **UNIT IV**

Wireless LAN : Infra red vs radio transmission, Infrastructure and ad-hoc network,

IEEE 802.11: System architecture, Protocol architecture, Physical layer (FHSS, DSSS), Medium access control layer (Basic DFWMAC-DCF using CSMA/CA, DFWMAC-DCF with RTS/CTS extension, DFWMAC-PCF with polling), MAC frames, MAC management (Registration, Handoff, Power Management).

### **UNIT V**

Third Generation (3G) Cellular Systems: Introduction, 3G Spectrum Allocation, Third Generation Service Classes and Applications, Third Generation Standards.

Fourth Generation (4G): Introduction, Design Goals for 4G and Beyond and Related Research Issues, 4G Services and Applications, Challenges.

Text Book:

1. Mobile Communications, by Jochen Schiller, 2<sup>nd</sup> Edition, Addison Wesley, 2003

Reference:

1. Wireless Networks, by P. Nicopolitidis, M. S. Obaidat, G. I. Papadimitriou, A. S. Pomportsis, John Wiley.
2. Principle of Wireless Networks, by Kaveh Pahlavan and Prashant Krishnamurthy.

**Probability and Stochastic Process (MIT-1.1.4)**  
**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

**UNIT I**

Probability: Introduction to Probability, Sample Space and Events, The complement of an Event, Mutually Exclusive Events, Additional Rules for Probability, Independent and Dependent Events, Conditional Probabilities, , Bayes Formula.

**UNIT II**

Random variables-What is random variable. Cumulative distribution function, Discrete Random Variables: Definition of probability mass function, The Bernoulli Random Variable, The Binomial Random Variable, The Geometric Random Variable, The Poisson Random Variable.

Continuous Random Variables: Definition of probability density function, The Uniform Random Variables, Exponential Random Variables, Gamma Random Variables, Normal Random Variables.

**UNIT III**

Expectation of Random Variables: The Discrete Case and the Continuous Case. Expectation of a Function of a Random Variables, Jointly Distributed Random Variables: Joint Distribution Function, Independent Random Variables. Covariance and Variance, Moment Generating Functions. Markov's and Chebyshev's Inequality, Central Limit Theorem.

**UNIT IV**

Stochastic processes: Definition with examples, Markov chains, Chapman Kolmogorov equations, Classification of states, Limiting Probabilities, some applications: The gambler's Ruin problem.

The Exponential Distribution: Definition, Properties of the Exponential Distribution.

The Poisson Process: Counting Processes, Definition of Poisson Process, Inter-arrival and Waiting Time Distributions, Properties of Poisson Processes, Conditional Distribution of the Arrival Times.

**UNIT V**

Continuous-time Markov Chains. Birth-and-death processes, Transition probability function, Limiting Probability.

Queuing Theory: Preliminaries, Steady State Probabilities, A single Server Exponential Queuing System (M/M/1), A single server Exponential Queuing System Having Finite Capacity, Network of Queues. A Queuing System with Bulk Service.

Text Books:

1. Introduction to Probability Models by Sheldon M. Ross, Academic Press Harcourt India Private Limited.
2. An Introduction to Probability and Statistics by V. K. Rohatgi and A.K. Md. Ehasanes Saleh, Second edition, John Wiley and Sons.

## **GREEN IT (MIT-1.1.5)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

The Importance of Green Information Technologies, The Governance and Regulatory Issues.

Velte: Chapter 1, Chapter 2.

Lamb: Chapter 1, Chapter 2 (15-30), Chapter 3, Chapter 4.

### **UNIT II**

Minimizing Power Usage, Cooling.

Velte: Chapter 3, Chapter 4(63-75)

Lamb: Chapter 2 (30-37), Chapter 7 (109-115), Chapter 8.

### **UNIT III**

Business Process Reengineering for Sustainability, Going Paperless, Recycling:

Velte: Chapter 5, Chapter 6, Chapter 7

Lamb: Chapter 3

### **UNIT IV**

Sustainable Hardware, Technology Company and University Case Studies.

Velte: Chapter 8, Chapter 9, Chapter 10

Lamb: Chapter 10, Chapter 11

### **UNIT V**

Data Centre Design and Redesign, Virtualization, Managing Your Green IT Transformation.

Velte: Chapter 11, Chapter 12, Chapter 13

Lamb: Chapter 6, Chapter 7 (115-121)

Text Books:

1. Green IT: Reduce Your Information System's Environmental Impact While Adding to the Bottom Line. by T. Velte, A. Velte and R. Elsenpeter, McGrawHill.
2. The Greening of IT: How Companies Can Make Difference for the Environment. by John Lamb – pearson.



# **SECOND SEMESTER**

## **Artificial Intelligence (MIT-1.2.1)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

Introduction to AI, Application areas of AI, State-space search: production system design, production system characteristics.

Search techniques

Blind search: depth first search, breadth first search

Heuristic search techniques: Hill climbing, best first search. Branch and bound, A\*, AO\*

### **UNIT II**

Game playing: Min- Max search, Alpha- Beta cutoff

Knowledge Logic: Propositional logic, Predicate logic, Unification algorithm, Resolution

Prolog: function, syntax and predicate, cut( blue cut, green cut, red cut)

### **UNIT III**

Structured knowledge representation: semantic nets, frames, conceptual dependency, scripts.

Expert system: expert system need & justification, rule bases architecture.

Non-production system architecture

### **UNIT IV**

Concept of learning, types of learning, genetic algorithm, neural networks.

Natural language processing: introduction syntactic processing, semantic analysis, discourse and pragmatic processing.

Knowledge organization & Management: Introduction, HAM

### **UNIT V**

LISP: syntax and numeric functions. Basic list manipulation function, functions, predicate and conditionals, input, output and local variables, iteration and recursion, property list and array

Text Book:

1. Introduction to Artificial Intelligence and Expert Systems, by D. W. Paterson, Prentice Hall.
2. Artificial Intelligence, E. Ritchie, K. Knight and S. B. Nair, 3<sup>rd</sup> Edition, McGraw Hill, 2009
3. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Prentice Hall.

## **Data Mining and Data Warehousing (MIT-1.2.2)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Major issues in Data Mining. Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

### **UNIT-II**

Data Warehouse and OLAP Technology for Data Mining: Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Further Development of Data Cube Technology, From Data Warehousing to Data Mining Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction.

### **UNIT-III**

Mining Frequent Patterns, Associations and Correlations: Basic Concepts, Efficient and Scalable Frequent Itemset Mining Methods, Mining various kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining.

### **UNIT-IV**

Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Backpropagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction, Accuracy and Error measures, Evaluating the accuracy of a Classifier or a Predictor, Ensemble Methods.

### **UNIT-V**

Cluster Analysis Introduction :Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid- Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint-Based Cluster Analysis, Outlier Analysis.

Text Book:-

1. Data Mining – Concepts and Techniques – J. Han and M. Kamber, Morgan Kaufmann Publishers, Elsevier, 2nd Edition, 2006.
2. Introduction to Data Mining – P. Tan, M. Steinbach and V. Kumar, Pearson Education.

## **Design and Analysis of Algorithms (MIT-1.2.3)**

**Full marks – 100 (Mid Semester: 20; End Semester:**

**50(Theory)+30(Practical))**

### **UNIT I**

Algorithm, Space and Time Complexity, Asymptotic notation, worst case, best case and average case, Insertion sort, Substitution method, Recursion-tree method, master method.

### **UNIT II**

Divide and conquer technique, Quick sort , Randomized quick sort, Priority Queue, Heap Sort, Rabin-Karp String Matching, Miller-Rabin Primality Test, Binary Search, Finding Minimum Maximum, Merge Sort.

### **UNIT III**

Greedy method, Activity selection problem, Huffman Codes, Fractional Knapsack, Job sequence with deadlines, Minimum Cost Spanning Trees-Prim's and Kruskal's algorithm.

### **UNIT IV**

Dynamic programming, Matrix chain multiplication, Longest Common Subsequence, Travelling Salesman Problem, Single Source Shortest Path: The Bellman Ford algorithm, Dijkstra's Algorithm, All pair Shortest path: Floyd Warshall algorithm, Backtracking, Eightqueens Problem, Subset Sum Problem.

### **UNIT V**

Complexity Class: P, NP, NP-Hard, NP Completeness and reducibility, P Space, NP Space, Clique, Vertex Cover, Hamiltonian Cycle, Approximation Algorithm: Vertex Cover problem, Approximation algorithm for travelling-salesman problem.

Text Books:

1. Fundamentals of Computer Algorithms by Ellis Horowitz, Sartaj Sahani, 2<sup>nd</sup> Edition, Universities Press.
2. Introduction to Algorithms by Thomas H. Cormen, 3rd Edition, MIT Press.

### **Practical**

Writing an efficient sorting algorithm. (Quick Sort, Merge sort, Heap sort), Designing efficient algorithm for inserting, deleting and searching in a binary tree, Minimum cost spanning tree (Prims and Kruskal ), Activity selection problem, Longest Common Subsequence, Travelling salesman problem.

## **Wireless Sensor Networks (MIT-1.2.4)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

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.

### **UNIT 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.

### **UNIT 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 Contention-free protocols.

Sleep-based topology control: Constructing topologies for connectivity, constructing topologies for coverage

### **UNIT 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.

### **UNIT V**

Dependability issues: Security Challenges, Threat and attack models, Quality of Service provisioning, Clock Synchronization, Supporting fault tolerant operations. Introduction to Tiny OS, Nes C, Sensor Simulator.

Text Books:

1. Wireless Sensor Networks: Technology, Protocols, and Applications: Kazem Sohraby, Daniel Minoli, Taieb Znati , 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, Taieb Znati , Springer.

## **ADVANCE DATA STRUCTURE AND ALGORITHM (MIT-1.2.5)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

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

### **UNIT 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.

### **UNIT 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, Ukkonen's Algorithm, Text pattern matching), Numerical Algorithm (Integer, Matrix and Polynomial multiplication, Extended Euclid's algorithm)

### **UNIT IV**

Geometric Algorithm (Convex hulls, Segment Intersections, Closest Pair), Internet Algorithm (Tries, Ukkonen's Algorithm, Text pattern matching), Numerical Algorithm (Integer, Matrix and Polynomial multiplication, Extended Euclid's algorithm)

### **UNIT V**

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

Text 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++, 2nd 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.

# **THIRD SEMESTER**

## **Software Evolution (MIT-2.3.1)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

Introduction to Evolution and Maintenance, Classification of Software Maintenance: Intention-based, Activity-based, and Evidence-based. Categories of Maintenance Concepts: Product, Types, Organization Processes, Peopleware. Evolution of Software Systems: SPE Taxonomy, Laws of S/W Evolution, Empirical Studies, Evolution of FOSS Systems, Maintenance of COTS-based Systems.

Maintenance Models: Reuse-Oriented Model, Staged-Model for Closed Source Software(CSS) and Open Source Software (OSS), and Change Mini-Cycle Model, IEEE?EIA and ISO/IEC Maintenance Process, Software Configuration Management.

### **UNIT II**

Reengineering Concepts, A General Model of Software Reengineering, Reengineering Process, Code Reverse Engineering, Techniques used for Reverse Engineering, De-compilation Versus Reverse Engineering, Data Reverse Engineering, Reverse Engineering Tools.

Legacy Information Systems, Wrapping, Migration, Migration Planning, Migration Methods: Cold Turkey, Database First, Database Last, Composite Database, Chicken Little, Butterfly, Iterative.

### **UNIT III**

Impact Analysis, Impact Analysis Process: Identifying the SIS, Analysis of Traceability Graph, Identifying the Candidate Impact Set, Dependency-Based Impact Analysis: Call Graph, Program Dependency Graph, Ripple Effect, Computing Ripple Effect, Change Propagation Model: Recall and Precision of Change Propagation Heuristics, Heuristics for Change Propagation, Empirical Studies.

### **UNIT IV**

Re-factoring, Activities in a Re-factoring Process, Formalisms for Re-factoring: Assertions, Graph Transformation, Software Metrics, Examples of Re-factorings, Initial Work on Software Restructuring, Factors Influencing Software Structure, Classification of Restructuring Approaches, Restructuring Techniques.

Reuse: Benefits of Reuse, Reuse Models, Factors Influencing Reuse, Success Factors of Reuse. Reuse Capability, Economic Models of Software Reuse: Cost Model of Gaffney and Durek, Cost Model of Gaffney and Cruickshank, Business Model of Poulin and Caruso.

Domain Engineering, Application Engineering, Domain Engineering Approaches.

### **Unit V**

Program Comprehension, Goal of Code Cognition, Knowledge, Mental Model, Understanding Code, Cognition Models for Program Understanding: Letovsky Model,

Shneiderman and Mayer Model, Brooks Model, Soloway, Adelson, and Ehrlich Model, Pennington Model, Integrated Meta-model, Protocol Analysis, Visualization for Comprehension.

Text Book:

1. .Software Evolution and Maintenance: A Practitioner's Approach, Priyadarshi (Piyu) Tripathy, and Kshirasagar (Sagar) Naik, Wiley, Hoboken, NJ, 2015.

Reference Book:

1. Software Maintenance Concepts and Practice, Grubb P. and Takang A, 2e, World Scientific, 2003.

## **Cryptography and Network Security (MIT-2.3.2)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, Access Control and availability) and mechanisms, OSI Security Architecture, Cryptography, Cryptanalysis, Symmetric Cipher Model, Substitution Technique: Monoalphabetic Ciphers, Polyalphabetic Ciphers(Playfair, Vigenere, Hill), Transposition Technique.

### **UNIT II**

Data Encryption Standard (DES), Block Cipher Principles, Stream Cipher, Block Cipher, Strength and Weakness of DES, Advanced Encryption Standard (AES).

### **UNIT III**

Modular Arithmetic, Euclid's Algorithm, Finite Fields of the form  $GF(P)$ , Principle of Public Key Cryptosystems, Applications for Public Key Cryptosystems, The RSA Algorithm, Diffie Hellman Key Exchange.

### **UNIT IV**

Authentication Requirement, Authentication Functions: Message Encryption, Message Authentication Code, Hash Function, Message Digest Algorithm: MD5.

### **UNIT V**

Digital Signatures: Direct Digital Signature, Arbitrated Digital Signature, Authentication Protocol: Mutual Authentication, Symmetric Encryption Approach, Public Key Encryption Approach, Digital Signature Standard, Kerberos (Version 4).

Text Books:

1. Cryptography and Network Security Principles and Practices by William Stallings.
2. Cryptography and Network Security by Behrouz A. Forouzan.



## **IT Infrastructure Design (MIT-2.3.3)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

Overview of Analysis, Architecture, and Design Processes: Process Components , Tactical and Strategic Significance, Hierarchy and Diversity, Importance of Network Analysis, Model for Network Analysis, Architecture, and Design

A Systems Methodology, System Description, Service Description, Service Characteristics: Service Levels, System Components and Network Services, Service Requests and Requirements, Service Offerings, Service Metrics.

Performance Characteristics: Capacity, Delay, RMA, Performance Envelopes, Network Supportability

Network Architecture: Component Architecture –Routing, Network Management, Performance, Security.

Architectural models: topological, flow model, Functional model.

### **UNIT II**

Enterprise LAN Design: Ethernet Design Rule. 100 Mbps Fast Ethernet Design rules, gigabit Ethernet Design Rules, 10 Gigabit Ethernet Design rules, 10GE Media types

Understanding Working of Repeater, hub, Bridge, routers, Layer2/3 Switch,

Campus LAN Design Best Practice, Server Farm Design, Campus LAN QoS consideration, Multicast Traffic Consideration

### **UNIT III**

Routing Protocol Characteristics, Static Versus Dynamic Route Assignment, Interior Versus Exterior Routing Protocols, Distance-Vector Routing Protocols, EIGRP, Link-State Routing Protocols, Distance-Vector Routing Protocols Versus Link-State Protocols, Hierarchical Versus Flat Routing Protocols, Classless Versus Classful Routing Protocols, Administrative Distance. Routing Protocol Metrics and Loop Prevention: Hop Count , Bandwidth, Cost, Load, Delay, Reliability ,Maximum Transmission Unit ,

Routing Loop-Prevention Schemes: Split Horizon, Poison Reverse, Counting to Infinity , Triggered Updates

RIPv2: Authentication, MD5 Authentication, RIPv2 Routing Database, RIPv2 Message Format, RIPv2 Timers, RIPv2 Design, RIPv2

RIPng: RIPng Timers, Authentication, RIPng Message Format, RIPng Design

OSPF: Metric, Adjacencies and Hello Timers, OSPF Areas, OSPF Router Types, OSPF DRs, LSA Types

EIGRP: Components , Neighbor Discovery and Recovery , Timers, Packet Types, Design

### **UNIT IV**

Server-Centric IT architecture and its Limitations, Storage-centric IT Architecture and its Advantages.

Intelligent Disk Subsystems: Architecture, Storage Virtualization using RAID, RAID levels,

I/O Techniques: SCSI, Fibre Channel Protocol stack, Fibre Channel SAN, IP Storage.

## **UNIT V**

Enterprise Wireless LAN Architecture: Components of Centralize Architecture: understanding 802.11X standards. WLAN technologies (Narrow Band, Spread Spectrum, FHSS, DSS) and topologies,

Wireless Network Components: Access Point and NICs, Router etc; WLAN enterprise design, WLAN performance, WLAN monitoring and troubleshooting, WLAN security. Intra and inter controller roaming.

### **Text Books:**

1. Network Analysis, Architecture, and Design, James D. McCabe, 3rd Edition, Morgan Kaufman
2. CCDA Cisco official Guide
3. Storage Networks explained by Ulf Troppen, Wiley.
4. Storage Network Management and Retrieval by Dr. Vaishali Khairnar, Nilima Dongre, Wiley, India

## **Internet of Things (MIT-2.3.4)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT-I**

INTRODUCTION& CONCEPTS: Introduction to Internet of Things, Definitions and 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 and Development Templates, IoT Level-1, IoT Level-2, IoT Level-3, IoT Level-4, IoT Level-5, IoT Level-6.

Textbook 1:1.1 – 1.5

### **UNIT-II**

IoT and M2M, Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization, IoT Platform Design Methodology, Introduction, IoT Design Methodology, Step1: Purpose and requirement specification, Step2: Process Specification, Step 3: Domain Model Specification, Step 4: Information Model Specification, Step 5: Service Specification, Step 6: IoT Level Specification, Step 7: Function View Specification, Step 8: Operational View Specification, Step 9: Device and Component Integration, Step 10: Application Development, IoT System Logical Design Using Python, Introduction, Installing Python, Python Data Types and Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date Time applications, Classes, Python Packages of Interest for IoT.

Textbooks 1:3.1-3.4, 5.1-5.4, 6.1-6.11

### **UNIT-III**

IoT Physical Devices and End Points: What is and IoT Device, Exemplary Device Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry pi interfaces, programming raspberry pi with python, other IoT devices. IoT physical servers and cloud offerings: introduction to cloud storage models and communication Networks, wamp-autobahn for IoT, xively cloud for IoT, python web application frame work-django, designing a RESTful web API, amazon web services for IoT, SkyNetIoT messaging platforms.

Textbook 1: 7.1-7.7, 8.1-8.7

### **UNIT-IV**

Data Analytics for IoT; Introduction ApacheHadoop, using HadoopMapReduce for Batch Data Analysis, Apache oozie, Apache Spark, Apache Storm, using Apache Storm for Real-time Data Analysis.

Textbook 1: 10.1 -10.8

### **UNIT-V**

Ethics: Characterizing the IoT, Privacy, Control, Distributing Control and Crowd Sourcing, Environment, Physical Thing, Electronics, Internet Service, Solutions, Internet of Things as Part of Solution, Cautious Optimizing, The Open IoT definition.

Textbook 2: Chapter 11

Text Books:

1. Internet Of Things-A Hands on Approach, by Arshdeep Bahga and Vijay Madisetti,

University of Penn, <http://www.internet-of-things-book.com/>

2. Designing the Internet of Things, by Adrian McEwen and Hakim Cassimally, Wiley Publication.

Reference Books:

1. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems. By Ovidiu Vermesan and Peter Friess, River Publishers Series in Communication.

## **ADVANCE OPERATING SYSTEM (MIT-2.3.5)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT 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,

### **UNIT 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.

### **UNIT III**

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

### **UNIT IV**

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

### **UNIT V**

Introduction to Real Time Operating Systems (RTOS), RTOS Taxonomy and Architecture, Paradigms.

Text 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.
4. John A. Stankovic and R. Rajkumar, "Real-time Operating Systems," *Real-Time Systems*, Vol. 28, Page:237-253, 2004. Kluwer Academic Publisher.(UNIT V)

# **FOURTH SEMESTER**

## **Cloud Computing (MIT-2.4.1 A)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

Cloud computing definition, Private, public and hybrid cloud, Types of cloud services: IaaS, PaaS, SaaS, Benefits and challenges of cloud computing, Evolution of cloud computing, Usage scenarios and applications, Business models around cloud, Major players in cloud computing, Issues in cloud, Eucalyptus, Nimbus, Open Nebula, CloudSim.

### **UNIT II**

Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service, Monitoring as a Service, Communication as a Service, Service providers: Google App Engine, Amazon EC2, Microsoft Azure, Sales force, Introduction to MapReduce, GFS, HDFS, Hadoop Framework.

### **UNIT III**

Collaborating on Calendars, Schedules and Task Management, Collaborating Event Management, Contact Management, Project Management, Collaborating on Word Processing, Database: Storing and Sharing Files, Collaborating via Web-based communication tools, Evaluating Web mail Service, Collaborating via Social Networks, Collaborating via Blogs and Wikis.

### **UNIT IV**

Need for Virtualization, Pro and Cons of Virtualization, Types of Virtualization, System VM, Process VM, Virtual Machine Monitor, Virtual Machine Properties, Interpretation and binary Translation, HLL VM, Hypervisors, Xen, KVM, VMWare, Virtual Box, Hyper – V.

### **UNIT V**

Cloud security challenges, Software as a Service Security, Common Standards, The Open Cloud Consortium, The Distributed Management Task Force, Standards for application developers, Standards for Messaging, Standards for Security, End user access to cloud computing, Mobile Internet device and the cloud.

Text Books:

1. Cloud Computing for Dummies, by J. Hurwitz , R. Bloor, M. Kanfman, and F. Haiper, Wiley India Edition, 2010 (Unit I).
2. Cloud Computing Implementation Management and Security by J. Rittinghouse and J. Ransome, CRC Press, 2010 (Unit II).
3. Cloud Computing: A Practical Approach by A. Velte, T. Velte and R. Elsenpeter, Tata McGraw Hill, 2009 (Unit II).

4. Cloud Computing: Web-based Applications That Change the Way You work and Collaborate Online by M.. Miller, Que Publishing, August 2008 (Unit III).
5. Virtual Machines by J. E. Smith and R. Nair, Morgan Kaufmann Publishers, 2006 (Unit IV).
6. [http://cloud-standards.org/wiki/index.php?title=Main\\_Page](http://cloud-standards.org/wiki/index.php?title=Main_Page) (Unit –V).

Reference Books:

1. Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS), by M. Kavis, Wiley, 2014.
2. Mastering In Cloud Computing by R. Buyya, C. Vecchiola and T. Selvi, Tata Mcgraw-Hill Education, 2013.
3. Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and more by K. Jamsa, Jones & Bartlett Learning Company LLC, 2013.

## **Bioinformatics (MIT-2.4.1 B)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

What is bioinformatics: an introduction and overview, application of bioinformatics in various fields of biology, scope of bioinformatics, overview of available bioinformatics resources on web: NCBI, EBI, EXPASY.

### **UNIT II**

Genome sequence, ORFs, genes, DNA, structure properties and classification of amino acids, primary, secondary and quaternary structure of proteins, globular protein, protein folding, Protein tertiary Structure.

### **UNIT III**

Basic concepts of sequence alignment: pairwise and multiple sequence alignment, significance of these methods in sequence analysis. Introduction to different online tools for sequence alignment, and interpretation of results.

Phylogeny: Phylogenetic analysis, Definition and description of phylogenetic trees and various types of trees, Method of construction of Phylogenetic trees [distance based method (UPGMA, NJ), Maximum Parsimony and Maximum Likelihood method]

### **UNIT IV**

Current Advancements in Bioinformatics: Introduction to System Biology, Structural bioinformatics, Prediction of secondary structure- PHD and PSI-PRED methods. Tertiary Structure: homology modeling, fold recognition and ab-initio approaches. Structures of oligomeric proteins and study of interaction interfaces, Chemoinformatics, Immunoinformatics.

### **UNIT V**

Overview of biological database, global biological database search, overview of various databases as follows:

Literature/Bibliographical database: PubMed, Nucleic acid sequence database: GenBank, EMBL, Protein sequence database: Uni Prot, PIR, TrEMBL, Protein family and domain database: Pfam, SMART, InterProscan, Prosite, BLOCKS, Superfamily, Gene3D, ProDom, PRINTS, Metabolic Pathway database: KEGG, MetaCyc, BioCyc, Protein structure database: PDB, CATH, SCOP, DALI, Enzyme, compound and reaction database: PubChem, LIGAND, BRENDA, ENZYME, Protein-protein interaction database: STRING, DIP, MINT, BIND

Text Books:

1. Introduction to Bioinformatics by Arthur M Lesk.
2. Developing Bioinformatics Computer Skills, by Cynthia Gibas and Per Jambeck.
3. Structural Bioinformatics, by J. Gu and P. Bourne (Edited), Wiley-Blackwell, 2009.



**Digital Image Processing (MIT-2.4.2 A)**  
**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

**UNIT I**

Digital Image Fundamentals & Image Transforms: Digital Image Fundamentals, Sampling and Quantization, Relationship between Pixels. Image Transforms: 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, KL Transform.

**UNIT II**

Image Enhancement (Spatial Domain): Introduction, Image Enhancement in Spatial Domain, Enhancement Through Point Operation, Types of Point Operation, Histogram Manipulation, Linear and Non — Linear Gray Level Transformation, Local or Neighborhood Operation, Median Filter, Spatial Domain High-Pass Filtering. Image Enhancement (Frequency Domain): Filtering in Frequency Domain, Obtaining Frequency Domain Filters from Spatial Filters, Generating Filters Directly in the Frequency Domain, Low Pass (Smoothing) and High Pass (Sharpening) Filters in Frequency Domain.

**UNIT III**

Image Restoration: Image Degradation, Types of Image Blur, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration. Image Denoising: Classification Noise in Image, Median Filtering, Trimmed Average Filter, Performance metrics in Image Restoration.

**UNIT IV**

Image Segmentation: Detection of Discontinuities, Edge Linking And Boundary Detection, Thresholding, Region Oriented Segmentation. Morphological Image Processing: Dilation and Erosion: Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, The Hit or Miss Transformation.

**UNIT V**

Image Compression: Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.

**Text Books:**

1. Digital Image Processing, by Rafael C. Gonzalez and Richard E. Woods, 3rd Edition, Pearson, 2008
2. Digital Image Processing, by S. Jayaraman, S. Esakkirajan and T Veerakumar, TMH, 2010.

**Reference Books:**

1. Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIP Tools, by Scotte Umbaugh, 2nd Edition, CRC Press, 2011

2. Digital Image Processing using MATLAB, by Rafael C. Gonzalez, Richard E Woods and Steven L. Eddings, 2nd Edition, TMH, 2010.
3. Fundamentals of Digital Image Processing, by A. K. Jain, PHI, 1989

## **EMBEDDED SYSTEMS (MIT-2.4.2 B)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

### **UNIT I**

Introduction to embedded systems, classifications, processor in the system, microcontroller, introduction: 8051 architecture, features of 8051, basic assembly language programming concepts, instruction set, data transfer, logical operations, arithmetic operations, jump/call instructions, interrupt handler, addressing modes, an 8051 microcontroller design & testing

### **UNIT II**

Interfacing of Keyboard, displays, ADC/DAC, stepper motor, dc motor; serial communication with PC using RS232, Serial Peripheral Interface (SPI), Inter-Integrated Circuit (I2C), serial communication with other microcontrollers/devices using I2C, SPI, RS232 and USB

### **UNIT III**

Introduction to 16-bit micro-controllers, ATMEGA, PIC and ARM processors: General architecture and their limitations, clocking unit, Real Time Clock and Timers, Reset Circuitry and Watchdog Timer; development tools: ATMEL assembler and simulator, ATMEL AVR studio; robotic control applications

### **UNIT IV**

Basic functions of PLC, advantages over microcontroller, basic architecture, register basics, timer functions, counter function, ladder diagram, overview of PLC systems, I/O modules, power supplies, isolators, programming PLC, Alarm signal generation for a process (e.g. heating, cooling or threshold of a process etc.), direct digital control (DDC) algorithm

### **Unit V**

Operating system services, I/O subsystem, Network operating system, Real Time and embedded system, Need of well tested and debugged Real time operating system (RTOS), Introduction to C/ OS- II.

#### **Text Books:**

1. Embedded Systems: Architecture, programming and Design, by Raj Kamal, TMH New Delhi.
2. 8051 Microcontroller, by Mazidi and Mazidi, Penram Publishers, New Delhi.
3. Microcontrollers: Theory and Applications, by Ajay V. Deshmukh, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
4. Embedded Real time system Programming, by Sriram V. Iyer and Pankaj Gupta, TMH.

#### **Reference Books:**

1. PIC Controllers, by Mike Predko, MGH.
2. Embedded System Design, by F. Vahid & T. Gargivis, John Wiley and Sons.
3. Embedded System Design: An Introduction to Process Tools and Techniques, A. S. Berger, CMP Books.

# **SOFTWARE PROJECT MANAGEMENT (MIT-2.4.3)**

**Full marks – 100 (Mid Semester: 20; End Semester: 80)**

## **UNIT I**

Introduction to Project Management, Project Planning, Project Scope Management, Project Scheduling.

## **UNIT II**

Project Cost Estimate, Project Cost Estimation Models.

## **UNIT III**

Project Quality Management, Quality Management Tools, Project Resource Management, Case Study and Issues Involved.

## **UNIT IV**

Planning and Reporting, Project Communication, Risk Management and Case Study.

## **UNIT V**

Procurement Procedures, Contract Administration, Project Management Process Groups.

### **Text Books:**

1. Information Technology Project Management: Kathy Schwalbe, International Student Edition, Thomson Course Technology, 2003.
2. Software Project Management: Bob Hughes and Mike Cotterell, Third Edition, Tata McGraw-Hill.
3. Basics of Software Project Management: NIIT, Prentice-Hall of India, 2004.
4. Software Project Management in Practice: Pankaj Jalote, Pearson Education, 2002.
5. Software Project Management – A Concise Study: S.A.Kelkar, Revised Edition, Prentice-Hall of India, 2003.

**Project (MITM-2.4.4)**

**Full marks – 300**