

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES,
RAJAMPET
(AN AUTONOMOUS INSTITUTION)**

Affiliated To
**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
ANANTAPUR, ANANTAPUR.**

**ACADAMIC REGULATIONS COURSE STRUCTURE
AND DETAILED SYLLABI**

**MASTER OF TECHNOLOGY
COMPUTER SCIENCE & ENGINEERING**



**M.Tech Regular Two Year P.G. Degree Course
Applicable for students admitted from 2014-15**

ACADEMIC REGULATIONS

Applicable for students admitted into M.Tech. Programme from 2014-15

The Jawaharlal Nehru Technological University Anantapur shall confer M.Tech. Post graduate degree to candidates who are admitted to the Master of Technology Programmes and fulfill all the requirements for the award of the degree.

1. ELIGIBILITY FOR ADMISSIONS:

Admission to the above programme shall be made subject to the eligibility, qualifications and specialization prescribed by the competent authority for each programme, from time to time.

Admissions shall be made either on the basis of merit rank obtained by the qualifying candidates at an Entrance Test conducted by the University or on the basis of GATE/PGECET score, subject to reservations or policies framed by the Government of Andhra Pradesh policies from time to time.

2. ADMISSION PROCEDURE:

As per the existing stipulations of AP State Council for Higher Education (APSCHE), Government of Andhra Pradesh, admissions are made into the first year as follows

- a) Category-A seats are to be filled by Convenor through PGECET/GATE score.
- b) Category-B seats are to be filled by Management as per the norms stipulated by Government of A. P.

3. SPECIALIZATION:

The following specializations are offered at present for the M.Tech. programme.

Sl. No.	Specialization
1.	CAD/CAM
2	Machine Design
2.	Digital Electronics and Communication Systems
3.	Embedded Systems
4.	VLSI System Design
5.	Computer Science and Engineering
6.	Electrical Power Engineering
7.	Electrical Power Systems
8	Structural Engineering

and any other specialization as approved by the concerned authorities from time to time.

4. COURSE WORK:

- 4.1. A Candidate after securing admission must pursue the M. Tech. programme of study for four semesters duration.
- 4.2. Each semester shall be of 20 weeks duration including all examinations.
- 4.3. A candidate admitted in to the programme should complete it within a period equal to twice the prescribed duration of the programme from the date of admission.

5. ATTENDANCE

- 5.1. A candidate shall be deemed to have eligibility to write end semester examinations if he has put in at least 75% of attendance aggregate in all subjects/courses in the semester.
- 5.2. Condonation of shortage of attendance up to 10% i.e., between 65% and above and less than 75% may be granted by the Institute Academic committee.
- 5.3. Shortage of attendance below 65% in aggregate shall in no case be condoned.
- 5.4. Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence.
- 5.5. A stipulated fee shall be payable towards condonation of shortage of attendance to the institute as per following slab system
 - 1st Slab: Less than 75% attendance but equal to or greater than 70% a normal condonation fee can be collected from the student.
 - 2nd Slab: Less than 70% but equal to or greater than 65%, double the condonation fee can be collected from the student.
- 5.6. Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled for that semester.
- 5.7. A student will not be promoted to the next semester unless he satisfies the attendance requirements of the current semester, as applicable.
- 5.8. A student detained due to shortage of attendance, will have to repeat that semester when offered next.

6. CREDIT SYSTEM NORMS:

	Period(s)/week	Credits
Theory	01	01
Practical	03	02
Seminar	01	01
Project	-	16

TABLE 1

7. EVALUATION:

7.1 Distribution of marks

S. No	Examination	Marks	Examination and Evaluation		Scheme of Evaluation
1.	Theory	60	Semester-end examination (External evaluation)		The question paper shall be of descriptive type with 5 questions with internal choice are to be answered in 3hours duration of the examination.
		40	Mid - Examination of 120 Min. duration (Internal evaluation). 4 descriptive type questions with internal choice are to be answered and evaluated for 30 marks, and the reaming 10 marks are to be allotted for 3-5 assignments to be submitted by the student. The assignment marks are to be awarded based on the completeness of the assignment, correctness of the assignment and in-time submission, evaluated for 10 marks and average of the total assignment marks are rounded to the next integer.		Two mid-exams 30 marks each are to be conducted. Better one to be considered. Mid-I: After first spell of instructions (I&II Units). Mid-II: After second spell of instructions (III - V Units).
2	Laboratory	60	Semester-end Lab Examination (External evaluation)		For laboratory courses: 3 hours duration. One External and One Internal examiners.
		40	30	Day to Day evaluation	Performance in laboratory experiments.

S. No	Examination	Marks	Examination and Evaluation		Scheme of Evaluation
				(Internal evaluation)	
			10	Internal evaluation	Practical Tests (one best out of two tests includes viva-voce)
3	Seminar in each of the semesters. 2 hours /week	100	Internal Evaluation 20 Marks for Report 20 Marks for subject content 40 Marks for presentation 20 Marks for Question and Answers		Continuous evaluation during a semester by the Departmental Committee (DC)
4	Project work	Grade A (95%) Grade B (85%)	12 credits	External evaluation	End Project Viva-Voce Examination by Committee as detailed under sect. 9.
			4 credits	Internal evaluation	Continuous evaluation by the DC. as detailed under sect. 9.5

- 7.2 A candidate shall be deemed to have secured the minimum academic requirement in a subject/practical if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.
- 7.3 A candidate has to secure a minimum of 50% to be declared successful.
- 7.4 In case the candidate does not secure the minimum academic requirement in any of the subjects/practical, he has to reappear for the Examination either supplementary or regular in that subject/practical along with the next batch students. A separate supplementary examinations will be conducted for the I semester students at the end of II semester.
- 7.5 **Revaluation / Recounting:** Students shall be permitted to request for recounting/ revaluation of the end theory examination answer scripts within a stipulated period after payment of prescribed fee. After recounting or revaluation, records are updated with changes if any and the student will be issued a revised memorandum of marks.

If there are no changes, the student shall be intimated the same through a letter or a notice.

8. RE-REGISTRATION FOR IMPROVEMENT OF INTERNAL EVALUATION MARKS(for theory subjects only):

- 8.1 Out of the subjects the candidate has failed in the examination due to internal evaluation marks secured being less than 50%, the candidate shall be given one chance for each theory subject and for a maximum of **Three** theory subjects for improvement of internal evaluation marks.
- 8.2 The candidate can re-register for the chosen subjects and fulfill the academic requirements. Re-registration shall not be permitted after the commencement of class work for that semester. The candidate can re-register for 1st semester subjects when he is in his 3rd semester and for 2nd semester subjects when he is in his 4th semester else the candidate can re-register after completion of 2 years course work.
- 8.3 For each subject re-registered, the candidate has to pay a fee equivalent to one third of the semester tuition fee.
- 8.4 In the event of re-registration, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for those subjects stand cancelled.

9. EVALUATION OF PROJECT WORK:

Every candidate shall be required to submit thesis/dissertation after taking up a topic approved by the Departmental Committee.

- 9.1 The Departmental Committee (DC) consisting of HOD, Project supervisor and two internal senior experts shall monitor the progress of the project work. A Project Review Committee (PRC) shall be constituted with Principal as Chair Person, Heads of the departments of the M.Tech Programs and Two other senior faculty members, as members of the PRC. PRC will come into action when the DC is not able to resolve the issues.
- 9.2 Registration of Project work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses (theory, practical and seminar of I & II semesters).
- 9.3 After satisfying 9.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the DC for approval. Only after obtaining the approval of DC, the student can initiate the project work.
- 9.4 The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project

thesis with the approval of DC after 36 weeks from the date of registration at the earliest but not later than one calendar year from the date of registration for the project work. Extension of time within the total permissible limit for completing the programme is to be obtained from the Head of the Institution.

- 9.5 The Internal Evaluation shall be made by the DC to grade, on the basis of two seminars presented by the student on the topic of his project.
- 9.6 The student must submit status report at least in two different phases during the project work period. These reports must be approved by the DC before submission of the Project Report.
- 9.7 A candidate shall be allowed to submit the thesis / dissertation only after passing all the prescribed subjects (theory, practical, seminar and project work internal evaluation).
- 9.8 A candidate has to prepare four copies of the thesis/dissertation certified in the prescribed format by the supervisor and HOD. Out of which three copies shall be submitted in the examination section.
- 9.9 Viva-voce examination shall be conducted by a board consisting of the supervisor, Head of the department and the examiner. The board shall jointly report candidate's work as.
 - A Very Good performance
 - B Moderate Performance
 - C Failure Performance

Head of the Department shall coordinate and make arrangements for the conduct of viva-voce.

If the report of the viva-voce is failure performance, the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination, he will not be eligible for the award of the degree.

10. CREDIT POINT AVERAGE AND CUMULATIVE CREDIT POINT AVERAGE:

10.1. CREDIT POINT AVERAGE (CPA):

$$\text{CPA} = \frac{\sum_i C_i T_i}{10 \sum_i C_i}$$

Where C_i = Credits earned for Course i in any semester/year.

T_i = Total marks obtained for course i in any semester/year.

10.2. CUMULATIVE CREDIT POINT AVERAGE (CCPA):

$$\text{CCPA} = \frac{\sum_n \sum_i C_{ni} T_{ni}}{10 \sum_n \sum_i C_{ni}}$$

Where n refers to the semester in which such courses were credited.
The CCPA is awarded only when a student earns all the credits prescribed for the programme.

10.3. OVERALL PERFORMANCE:

CCPA	Classification of Final Results
7.0 and above	First Class with Distinction
6.0 and above but below 7.0	First Class
5.0 and above but below 6.0	Second Class

11. TRANSCRIPTS:

After successful completion of the entire programme of study, a transcript containing performance of all the academic years will be issued as a final record. Duplicate transcripts will be issued if required, after payment of requisite fee. Partial transcript will also be issued up to any point of study to a student on request.

12. ELIGIBILITY:

A student shall be eligible for the award of M.Tech Degree if he fulfills all the following conditions:

- i. Registered and successfully completed all the components prescribed in the programme of study to which he was admitted.
- ii. Successfully acquired all **72 credits** as specified in the curriculum corresponding to the branch of his study within the stipulated time.
- iii. No disciplinary action is pending against him.

13. AWARD OF DEGREE:

The Degree will be conferred and awarded by Jawaharlal Nehru Technological University Anantapur, Anantapur on the recommendations of the Principal, AITS (Autonomous) based on the eligibility as mentioned in clause 11.

14. WITHHOLDING OF RESULTS:

If the candidate has any dues to the Institute or if any case of in-discipline is pending against him, the result of the candidate shall be withheld and he will not be allowed / promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

15. TRANSITORY REGULATIONS:

Candidates who have discontinued or have been detained for want of attendance or who have failed after having undergone the course in earlier regulations and wish to continue the course are eligible for admission into the unfinished

semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered. Whereas, he continues to be in the academic regulations he was first admitted.

16. AMENDMENTS OF REGULATIONS:

The Chairman, Academic Council of Annamacharya Institute of Technology and Sciences, Rajampet (Autonomous) reserves the right to revise, amend, or change the Regulations, Scheme of Examinations and/or Syllabi or any other policy relevant to the needs of the society or industrial requirements etc., without prior notice.

17. GENERAL:

Where the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

18. Any legal issues are to be resolved in Rajampet Jurisdiction.

Annamacharya Institute of Technology and Sciences, Rajampet.	
Curriculum for the Programmes under Autonomous Scheme	
Regulation	R 2014
Department	Department of Computer Science and Engineering
Programme Code & Name	M.Tech. Computer Science and Engineering

Semester I

Course Code	Course Name	Hours/Week		Credits	Maximum marks		
		L	P		C	Internal	External
4P3111	Advanced Data Mining	4	0	4	40	60	100
4P3112	Advanced data structures and Algorithms	4	0	4	40	60	100
4P3113	Advanced Databases	4	0	4	40	60	100
4P3114	Advanced Computer Architecture	4	0	4	40	60	100
4P3115	Advanced Software Engineering	4	0	4	40	60	100
4P3116	Advanced Computer Networks	4	0	4	40	60	100
4P3117	Seminar – I	0	0	2	100	00	100
4P3118	Software Laboratory-1	0	3	4	40	60	100
Total		24	3	30	800		

Semester II

Course Code	Course Name	Hours/Week		Credits	Maximum marks		
		L	P		C	Internal	External
4P3121	Managing Big Data	4	0	4	40	60	100
4P3122	Open Systems for Web Technologies	4	0	4	40	60	100
4P3123	Software Architecture and Design Patterns	4	0	4	40	60	100
4P3124	Distributed Operating System	4	0	4	40	60	100
	Elective – I	4	0	4	40	60	100
	Elective – II	4	0	4	40	60	100
4P312B	Seminar – II	0	0	2	100	00	100
4P312C	Software Laboratory-2	0	3	4	40	60	100
Total		24	3	30	800		

List of Electives		Course code
Elective – I	Artificial Intelligence and Neural Networks	4P3125
	Grid and Cluster Computing	4P3126
	Cloud Computing	4P3127
Elective – II	Mobile Computing	4P3128
	Information Security	4P3129
	Network Management Systems	4P312A

Semester III & IV

Course Code	Course Name	Credits	Maximum Marks		
		C	Internal	External	Total
4P3131	Project	16	40	60	100

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M.Tech (CSE) I Semester**

(4P3111)ADVANCED DATA MINING

UNIT I

Data mining Overview and Advanced Pattern Mining Data mining tasks – mining frequent patterns, associations and correlations, classification and regression for predictive analysis, cluster analysis , outlier analysis; advanced pattern mining in multilevel, multidimensional space –mining multilevel associations, mining multidimensional associations, mining quantitative association rules, mining rare patterns and negative patterns.

UNIT II

Advance Classification

Classification by back propagation, support vector machines, classification using frequent patterns, other classification methods – genetic algorithms, roughset approach, fuzzy set approach;

UNIT III

Advance Clustering

Density – based methods – DBSCAN, OPTICS, DENCLUE; Grid -Based methods –STING, CLIQUE; Exception –maximization algorithm; clustering High-Dimensional Data; Clustering Graph and Network Data.

UNIT - IV

Web and Text Mining

Introduction, web mining, web content mining, web structure mining, we usage mining, Text mining – unstructured text, episode rule discovery for texts, hierarchy of categories, text clustering.

UNIT - V

Temporal and Spatial Data Mining

Introduction; Temporal Data Mining – Temporal Association Rules, Sequence Mining, GSP algorithm, SPADE, SPIRIT Episode Discovery, Time Series Analysis, Spatial Mining – Spatial Mining Tasks, Spatial Clustering. Data Mining Applications.

TEXT BOOKS:

1. Data Mining Concepts and Techniques, Jiawei Han Micheline Kamber, Jian Pei, Morgan Kaufmann.
2. Data Mining Techniques – Arun K. Pujari, Universities Press.

REFERENCE BOOKS:

1. Introduction to Data Mining – Pang - Ning Tan, Vipin kumar, Michael Steinbach, Pearson.
2. Data Mining Principles & Applications – T.V Sveresh Kumar, B.Esware Reddy, Jagadish S Kalimani, Elsevier.

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M.Tech (CSE) I Semester

(4P3112)ADVANCED DATA STRUCTURES AND ALGORITHMS

UNIT I

C++ Class Overview- Basics of C++, Generic Programming- Function and class templates, Inheritance basics, base and derived classes, inheritance types, base class access control, runtime polymorphism using virtual functions, abstract classes.

Algorithms, performance analysis-time complexity and space complexity, Asymptotic Notations, Amortized analysis. Review of basic data structures- The list ADT, Stack ADT, Queue ADT.

UNIT II

Dictionaries, linear list representation, skip list representation, ADT operations, hash table representation, hash functions, collision resolution-separate chaining, open addressing-linear probing, quadratic probing, double hashing, rehashing, extendible hashing, comparison of hashing and skip lists.

Priority Queues – Definition, ADT, Realizing a Priority Queue using Heaps, Definition, insertion, Deletion.

UNIT III

Search Trees (Part1):- Binary Search Trees, Definition, ADT, Implementation, Operations- Searching, Insertion and Deletion, AVL Trees, Definition, Height of an AVL Tree, Operations – Insertion, Deletion and Searching

Search trees (part II) : B-Trees, B-Tree of order m, height of a B-Tree, insertion, deletion and searching, Comparison of Search Trees
Divide and Conquer: General method, merge sort, quick sort.

UNIT IV

Searching and Traversal techniques: Efficient non recursive tree traversal algorithms, DFS, BFS of Graphs, AND/OR graphs, game tree, Bi-connected components.

Greedy method and: General method, Minimum cost spanning trees, Job sequencing with deadlines,

.

UNIT V

Dynamic programming General method, Optimal binary search trees, 0/1 knapsack problem, Travelling sales person problem

Backtracking: General Method, applications-8-Queens problem, Sum of subsets, graph coloring.

Branch and Bound: General method Applications-Travelling sales person (*),LC Branch and Bound solution, FIFO Branch and Bound Solution

TEXT BOOKS :

1. Data structures, Algorithms and Applications in C++, S.Sahni, University Press (India) Pvt.Ltd, 2nd edition, Universities Press Orient Longman Pvt. Ltd.
2. Data structures and Algorithms in C++, Michael T.Goodrich, R.Tamassia and .Mount, Wiley student edition, John Wiley and Sons.
3. Fundamentals of Computer Algorithms Ellis Horowitz,S.Sahni, Galgotia publications

REFERENCES :

1. Data structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education. Ltd., Second Edition.
2. Data structures and algorithms in C++, 3rd Edition, Adam Drozdek, Thomson
3. Data structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.
4. Problem solving with C++, The OOP, Fourth edition, W.Savitch, Pearson education.

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M.Tech (CSE) I Semester

(4P3113)ADVANCED DATABASES

UNIT I

Introduction. Distributed Data Processing, Distributed Database System, Promises of DDBS, Problem areas. Overview of Relational DBMS: Relational Database Concepts, Normalization, Integrity rules, Relational data languages.

UNIT II

Distributed DBMS Architecture: Architectural Models for Distributed DBMS, DDBS Architecture. Distributed Database Design: Alternative Design Strategies, Distribution Design issues, Fragmentation, Allocation.

UNIT III

Query Processing and decomposition: Query Processing Objectives, Characterization of query processors, layers of query processing, query decomposition, Localization of distributed data.

UNIT IV

Distributed query Optimization: Query optimization, centralized query , optimization, Distributed query optimization algorithms. Transaction Management: Definition, properties of transaction, types of transactions. Distributed concurrency control: Serializability, concurrency control Mechanisms & Algorithms, Time stamped & Optimistic concurrency control Algorithms, Deadlock Management.

UNIT V

Distributed DBMS Reliability: Reliability concepts and Measures, fault-tolerance in Distributed systems, failures in Distributed DBMS, local & Distributed Reliability Protocols, site failures and Network partitioning. Parallel Database Systems: Database Series, Parallel Architecture, Parallel DBMS Techniques, Parallel exception problems, Parallel Execution for Hierarchical architecture.

TextBooks:

1. M.Tamer OZSU and PatuckValduriez: Principles of Distributed Database Systems,PearsonEdn.Asia,2001.
2. StefanoCeriandWillipsePelagatti: Distributed Databases, McGraw Hill.
3. Henry F Korth, A Silberchatz and Sudershan : Database System Concepts, MGH
4. Raghuramakrishnan and JohhanesGehrke: Database Management Systems,MGH

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M.Tech (CSE) I Semester

(4P3114)ADVANCED COMPUTER ARCHITECTURE

UNIT I

Parallel Computer Models: - The state of computing-Multiprocessors and Multi computers- Multivector and SIMD Computers-PRAM and VLSI Models-Architectural Development tracks.

Program and Networks Properties: - Conditions of Parallelism- Program Partitioning and Scheduling- Program Flow Mechanisms-System Interconnect Architectures.

Principles of Scalable Performance: - Performance Metrics and Measures-Parallel Processing Applications-Speedup Performance Laws-Scalability Analysis and Approaches.

UNIT II

Processors and Memory Hierarchy: - Advanced Processor Technology-Superscalar and Vector Processors- Memory Hierarchy Technology.

Bus, Cache and Shared Memory: - Bus Systems-Cache Memory Organizations-Shared-Memory Organizations.

UNIT III

Pipelining and Super Scalar Techniques: - Linear Pipeline Processors-Nonlinear Pipeline Processors-Instruction Pipeline Design-Arithmetic Pipeline Design.

Multiprocessors and Multi computers: -Multiprocessor System Interconnects-Cache Coherence and Synchronization Mechanisms-Three Generations of Multi computers –Message-Passing Mechanisms.

UNIT IV

Multivector and SIMD Computers: - Vector Processing Principles-Multivector Multiprocessors-Compound Vector Processing-SIMD Computer Organizations-The Connection Machine CM-5.

Scalable, Multithreaded, and Dataflow Architectures: - Latency –Hiding Techniques-Principles of Multithreading-Fine-Grain Multicomputers-Scalable and Multithreaded Architectures- Dataflow and Hybrid Architectures.

UNIT V

Instruction Level Parallelism:- Introduction-Basic Design Issues-Problem Definition-Model of a Typical Processor- Operand Forwarding-Reorder Buffer-Register Renaming-Tomasulo's Algorithm- Branch Prediction- Limitations in Exploiting Instruction Level Parallelism-Thread Level Parallelism.

Trends in Parallel Systems: - Brief Overview of Technology-Forms of Parallelism-
Case Studies

TEXT BOOK

1. Advanced Computer Architecture- by Kai Hwang & Jotwani, 2nd Edition, McGraw-Hill Publications.

REFERENCES

1. Advanced Computer Architecture, D.Sima, T.Fountain, P.Kacsuk, Pearson Education.
2. Computer Architecture A quantitative approach 3rd edition john L.Hennessy& David A. Patterson, Morgan Kufmann(An Imprint of Elsevier).
3. Computer Architecture and parallel processing by Hwang and Briggs.

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M.Tech (CSE) I Semester

(4P3115)ADVANCED SOFTWARE ENGINEERING

UNIT I

Software and Software Engineering

The Nature of Software, Software characteristics, The Unique Nature of Web Apps, Software Engineering, The Software Process, Software Engineering Practice, Software Myths.

Software Paradigms: Perspective Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models, Process Technology, Product and Process.

Agile Development: What is Agility? Agility and the Cost of Change, What is an Agile Process? Extreme Programming (XP), Other Agile Process Models, A Tool set for the Agile Process.

UNIT II

Critical Systems: A simple safety-critical system, System dependability, Availability and reliability, Safety, Security. **Critical systems specification:** Risk-driven specification, Safety specification, Security specification Software reliability specification.

Formal Specification: Formal specification in the software process, Sub-system interface specification, Behavioral specification.

Software Reuse: The reuse landscape, Design patterns, Generator-based reuse, Application frameworks, Application system reuse.

UNIT III

Component-based Software Engineering: Components and component models, The CBSE process, Component composition.

Software Testing: System testing, Component testing, Test case design, Test automation.

Software Evolution: Program evolution dynamics, Software maintenance, Evolution Processes, Legacy system evolution.

Aspect oriented software engineering: The separation of concerns, Aspects, Join points and pointcuts, Software engineering with aspect.

UNIT IV

Service oriented software engineering: Service-based concepts, modeling and documentation, Service discovery and composition, Service-oriented architecture, Services as reusable components, Software development with services.

Quality Management

Process and product quality, Quality assurance and standards, Quality Planning, Quality control, Software Measurement and metrics.

UNIT V

Process Improvement

Process and product quality, process classification, Process measurement, Process analysis and modeling, Process change, The CMMI process improvement framework.

Emerging Trends in Software Engineering

Technology Evolution, Observing Software engineering Trends, Identifying “Soft trends”, Technology directions, Tools -Related trends-Tools that respond to soft trends, Tools that address Technology Trends

TEXT BOOKS;

1. Object oriented software engineering by Timothy c. Leth Bridge, Robertlagniere-TATA McGrawhill
2. Object oriented software engineering by Ivar Jacobson
3. Software Engineering Principles By Roger S.PressMan 6th edition.
4. GradyBooch, James Rumbaugh, IvarJacobson : The Unified Modeling
5. Language User Guide, Pearson Education.

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M.Tech (CSE) I Semester

(4P3116)ADVANCED COMPUTER NETWORKS

UNIT I

Review of Computer Networks and the Internet: What is the Internet, The Network edge, The Network core, Access Networks and Physical media, ISPs and Internet Backbones, Delay and Loss in Packet-Switched Networks, History of Computer Networking and the Internet - **Foundation of Networking Protocols:** 5-layer TCP/IP Model, 7-Layer OSI Model, Internet Protocols and Addressing, Equal-Sized Packets Model: ATM

UNIT II

Networking Devices: Multiplexers, Modems and Internet Access Devices, Switching and Routing Devices, Router Structure. **The Link Layer and Local Area Networks:** Link Layer: Introduction and Services, Error-Detection and Error-Correction techniques, Multiple Access Protocols, Link Layer Addressing, Ethernet, Interconnections: Hubs and Switches, PPP: The Point-to-Point Protocol, Link Virtualization

UNIT III

Routing and Internetworking: Network-Layer Routing, Least-Cost-Path algorithms, Non-Least-Cost-Path algorithms, Intradomain Routing Protocols, Interdomain Routing Protocols, Congestion Control at Network Layer. **Logical Addressing:** IPv4 Addresses, IPv6 Addresses - **Internet Protocol:** Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6 – **Multicasting Techniques and Protocols:** Basic Definitions and Techniques, Intradomain Multicast Protocols, Interdomain Multicast Protocols, Node-Level Multicast algorithms

UNIT IV

Transport and End-to-End Protocols: Transport Layer, Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Mobile Transport Protocols, TCP Congestion Control **Application Layer:** Principles of Network Applications, The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, Domain Name System (DNS), P2P File Sharing, Socket Programming with TCP and UDP, Building a Simple Web Server

UNIT V

Wireless Networks and Mobile IP: Infrastructure of Wireless Networks, Wireless LAN Technologies, IEEE 802.11 Wireless Standard, Cellular Networks, Mobile IP, Wireless Mesh Networks (WMNs)

Mobile A-Hoc Networks: Overview of Wireless Ad-Hoc Networks, Routing in Ad-Hoc Networks, Routing Protocols for Ad-Hoc Networks – **Wireless Sensor Networks:** Sensor Networks and Protocol Structures, Communication Energy Model, Clustering Protocols, Routing Protocols

TEXT BOOKS:

1. Computer Networking: A Top-Down Approach Featuring the Internet, *James F. Kurose, Keith W. Ross*, Third Edition, Pearson Education, 2007
2. Computer and Communication Networks, *Nader F. Mir*, Pearson Education, 2007

REFERENCE BOOKS:

1. Data Communications and Networking, *Behrouz A. Forouzan*, Fourth Edition, Tata McGraw Hill, 2007
2. Guide to Networking Essentials, *Greg Tomsho, Ed Tittel, David Johnson*, Fifth Edition, Thomson.
3. An Engineering Approach to Computer Networking, *S. Keshav*, Pearson Education.
4. Campus Network Design Fundamentals, *Diane Teare, Catherine Paquet*, Pearson
5. Education (CISCO Press)
6. Computer Networks, *Andrew S. Tanenbaum*, Fourth Edition, Prentice Hall.
7. The Internet and Its Protocols, *A. Farrel*, Elsevier.

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M.Tech (CSE) IISemester**

(4P3121) MANAGING BIG DATA

UNIT I

UNDERSTANDING BIG DATA

What is big data – why big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data and marketing – fraud and big data – risk and big data – credit risk management – big data and algorithmic trading – big data and healthcare – advertising and big data.

Big data technologies-Introduction to Hadoop – open source technologies – cloud and big data – mobile business, intelligence – Crowd sourcing analytics – inter and trans firewall analytics

UNIT II

NOSQL DATA MANAGEMENT

Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – sharding – master-slave replication – peer-peer replication – sharding and replication – consistency – relaxing consistency – version stamps – mapreduce – partitioning and combining – composing map-reduce calculations

UNIT III

BASICS OF HADOOP

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures

UNIT IV

MAPREDUCE APPLICATIONS

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats

UNIT V

HADOOP RELATED TOOLS

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Cassandra – cassandra data model – cassandra examples – cassandra clients –Hadoop integration. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

TEXT BOOKS:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics:Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley,2013.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
4. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
5. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
6. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
7. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley 2010.

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(4P3122) OPEN SYSTEMS FOR WEBTECHNOLOGIES

UNIT I

JDBC: Introduction to JDBC, JDBC architecture, JDBC drivers, java.sqlPackage ,Connection, Statement, ResultSet, Prepared Statement, Callable Statement, Scrollable and Updatable ResultSet, Batch Updates, ResultSet Metadata, Simple Transaction Management

UNIT II

Servlets 3.0: Need of Server side Programming, Introduction to Servlets, Servlet Life Cycle, javax.servlet package, ServletConfig, ServletContext, ServletResponse, Supplying initialization parameters to Servlets, ,Include and forward mechanisms ,javax.servlet.http Package ,Http request methods GET vsPOST, HttpServletRequest, HttpServletResponse, Dealing with Http headers & error codes, Session Tracking, purpose ,Hidden form fields, Cookies, Http Session, URL rewriting, Event listeners, Performing database operations in Servlets ,Web application security.

UNIT III

JSP: Disadvantages of Servlets, Introduction to JSP, JSP Life Cycle, Creating dynamic Web content with JSP, Scripting elements, Scriptlet, Declaration, Expression, JSP directives page, include and taglib, JSP implicit objects ,JSPscopes, Include and forward mechanism, Using a Java bean in a jsp, JSP (MVC) architecture, XML syntax for JSP elements, Custom Tag Development, Classic Tags, Simple Tags, Error Handling in a jsp, JSTL.

UNIT IV

Struts Framework-I: Introduction to Struts Framework, Building a Simple Struts Application, The Model Layer, The View Layer, The Controlled Layer.

UNIT V

Struts Framework-II: Validator, Tiles, Declarative Exception Handling, Introduction to struts tag libraries-HTML, Bean, Logic, JSTL tag libraries.

TEXT BOOK:

1. J2EE: The Complete Reference , [James Keogh](#), McGraw-Hill Osborne edia
2. Struts: The Complete Reference, 2nd Edition ,James Holmes, McGraw-Hill Osborne Media

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(4P3123) SOFTWARE ARCHITECTURE AND DESIGN PATTERNS

UNIT I

Introduction: Architectural to Software Design Patterns, What Is a Design Pattern? More about Design Patterns, design patterns to solve design problems, selecting a design pattern, Use of a design pattern

BASIC PATTERNS: Interface, Abstract Parent Class, Private Methods, Accessor Methods, Constant Data Manager, Immutable Object, Monitor

UNIT II

CREATIONAL PATTERNS: Factory Method, Singleton, Abstract Factory, Prototype, Builder.

COLLECTIONAL PATTERNS: Composite, Iterator, Flyweight, Visitor

UNIT III

STRUCTURAL PATTERNS: Decorator, Adapter, Chain of Responsibility, Facade, Proxy, Bridge, Virtual Proxy, Counting Proxy, Aggregate Enforcer, Explicit Object Release, Object Cache

UNIT IV

BEHAVIORAL PATTERNS-1: Command, Mediator, Memento, Observer, Interpreter, State, Strategy, Null Object.

BEHAVIORAL PATTERNS-2: Template Method, Object Authenticator, Common Attribute Registry

UNIT V

CONCURRENCY PATTERNS: Critical Section, Consistent Lock Order, Guarded Suspension, Read-Write Lock

Text Books:

1. Software Architecture Design Patterns in Java, ParthaKuchana
2. Design Patterns: Elements of Reusable Object-Oriented Software, Erich Gamma, Richard Helm et al, PEA

REFERENCE BOOKS:

1. Beyond Software architecture, Luke Hohmann, Addison wesley, 2003.
2. Software architecture, David M. Dikel, David Kane and James R. Wilson, Prentice Hall PTR,2001

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(4P3124) DISTRIBUTED OPERATING SYSTEM

UNIT I

Introduction to Distributed Systems: Distributed systems: Goals Hardware Concepts Software – design

Communication distributed systems: Layered Protocol: ATM Networks, Client Server Model - Remote Procedure Call – Group Communication.

UNIT II

Synchronization: Clock synchronization - mutual exclusion - dead locks.

Process and Processors: Threads - System models processor allocation - scheduling fault tolerance - real time distributed systems.

UNIT III

Distributed file systems: File system design and implementation - trends in distributed file systems.

UNIT IV

Shared Memory: Introduction - bus based multi processors ring based multiprocessors switched multiprocessors - NUMA comparison of shared memory systems.

UNIT V

Consistency models - page based distributed shared memory - shared variable-distributed shared memory - object based distributed shared memory.

Case study: Mach

Text Book:

1. Andrew S.Tanenbaum: Distributed Operating System, Prentice Hall International Inc.

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**(4P3125) ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS
(ELECTIVE-I)**

UNIT I

Introduction : AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

Searching :Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Greedy best first search, A* search.

UNIT II

Adversial search, Games, minimax-algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions, cutting of search.

Knowledge Representation & Reasons logical Agents, Knowledge – Based Agents, the Wumpus World, logic, propositional logic, Resolution patterns in propositional logic, Resolution, Forward & Backward Chaining.

UNIT III

Characteristics of Neural Networks, Historical Development of Neural Networks Principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws, Pattern Recognition Problem, Basic Functional Units, Pattern Recognition Tasks by the Functional Units.

UNIT IV

Feed forward Neural Networks:

Introduction, Analysis of pattern Association Networks, Analysis of Pattern Classification Networks, Analysis of pattern storage Networks. Analysis of Pattern Mapping Networks.

Feedback Neural Networks

Introduction, Analysis of Linear Auto associative FF Networks, Analysis of Pattern Storage Networks.

UNIT V

Competitive Learning Neural Networks & Complex pattern Recognition

Introduction, Analysis of Pattern Clustering Networks, Analysis of Feature Mapping Networks, Associative Memory.

TEXT BOOKS:

1. Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, Peter Norvig, PHI/ Pearson Education.
2. Artificial Neural Networks B. YagnaNarayana, PHI

REFERENCES :

1. Artificial Intelligence, 2nd Edition, E.Rich and K.Knight (TMH).
2. Artificial Intelligence and Expert Systems – Patterson PHI.
3. Expert Systems: Principles and Programming- Fourth Edn, Giarrantana/ Riley, Thomson.
4. PROLOG Programming for Artificial Intelligence. Ivan Bratka- Third Edition – Pearson Education.
5. Neural Networks Simon Haykin PHI
6. Artificial Intelligence, 3rd Edition, Patrick Henry Winston., Pearson Edition.

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**(4P3126) GRID AND CLUSTER COMPUTING
(ELECTIVE-1)**

UNIT I

Grid Computing: Data & Computational Grids, Grid Architectures and its relations to various Distributed Technologies

Autonomic Computing: Autonomic Computing, Examples of the Grid Computing Efforts (IBM)

UNIT II

Cluster Computing 1: Cluster setup & its Administration, Performance Models & Simulations, Networking, Protocols & I/O, Lightweight Messaging systems, Active Messages, Distributed shared memory, parallel I/O Clusters, Jib and Resource management system, scheduling parallel jobs on clusters

UNIT III

Cluster Computing 3: Load sharing and Fault tolerance manager, parallel programming scheduling techniques, Dynamic load balancing Example Cluster System, Beowlf, COMPaS and NanOS

UNIT IV

Pervasive Computing: Pervasive Computing concepts & Scenarios, Hardware & Software, Human - machine interface Device connectivity, Java for Pervasive devices, Application examples

UNIT V

Cloud Computing: History, Working of cloud computers, pros and cons of cloud computing, developing cloud services, cloud computer web based applications

Quantum Computing: Introduction to Quantum Computing, QUbits, Quantum Mechanics, Quantum gates, Applications of quantum computing.

TEXT BOOKS:

1. Grid Computing, J. Joseph & C. Fellenstein, PEA.
2. High performance cluster computing, Raj Kumar Buyya, PEA.
3. Pervasive computing, J.Burkhardt et al, PEA.
4. Quantum computing, Vishal Sahni, TMH.

REFERENCE BOOKS:

1. Approaching quantum computing, Marivesar, PEA.
2. Quantum computing and Quantum Information, Neilsen & Chung L, Cambridge University Press.
3. A Networking approach to Grid Computing, Minoli, Wiley.

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**(4P3127)CLOUD COMPUTING
(ELECTIVE-1)**

UNIT I

Introduction to Virtualization: Objectives of virtualization, history of virtualization, benefits of virtualized technology, the virtual service desk, what can be virtualized, related forms of computing, cloud computing, software as a service – SaaS, grid computing, utility computing, virtualization processes.

Virtualization Technologies-I: ubuntu (server edition), altiris, windows, server, software virtualization, vmware, intel virtualization, red hat virtualization, softgrid application, Linux virtualization.

UNIT II

Virtualization Technologies-II: Desktop, virtualization, hardware virtualization, resource virtualization, processor virtualization, application virtualization Storage virtualization, virtualization density, para-virtualization, OS virtualization, virtualization software, data storage virtualization, Intel virtualization technology, thinstall virtualization suite, net framework virtualization, windows virtualization on fedora, storage virtualization technologies, virtualization level, security monitoring and virtualization, oracle virtualization.

UNIT III

Virtualization and Storage Management: The heart of cloud computing - virtualization, defining virtualization, why virtualize, what can be virtualized, where does virtualization happen, how does virtualization happen, on the road to storage virtualization, improving availability using virtualization, improving performance through virtualization, improving capacity through virtualization, business value for virtualization.

UNIT IV

Introduction to Cloud Computing: Cloud Introduction and overview- Components, Infrastructure and Services, Why Use Cloud Computing, Benefits and Limitations, Cloud Application Architectures, Cloud Infrastructure Models, Cloud Computing Technology- Hardware & Software Infrastructure Cloud Computing Architecture: Requirements, Introduction to Cloud Computing Architecture, various kinds of Cloud Computing Architecture, Grid Computing, Transactional Computing, On Demand Computing, and Distributed Computing.

UNIT V

Security: Security issues in Cloud Computing - Data Security, Network Security, and Host Security.

Disaster Recovery: Disaster Recovery Planning, Disasters in the Cloud, Disaster Management. Scaling a Cloud Infrastructure- Capacity Planning, Cloud Scale.

Case Studies: Amazon S3, Google APP Engine, IBM Clouds, Oracle OBIEE

TEXT BOOKS:

1. Cloud Computing Virtualization Specialist Complete Certification Kit - Study Guide Book, Ivanka Menken, Gerard Blokdijk, 2009.
2. Cloud Application Architectures Building Applications and Infrastructure in the Cloud, George Reese, O'Reilly Media Press, 2009.

REFERENCE BOOKS:

1. Cloud Computing: A Practical Approach, Anthony T.Velte, TobeJ.Velte, Robert Elsenpeter, Publication Person Education, 2009
2. Storage Virtualization: Technologies for Simplifying Data Storage and Management, Tom Clark, Addison-Wesley, 2005
3. Cloud Computing Technologies and Strategies of the Ubiquitous Data Center, Curtis Franklin Jr. Brian J.S. Chee, 2010
4. Introduction to Cloud Computing: Business & Technology, Timothy Chou, 2009

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**(4P3128)MOBILE COMPUTING
(ELECTIVE – II)**

UNIT I

INTRODUCTION TO MOBILE COMMUNICATIONS AND COMPUTING: Mobile Computing (MC): Introduction to MC, Novel applications, limitations and architecture.

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

UNIT II

(WIRELESS) MEDIUM ACCESS CONTROL: Motivation of a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA.

MOBILE NETWORK LAYER: Mobile IP (Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP).

UNIT III

MOBILE TRANSPORT LAYER: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/time-out freezing, Selective retransmission, Transaction oriented TCP.

DATABASE ISSUES: Hoarding techniques, caching invalidation mechanisms, client server computing with adaption, power-aware and context-aware computing, transactional models, query processing, recovery and quality of service issues.

UNIT IV

DATA DISSEMINATION: Communications asymmetry, classification of new data delivery mechanisms, push-based mechanisms, pull-based mechanisms, hybrid mechanisms, selective tuning (indexing) techniques

MOBILE ADHOC NETWORKS (MANETs): Overview, Properties of a MANET, MANET routing algorithms, security in MANETs.

UNIT V

PROTOCOLS AND TOOLS: Wireless Application Protocol-WAP, (Introduction, protocol architecture and treatment of protocols of all layers), Bluetooth (User scenarios, physical layer, MAC layer, networking, security, link management) and J2ME.

TEXT BOOKS:

1. Jochen Schiller, "Mobile Communications", Addison-Wesley. (Chapters 4, 7, 9, 10, 11), second edition, 2004.
2. Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002, ISBN 0471419028. (Chapters 11, 15, 17, 26 and 27)

REFERENCE BOOKS:

1. Reza Behravanfar, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", ISBN: 0521817331, Cambridge University Press, October 2004,
2. Adelstein, Frank, Gupta, Sandeep KS, Richard III, Golden, Schwiebert, Loren, "Fundamentals of Mobile and Pervasive Computing", ISBN: 0071412379, McGraw-Hill Professional, 2005.
3. Hansmann, Merk, Nicklous, Stober, "Principles of Mobile Computing", Springer, second edition, 2003.
4. Martyn Mallick, "Mobile and Wireless Design Essentials", Wiley DreamTech, 2003

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**(4P3129) INFORMATION SECURITY
(ELECTIVE-II)**

UNIT I

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs. Buffer overflow & format string vulnerabilities,

UNIT II

Conventional Encryption Principles, Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, key distribution. Approaches of Message Authentication, Secure Hash Functions and HMAC. Introduction to number theory concepts: Prime Numbers, Euler's theorem, Discrete Logarithms. Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management

UNIT III:

Kerberos, X.509 Directory Authentication Service. Email privacy: Pretty Good Privacy (PGP) and S/MIME.

UNIT IV:

IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET).

UNIT V:

Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3. Intruders, Viruses and related threats. Firewall Design principles, Trusted Systems. Intrusion Detection Systems.

TEXT BOOKS:

1. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education.

Reference Books :

1. Fundamentals of Network Security by Eric Maiwald (Dreamtech press)
2. Network Security - Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Pearson/PHI.
3. Principles of Information Security, Whitman, Thomson.
4. Cryptography and network Security, Third edition, Stallings, PHI/Pearson
5. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH
6. Introduction to Cryptography, Buchmann, Springer.

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**(4P312A) NETWORK MANAGEMENT SYSTEMS
((ELECTIVE – II)**

UNIT I

DATA COMMUNICATIONS AND NETWORK MANAGEMENT

OVERVIEW: Analogy of Telephone Network Management, Communications protocols and Standards, Case Histories of Networking and Management, Challenges of Information Technology Managers, Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network Management.

UNIT II

SNMPV1 NETWORK MANAGEMENT: Organization and Information and Information Models. Communication and Functional Models.

Managed network -The History of SNMP Management, The SNMP Model, The Organization Model, The Information Model. Communication and Functional Models. The SNMP Communication Model, Functional model.

UNIT III

SNMP MANAGEMENT: SNMPv2: Major Changes in SNMPv2, SNMPv2 System Architecture, SNMPv2 Structure of Management Information, SNMPv2 Protocol,

RMON: What is Remote Monitoring? , RMON SMI and MIB, RMON1, RMON2, ATM Remote Monitoring,

UNIT IV

TELECOMMUNICATIONS MANAGEMENT NETWORK: Why TMN?, Operations Systems, TMN Conceptual Model, TMN Standards, TMN Architecture, TMN Management Service Architecture, An Integrated View of TMN, Implementation Issues.

UNIT V

WEB-BASED MANAGEMENT: NMS with Web Interface and Web-Based Management, Web Interface to SNMP Management, Web-Based Enterprise Management, WBEM: Windows Management Instrumentation.

TEXT BOOK:

1. Mani Subrahmanian, *Network Management- Principles and Practice*. Pearson Education.

REFERENCE BOOKS:

1. Morris, *Network management*. Pearson Education.
2. Mark Burges, *Principles of Network System Administration*. Wiley Dreamtech.
3. Paul, *Distributed Network Management*. John Wiley.