SRI VENKATESWARA COLLEGE OF ENGINEERING

An Autonomous Institution,

Affiliated to Anna University, Chennai

SRIPERUMBUDUR TK - 602 117

REGULATIONS 2018

M.E COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System

Curriculum and Syllabus

REGULATION – 2018

ME Computer Science and Engineering

Choice Based Credit System

I-IV Semesters CURRICULUM

SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Pre requisites	Fixed/Movable
THEORY										
1.	MA18185	Applied Probability and Statistics (Common to CP & NW)	PC	4	3	1	0	4	-	Fixed
2.	CP18101	Advanced Data Structures and Algorithms (Common to CP & NW)	PC	4	3	1	0	4	-	Fixed
3.	CP18102	Advanced Computer Architecture (Common to CP & NW)	PC	3	3	0	0	3	-	Fixed
4.	CP18103	Operating System Internals	PC	3	3	0	0	3	-	Fixed
5.	CP18104	Advanced Software Engineering (Common to CP & NW)	PC	3	3	0	0	3	-	Fixed
6.	CP18105	Machine Learning Techniques (Common to CP & NW)	PC	3	3	0	0	3	-	Fixed
PRACTICAL										
7.	CP18111	Advanced Data Structures Laboratory	PC	4	0	0	4	2	-	Fixed
8.	CP18112	Advanced Operating System Laboratory	PC	4	0	0	4	2	-	Fixed
TOTAL				**28**	**18**	**2**	**8**	**24**	-	-

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Pre requisites	Fixed/Movable
THEORY										
1.	CP18201	Network Design and Technologies	PC	3	3	0	0	3	-	Fixed
2.	CP18202	Security Practices	PC	3	3	0	0	3	-	Fixed
3.	CP18203	Advanced Internet of Things	PC	3	3	0	0	3	-	Fixed
4.	CP18204	Big Data Analytics	PC	3	3	0	0	3	-	Fixed
5.		Professional Elective – I	PE	3	3	0	0	3	-	Fixed
6.		Professional Elective – II	PE	3	3	0	0	3	-	Fixed
7.	MC18081	Introduction to Research Methodology and IPR	MC	2	2	0	0	2	-	Fixed
PRACTICAL										
7.	CP18211	Data Analytics Laboratory	PC	4	0	0	4	2	-	Fixed
8.	CP18212	Industrial Visit and Technical Seminar	EEC	4	0	0	4	2	-	Fixed
TOTAL				**28**	**20**	**0**	**8**	**24**	-	-

SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Pre requisites	Fixed/Movable
THEORY										
1.		Professional Elective - III	PE	3	3	0	0	3	-	Fixed
2.		Professional Elective - IV	PE	3	3	0	0	3	-	Fixed
3.		Professional Elective - V	PE	3	3	0	0	3	-	Fixed
PRACTICAL										
4.	CP18311	Project Work – Phase I	EEC	12	0	0	12	6	-	Fixed
TOTAL				**21**	**9**	**0**	**12**	**15**	-	-

SEMESTER IV

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Pre requisites	Fixed/Movable
PRACTICAL										
1.	CP18411	Project Work – Phase II	EEC	24	0	0	24	12	-	Fixed
TOTAL				**24**	**0**	**0**	**24**	**12**	**-**	**-**

Professional Elective – I

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Pre requisites	Fixed/Movable
THEORY										
1.	CP18001	Advanced Databases	PE	3	3	0	0	3	-	Fixed
2.	CP18002	Mobile and Pervasive Computing (Common to CP & NW)	PE	3	3	0	0	3	-	Fixed
3.	CP18003	Image Processing and Analysis	PE	3	3	0	0	3	-	Fixed
4.	CP18004	Web Engineering	PE	3	3	0	0	3	-	Fixed
5.	CP18005	Software Architectures and Design	PE	3	3	0	0	3	-	Fixed
6.	CP18006	Data Communication and Networks	PE	3	3	0	0	3	-	Fixed

Professional Elective – II

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Pre requisites	Fixed/Movable
THEORY										
1.	CP18007	Real Time Systems	PE	3	3	0	0	3	-	Fixed
2.	CP18008	Information Storage Management	PE	3	3	0	0	3	-	Fixed
3.	CP18009	Parallel Programming Paradigms	PE	3	3	0	0	3	-	Fixed
4.	CP18010	Reconfigurable Computing	PE	3	3	0	0	3	-	Fixed

5.	CP18011	Cloud Computing Technologies (Common to CP & NW)	PE	3	3	0	0	3	-	Fixed

Professional Elective – III

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed/Movable
THEORY										
1.	CP18012	Embedded Software Development	PE	3	3	0	0	3	-	Fixed
2.	CP18013	Language Technologies	PE	3	3	0	0	3	-	Fixed
3.	CP18014	Computer Vision	PE	3	3	0	0	3	-	Fixed
4.	CP18015	Speech Processing and Synthesis	PE	3	3	0	0	3	-	Fixed
5.	CP18016	Social Network Analysis	PE	3	3	0	0	3	-	Fixed

Professional Elective – IV

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed/Movable
THEORY										
1.	CP18017	Formal models of software systems	PE	3	3	0	0	3	-	Fixed
2.	CP18018	Network Performance Analysis	PE	3	3	0	0	3	-	Fixed
3.	CP18019	Software Quality Assurance and Testing	PE	3	3	0	0	3	-	Fixed
4.	CP18020	Bio-inspired Computing	PE	3	3	0	0	3	-	Fixed
5.	CP18021	Bio Informatics	PE	3	3	0	0	3	-	Fixed

Professional Elective – V

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C	Prerequisites	Fixed/Movable
THEORY										
1.	CP18022	Data Visualization Techniques	PE	3	3	0	0	3	-	Fixed
2.	CP18023	Next Generation Networks	PE	3	3	0	0	3	-	Fixed
3.	CP18024	High Speed Switching Architectures (Common to CP & NW)	PE	3	3	0	0	3	-	Fixed
4.	CP18025	Software Defined Networks	PE	3	3	0	0	3	-	Fixed
5.	CP18026	Multimedia Communication Network	PE	3	3	0	0	3	-	Fixed

MA18185	APPLIED PROBABILITY AND STATISTICS (Common to CP & NW)	L	T	P	C
		3	1	0	4

OBJECTIVES

- To introduce the basic concepts of one dimensional and two dimensional Random Variables.
- To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution and principle components analysis.

UNIT I ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT III ESTIMATION THEORY 12

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT IV TESTING OF HYPOTHESES 12

Sampling distributions - Type I and Type II errors - Tests based on Normal, t,2 and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT V MULTIVARIATE ANALYSIS 12

Random Vectors and Matrices - Mean vectors and Covariance matrices – Multivariate Normal density and its properties - Principal components Population principal components - Principal components from standardized variables.

TOTAL (L:45 + T:15): 60 PERIODS

OUTCOMES:

The student will able to acquire the basic concepts of Probability and Statistical techniques for solving mathematical problems which will be useful in solving Engineering problems

REFERENCES:

1. Jay L. Devore, “Probability and Statistics For Engineering and the Sciences”, Thomson and Duxbury, 2002.
2. Richard Johnson. ”Miller & Freund’s Probability and Statistics for Engineer”, Prentice Hall, Seventh Edition, 2007.
3. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, Fifth Edition, 2002.
4. Gupta S.C. and Kapoor V.K. “Fundamentals of Mathematical Statistics”, Sultan and Sons, 2001.
5. Dallas E Johnson, “Applied Multivariate Methods for Data Analysis”, Thomson and Duxbury press, 1998.

CP18101	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	1	0	4

(Common to CP & NW)

OBJECTIVES

- To understand the usage of algorithms in computing.
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications.
- To select and design data structures and algorithms that is appropriate for problems.
- To study about NP Completeness of problems.

UNIT I ROLE OF ALGORITHMS IN COMPUTING **9+3**

Algorithms – Algorithms as a Technology- Insertion Sort – Analyzing Algorithms – Designing Algorithms- Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions- Recurrences: The Substitution Method – The Recursion-Tree Method

UNIT II HIERARCHICAL DATA STRUCTURES **9+3**

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B-trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.

UNIT III GRAPHS **9+3**

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra‘s Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm;

UNIT IV ALGORITHM DESIGN TECHNIQUES **9+3**

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy- Huffman Codes.

UNIT V NP COMPLETE AND NP HARD **9+3**

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducability – NP-Completeness Proofs – NP-Complete Problems

TOTAL (L:45 + T:15): 60 PERIODS

OUTCOMES:

Upon the completion of the course the students should be able to:

- Design data structures and algorithms to solve computing problems
- Design algorithms using graph structure and various string matching algorithms to solve real-life problems
- Apply suitable design strategy for problem solving

TEXT BOOKS:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, ―Data Structures and Algorithms‖, Pearson Education, Reprint 2006.
2. Robert Sedgewick and Kevin Wayne, ―ALGORITHMS‖, Fourth Edition, Pearson Education.

REFERENCES:

1. S. Sridhar, Design and Analysis of Algorithms‖, First Edition, Oxford University Press. 2014
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms‖, Third Edition, Prentice-Hall, 2011.
3. Steven S. Skiena, "The Algorithm Design Manual", Springer, 2008.
4. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms", Cambridge University Press, 1995.
5. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, "The Design and Analysis of Computer Algorithms**",** Addison-Wesley, 1975.

CP18102	ADVANCED COMPUTER ARCHITECTURE (Common to CP & NW)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
- To learn the different multiprocessor issues.
- To expose the different types of multicore architectures.
- To understand the design of the memory hierarchy.

UNIT I FUNDAMENTALS OF COMPUTER DESIGN AND ILP 9

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP – Multithreading

UNIT II MEMORY HIERARCHY DESIGN 9

Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

UNIT III MULTIPROCESSOR ISSUES 9

Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks

UNIT IV WAREHOUSE SCALE COMPUTERS 9

Introduction to Warehouse-scale computers- Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study- Google Warehouse-Scale Computer.

UNIT V VECTOR, SIMD AND GPU ARCHITECTURES 9

Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism- Case Studies.

TOTAL (L:45): 45 PERIODS

Upon completion of this course, the students should be able to:

- Identify the limitations of ILP.
- Discuss the issues related to multiprocessing and suggest solutions
- Point out the salient features of different multicore architectures and how they exploit parallelism.
- Design hierarchal memory system
- Point out how data level parallelism is exploited in architectures

TEXT BOOK

1. John L. Hennessey and David A. Patterson, ―Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier, 5th edition, 2012.

REFERENCES :

1. Darryl Gove, Multicore Application Programming: For Windows, Linux, and Oracle Solaris‖, Pearson, 2011
2. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors‖, Morgan Kauffman, 2010
3. David E. Culler, Jaswinder Pal Singh, ―Parallel computing architecture : A hardware/software approach‖ , Morgan Kaufmann /Elsevier Publishers, 1999

CP18103 OPERATING SYSTEM INTERNALS

L	T	P	C
3	0	0	3

OBJECTIVES :

- To be able to read and understand sample open source programs and header files.
- To learn about the process management in Unix/linux
- To learn about the Unix/Linux file system Implementation.
- To study Linux memory management data structures and algorithms.
- To acquire the knowledge in implementation of interprocess communication.

UNIT I INTRODUCTION TO OPERATING SYSTEM 9

Overview of Operating System – Unix Basics– System Structure- File System -Files - Links - Types - inodes- Access Rights - System Calls - Overview of Unix Kernels -Model - Implementation –- Address Space - Synchronization - Interprocess Communication - Process Management - Memory Management - Device Drivers.

UNIT II OPERATING SYSTEM PROCESSES 9

Processes, Lightweight Processes, and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes – System Calls - Fork(),Vfork()getpid(),getppid() - Changing the size of the process-Brk() - Destroying Processes - Termination –The SHELL.

UNIT III FILE SYSTEM IMPLEMENTATION 9

The Virtual File System (VFS) - Role - File Model -System Calls - Data Structures - Super Block, Inode, Path Name Conversion to Inode, File, dentry Objects - dentry Cache –Structure of Regular Files- Files Associated with a Process - Filesystem Types - Special File systems – File system Type Registration - Filesystem Handling - Namespaces – Mounting - Unmounting - Data Structures Associated with File System and Process.

UNIT IV MEMORY MANAGEMENT 9

Page frame management -page descriptors - non-uniform memory access - memory zones - reserved page frames - zoned page frame allocator - kernel mappings - buddy system algorithm –Demand Paging-Data structures- Fork in a Paging System.

UNIT V INTERPROCESS PROCESS COMMUNICATION 9

Inter Process Communication –Message Passing Mechanisms-Pipes -Usage - Data Structures - Creating and Destroying a Pipe - Reading from and Writing into a Pipe. Program Execution - Executable Files – Process Credentials – Message Queue-Structure-Sending and Receiving messages- Shared Memory- Structure - shared memory usage - Program Segments and Process Memory Regions - Execution tracing - Executable Formats - Execution Domains.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- To understand the functionality of a large software system
- To understand and improve any algorithm present in operating system.
- To develop a new memory management algorithm
- Able to develop a data structures for Unix/linux kernel based operations
- Understand the message passing mechanism

TEXT BOOK:

1. Daniel P. Bovet and Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O'Reilly Publications, 2005.

REFERENCES:

1. Harold Abelson, Gerald Jay Sussman and Julie Sussman, ―Structure and Interpretation of Computer Programs‖, Second Edition, Universities Press, 2013.
2. Maurice J. Bach, ―The Design of the Unix Operating System‖ 1st Edition Pearson Education, 2003.
3. Michael Beck, Harald Bohme, Mirko Dziadzka, Ulrich Kunitz, Robert Magnus, Dirk Verworner, ―Linux Kernel Internals‖, 2nd Edition, Addison-Wesley, 1998.
4. Robert Love, ―Linux Kernel Development‖, 3rd Edition, Addison-Wesley, 2010.

CP18104	ADVANCED SOFTWARE ENGINEERING (Common to CP & NW)	L	T	P	C
		3	0	0	3

OBJECTIVES

- To have a clear understanding of Software Engineering concepts.
- To gain knowledge of the Analysis and System Design concepts.
- To learn how to manage change during development.
- To learn the SOA and AOP concepts.

UNIT I INTRODUCTION **9**

System Concepts–Software Engineering Concepts-Software Life Cycle–Development Activities–Managing Software Development–Unified Modelling Language–Project Organization–Communication

UNIT II ANALYSIS **9**

Requirements Elicitation–Use Cases–Unified Modelling Language, Tools–Analysis Object Model (Domain Model)–Analysis Dynamic Models–Non-functional requirements–Analysis Patterns.

UNIT III SYSTEM DESIGN **9**

Overview of System Design–Decomposing the system – System Design Concepts–System Design Activities–Addressing Design Goals–Managing System Design.

UNIT IV IMPLEMENTATION AND MANAGING CHANGE **9**

Programming languages and coding-Human computer interaction-Reusing Pattern Solutions–Specifying Interfaces–Mapping Models to Code–Testing- Rationale Management–Configuration Management–Project Management- Real time interface design (eg: mobile design)

UNIT V ASPECT ORIENTED SOFTWARE DEVELOPMENT **9**

AO Design Principles-Separations of Concerns, Subject Oriented Decomposition, Traits, Aspect Oriented Decomposition, Theme Approach, Designing Base and Crosscutting Themes, Aspect-Oriented Programming using Aspect-J.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

- A clear understanding of Software Engineering concepts.
- Knowledge gained of Analysis and System Design concepts.
- Ability to manage change during development.
- Basic idea of the SOA and AOP concepts.

TEXT BOOKS:

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd ed, Pearson Education, 2004.
2. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.

REFERENCES:

1. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.
2. AspectJ in Action, RamnivasLaddad, Manning Publications, 2003
3. Aspect-Oriented Software Development, Robert E. Filman, TzillaElrad, Siobhan Clarke, and Mehmet Aksit, October 2006.
4. Mastering AspectJ: Aspect-Oriented Programming in Java, Joseph D. Gradecki and Nicholas Lesiecki, March 2003

CP18105	MACHINE LEARNING TECHNIQUES (Common to CP & NW)	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques.
- To study the various probability based learning techniques.
- To understand graphical models of machine learning algorithms.

UNIT I INTRODUCTION **9**

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

UNIT II LINEAR MODELS **9**

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

UNIT III TREE AND PROBABILISTIC MODELS **9**

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map

UNIT IV DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS **9**

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process

UNIT V GRAPHICAL MODELS **9**

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

TOTAL: 45PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the apt machine learning strategy for any given problem
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification efficiency

TEXT BOOK

1. Ethem Alpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)", Third Edition, MIT Press, 2014

REFERENCES:

1. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", First Edition, Wiley, 2014
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
3. Stephen Marsland,"Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall, CRC Machine Learning and Pattern Recognition Series, 2014.
4. Tom M Mitchell, "Machine Learning", First Edition, McGraw Hill Education, 2013.

CP18111 ADVANCED DATA STRUCTURES LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To acquire the knowledge of using advanced tree structures.
- To learn the usage of heap structures.
- To understand the usage of graph structures and spanning trees.

LIST OF EXPERIMENTS

1. Implementation of Merge Sort and Quick Sort-Analysis
2. Implementation of a Binary Search Tree
3. Red-Black Tree Implementation
4. Heap Implementation
5. Fibonacci Heap Implementation
6. Graph Traversals
7. Spanning Tree Implementation
8. Shortest Path Algorithms (Dijkstra's algorithm, Bellmann Ford Algorithm)
9. Implementation of Matrix Chain Multiplication
10. Activity Selection and Huffman Coding Implementation.

TOTAL: 60 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Design and implement basic and advanced data structures extensively.
- Design algorithms using graph structures
- Design and develop efficient algorithms with minimum complexity using design techniques.

CP18112 ADVANCED OPERATING SYSTEM LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

The student should be made to:

- To learn the fundamentals and shell programming in UNIX/LINUX environment.
- To learn the mechanisms of OS to handle processes and threads and their communication.
- To learn the mechanisms involved in memory management in Operating Systems
- To gain knowledge with implementation of CPU Scheduling Algorithms, page replacement algorithms and Deadlock avoidance.
- To learn programmatically to implement simple OS mechanisms

List of Experiments

1. Study of basic commands, editors in LINUX and its use.
2. Study of File Access Permission and Shell Programming in LINUX.
3. Study of Systems Calls in UNIX operating System.
4. Implementation of Producer-Consumer problem using semaphores (using UNIX system calls)
5. Simulation of CPU Scheduling Algorithms. (FCFS, RR, SJF, Priority, Multilevel Queuing).
6. Develop an application for Inter-Process Communication (Shared memory, Pipes and Message Queues).
7. Simulation of Banker's Algorithm for Deadlock Avoidance.
8. Implementation of Memory management schemes (Paging, Segmentation, First fit, Best fit and Worst fit).
9. Implementation of Page Replacement algorithms (FIFO, LRU and OPTIMAL).
10. Implementation of file allocation techniques (Contiguous, Linked or Indexed).

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Compare the performance of various CPU Scheduling Algorithms.
- Critically analyze the performance of the various page replacement algorithms.
- Create processes and implement Inter-process communication.
- Conceptualize the components involved in designing contemporary Operating Systems.
- Implement deadlock avoidance Algorithms.

CP18201	NETWORK DESIGN AND TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the principles required for network design
- To explore various technologies in the wireless domain
- To study about 3G and 4G cellular networks

UNIT I NETWORKING PRINCIPLES 9

Advanced multiplexing – Code Division Multiplexing and OFDM – Shared media networks – Collision detection and collision avoidance, Hidden and Exposed Terminals – Switched networks – Datagrams, Virtual circuits, Cell switching– End to end semantics – Connectionless, Connection oriented, Wireless Networks – Infrastructure based, ad hoc and hybrid – Wireless Scenarios –Applications, Quality of Service

UNIT II PHYSICAL NETWORK DESIGN 9

LAN cabling topologies – Ethernet Switches – High speed and Gigabit and 10Gbps – Building cabling topologies and Campus cabling topologies – Routers, Firewalls and L3 switches– Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP

UNIT III WIRELESS NETWORKS 9

IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security – IEEE 802.11e– Bluetooth- Security

UNIT IV CELLULAR NETWORKS 9

GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management –UTRAN –Core and Radio Network Mobility Management – UMTS Security

UNIT V 4G NETWORKS 9

LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks – Scheduling– Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) - Introduction to 5G

TOTAL (L:45):45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to

- Identify the components required for designing a network
- Design a network at a high-level using different networking technologies
- Analyze the various protocols of wireless and cellular networks
- Discuss the features of 4G and 5G networks

TEXT BOOKS :

1. Behrouz. A. Forouzan , Data Communication and Networking, 5th.edition , McGraw Hill, 2012
2. Martin Sauter, From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband, Wiley, 2014.

REFERENCES:

1. Savo G Glisic, ―Advanced Wireless Networks – 4G Technologies‖, John Wiley & Sons, 2007
2. Larry Peterson and Bruce Davie, ―Computer Networks: A Systems Approach‖, 5th edition, Morgan Kauffman, 2011
3. Jochen Schiller, "Mobile Communications", PHI, Second Edition, 2003.
4. Ying Dar Lin, Ren-Hung Hwang and Fred Baker, ―Computer Networks: An Open Source Approach‖, McGraw Hill, 2011

CP18202	SECURITY PRACTICES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and encryption Concepts
- To perform a detailed study of Privacy and Storage security and related Issues.

UNIT I SYSTEM SECURITY 9

Building a secure organization- A Cryptography primer- Preventing system Intrusion- Unix and linux security- Eliminating the Security Weakness of Linux and Unix Operating Systems

UNIT II NETWORK SECURITY 9

Internet Security - Botnet Problem- Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security- RFID security

UNIT III SECURITY MANAGEMENT 9

Information security essentials for IT Managers- Security Management System - IT Security - Online Identity and User Management System - Intrusion and Detection and Prevention System.

UNIT IV CYBER SECURITY AND CRYPTOGRAPHY 9

Computer forensics- Network Forensics –Firewall- Penetration testing-vulnerability assessment- Data Encryption- Satellite Encryption –Public key infrastructure- Instant messaging security

UNIT V PRIVACY AND STORAGE SECURITY 9

Net Privacy - Personal privacy Policies –Virtual Private Networks- VoIP security-Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon completion of this course the students should be able to

- Understand the core fundamentals of system security

- Apply the security concepts related to networks in wired and wireless scenario
- Implement and Manage the security essentials in IT Sector
- Able to explain the concepts of Cyber Security and encryption Concepts
- Able to attain a through knowledge in the area of Privacy and Storage security and related Issues.

TEXT BOOKS :

1. John R.Vacca, Computer and Information Security Handbook, Second Edition, Elsevier 2013

REFERENCES:

1. Michael E. Whitman, Herbert J. Mattord, Principal of Information Security, Fourth Edition, Cengage Learning, 2012.
2. Richard E.Smith, Elementary Information Security, Second Edition, Jones and Bartlett Learning, 2016

CP18203	ADVANCED INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES

To understand the fundamentals of Internet of Things

- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario

UNIT I THE INTERNET OF THINGS: AN OVERVIEW 9

The Technology of Internet of Things - Design Principles for Connected Devices - Internet Communications Overview - IP Address - MAC Addresses - TCP and UDP Ports - application Layer Protocols

UNIT II PROTOTYPING PRINCIPLES 9

Sketching - Familiarity - Cost versus Ease of Prototyping - Prototypes and Production - Open source versus closed source

UNIT III PROTOTYPING HARDWARE 9

Prototyping embedded devices - Prototyping the Physical Design - Prototyping Online Component

UNIT IV PROTOTYPING TO REALITY 9

Business Models History - The Business model canvas - Models - Funding an Internet of Things Startup -Moving to Manufacture - Designing Kits - Printed circuit boards - Scaling up Software – Ethics

UNIT V IOT APPLICATIONS 9

Smart monitoring and Diagnostics Systems at Major Power Plants - Smart Factory - Intelligent Lot Tracking -Cleaning services Industry and Technology - Global coin chain Management - LHCb Experiment at CERN -Connected Vehicles - Smart city

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Analyze various protocols for IoT
- Develop web services to access/control IoT devices.

- Design a portable IoT using Rasperry Pi
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario

TEXT BOOKS:

1. McEwen, Adrian, and Hakim Cassimally. “Designing the internet of things”. John Wiley & Sons, 2013.

REFERENCES:

1. Slama, Dirk, et al. “Enterprise IoT: Strategies and Best Practices for Connected Products and Services”, O'Reilly Media, Inc., 2015.
2. Bahga, Arshdeep, and Vijay Madisetti. “Internet of Things: A Hands-on Approach,” VPT, 2014.
3. Greengard, Samuel. “The Internet of things. MIT Press,” 2015.

CP18204	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the competitive advantages of big data analytics
- To understand the big data frameworks
- To learn data analysis methods
- To learn stream computing
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

UNIT I INTRODUCTION TO BIG DATA **8**

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.

UNIT II HADOOP FRAMEWORK **8**

Distributed File Systems - Large-Scale File System Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN

UNIT III DATA ANALYSIS **12**

Statistical Methods : Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R

UNIT IV MINING DATA STREAMS **7**

Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

UNIT V BIG DATA FRAMEWORKS **10**

Introduction to NoSQL – Aggregate Data Models – Hbase : Data Model and Implementations – Hbase Clients – Examples – Cassandra : Data Model – 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

TOTAL (L:45): 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand how to leverage the insights from big data analytics
- Analyze data by utilizing various statistical and data mining approaches
- Perform analytics on real-time streaming data
- Understand the various NoSql alternative database models

TEXT BOOKS :

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.

REFERENCES:

1. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, Second Edition, 2007.
2. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
4. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis”, O‘Reilly Media, 2013.

MC18081 INTRODUCTION TO RESEARCH METHODOLOGY AND IPR

L	T	P	C
2	0	0	2

OBJECTIVES:

- To impart knowledge on formulation of research problem, research methodology, ethics involved in doing research and importance of IPR protection.

UNIT I RESEARCH METHODOLOGY 6

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, Plagiarism, Research ethics

UNIT II RESULTS AND ANALYSIS 6

Importance and scientific methodology in recording results, importance of negative results, different ways of recording, industrial requirement, artifacts versus true results, types of analysis (analytical, objective, subjective), outcome as new idea, hypothesis, concept, theory, model etc.

UNIT III TECHNICAL WRITING 6

Effective technical writing, how to write a manuscript/ responses to reviewers comments, preparation of research article/ research report, Writing a Research Proposal - presentation and assessment by a review committee

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

Nature of Intellectual Property: Patents, Designs, Trade Mark and Copyright. Process of Patenting and Development: technological research, innovation, patenting & development. Procedure for grants of patents, Patenting under PCT.

UNIT V PATENT RIGTS AND NEW DEVELOPMENTS IN IPR 6

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

TOTAL: (L: 30): 30 PERIODS

OUTCOMES:

At the end of this course, students will be able to

- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understand research problem formulation & Analyze research related information and Follow research ethics

- Correlate the results of any research article with other published results. Write a review article in the field of engineering.
- Appreciate the importance of IPR and protect their intellectual property. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

TEXT BOOKS:

1. Ranjit Kumar, Research Methodology- A step by step guide for beginners, Pearson Education, Australia, 2005.
2. Ann M. Korner, Guide to Publishing a Scientific paper, Bioscript Press 2004.
3. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

REFERENCES:

1. Kothari, C. R. Research Methodology - Methods and Techniques, New Age International publishers, New Delhi, 2004.
2. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students', Juta & Company, 1996.
3. Robert P. Merges, Peter S. Menell and Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers, 2016.
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.

CP18211	DATA ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To implement Map Reduce programs for processing big data
- To realize storage of big data using H base, Mongo DB
- To analyze big data using linear models
- To analyze big data using machine learning techniques such as SVM / Decision tree classification and clustering

List of Experiments

Applying Hadoop

1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce
3. Implement an MR program that processes a weather dataset

Applying R

4. Implement Linear and logistic Regression
5. Implement SVM / Decision tree classification techniques
6. Implement clustering techniques
7. Visualize data using any plotting framework
8. Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- Process big data using Hadoop framework
- Build and apply linear and logistic regression models
- Perform data analysis with machine learning methods
- Perform graphical data analysis

LIST OF SOFTWARE REQUIRED:

Hadoop, YARN, R Package, Hbase, MongoDB

CP18212	INDUSTRIAL VISIT AND TECHNICAL SEMINAR	L	T	P	C
		0	0	4	2

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps
:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

CP18001	ADVANCED DATABASES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the design of databases.
- To acquire knowledge on parallel and distributed databases and its applications.
- To study the usage and applications of Object Oriented and Intelligent databases.
- To understand the emerging databases like Mobile, XML, Cloud and Big Data

UNIT I PARALLEL AND DISTRIBUTED DATABASES 9

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies

UNIT II INTELLIGENT DATABASES 9

Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy- Applications-Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases TSQL2- Deductive Databases-Recursive Queries in SQL- Spatial Databases- Spatial Data Types - Spatial Relationships- Spatial Data Structures-Spatial Access Methods- Spatial DB Implementation.

UNIT III XML DATABASES 9

XML Databases: XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity.

UNIT IV MOBILE DATABASES 9

Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols

UNIT V MULTIMEDIA DATABASES 9

Multidimensional Data Structures – Image Databases – Text / Document Databases – Video Databases – Audio Databases – Multimedia Database Design.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon the completion of the course the students should be able to:

- To develop skills on databases to optimize their performance in practice.
- To analyze each type of databases and its necessity
- To design faster algorithms in solving practical database problems

TEXT BOOKS:

1. C. J .Date, A. Kannan, S. Swamynathan, ―An Introduction to Database Systems‖, Eighth Edition, Pearson Education, 2006.
2. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T. Snodgrass, V.S.Subrahmanian, Roberto Zicari, ―Advanced Database Systems‖, Morgan Kaufmann publishers,2006.

REFERENCES:

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, ―Database System Concepts‖, Sixth Edition, McGraw Hill, 2011.
2. R. Elmasri, S.B. Navathe, ―Fundamentals of Database Systems‖, Sixth Edition, Pearson Education/Addison Wesley, 2010.
3. Vijay Kumar, ―Mobile Database Systems‖, John Wiley & Sons, 2006.

CP18002	MOBILE AND PERVASIVE COMPUTING (Common to CP & NW)	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the characteristics, basic concepts and systems issues in mobile and pervasive computing
- To familiar with the network protocol stack.
- To learn the latest mobile telecommunication system.
- To introduce the characteristic features of Ad-hoc wireless networks and their applications to the students.
- To introduce the pervasive computing device technology

UNIT I INTRODUCTION 9

Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications – Characteristics of Mobile Computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues- Pervasive computing- Basics and Vision- Principle of pervasive computing

UNIT II MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER 9

Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – Route Optimization. Overview of TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP performance

UNIT III MOBILE TELECOMMUNICATION SYSTEM 9

Migration to 3G network- IMT 2000 and UMTS- UMTS Architecture- USer Equipment- Radio Network system-UTRAN- NodeB- RNC Function-USIM- 4G- LTE- Control Plane- NAS and RRC

UNIT IV MOBILE AD-HOC NETWORKS 9

Ad-Hoc Basic Concepts – Characteristics – Applications Design Issues of Routing Protocols for Ad Hoc Networks- Classification of Routing Protocols- Proactive Routing- WRP, DSDV, OLSR Protocol- Reactive Routing- AODV, DSR, TORA, CBRP Protocol- Hybrid Routing.- ZRP, ZHLS

UNIT V PERVASIVE COMPUTING 9

Pervasive computing infrastructure-applications- Device Technology - Hardware, Human-machine Interfaces, Biometrics, and Operating systems– Device Connectivity –Protocols, Security, and Device Management- Pervasive Web Application architecture-Access from PCs and PDAs - Access via WAP

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- To introduce the characteristics, basic concepts and systems issues in mobile and pervasive computing
- To learn the latest mobile telecommunication system.
- To introduce the characteristic features of Ad-hoc wireless networks and their applications to the students.
- To introduce the pervasive computing device technology

TEXT BOOKS:

1. Jochen Schiller, “Mobile Communications”, PHI, Second Edition, 2003.
2. Jochen Burthardt et al , “Pervasive computing: Technology and Architecture of mobile Internet application ", pearson educaiton, 2003.

REFERENCES:

1. Asoke K Talukder, hasan Ahmed, Roopa R Yavagal, "Mobile Computing: Technology, Applicaitons and service creations", 2nd edition, Tata MCGraw Hill, 2010.
2. Frank Adeistein, “Fundamentals of mobile and pervasive computing”, Tata MCGraw Hill, 2005.

CP18003	IMAGE PROCESSING AND ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To understand the image processing concepts and analysis
- To understand the image processing techniques
- To familiarize the image processing environment and their applications,
- To appreciate the use of image processing in various applications

UNIT I IMAGE PROCESSING FUNDAMENTALS 9

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations.

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform, Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY 9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms- Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques.

UNIT IV IMAGE ANALYSIS AND CLASSIFICATION 9

Page frame management -page descriptors - non-uniform memory access - memory zones - reserved page frames - zoned page frame allocator - kernel mappings - buddy system algorithm -page frame cache - zone allocator.

UNIT V IMAGE REGISTRATION AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon completion of this course, a student should be able to:

- Design and implement algorithms for image processing applications that incorporates different concepts of medical Image Processing
- Familiar with the use of MATLAB and its equivalent open source tools
- Critically analyze different approaches to image processing applications
- Explore the possibility of applying Image processing concepts in various applications

REFERENCES:

1. Alasdair McAndrew, ―Introduction to Digital Image Processing with Matlab, Cengage Learning 2011, India
2. Anil J Jain, ―Fundamentals of Digital Image Processing‖, PHI, 2006.
3. Kavyan Najarian and Robert Splerstor, Biomedical signals and Image processing, CRC – Taylor and Francis, New York, 2006
4. Rafael C. Gonzalez and Richard E. Woods, ―Digital Image Processing‖, Third Edition, Pearson Education, 2008, New Delhi
5. S. Sridhar, ―Digital Image Processing‖, Oxford University Press, 2011

CP18004	WEB ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Understand the characteristics of web applications
- To learn to Model web applications
- Be aware of Systematic methods
- To familiarize with the testing techniques for web applications

UNIT I INTRODUCTION TO WEB ENGINEERING AND REQUIREMENTS ENGINEERING **9**

Motivation, Categories of Web Applications, Characteristics of Web Applications, Product-related Characteristics, Usage related Characteristics, Development-related Characteristic, Evolution of web engineering – Requirements Engineering Activities RE Specifics in Web Engineering, Principles for RE of Web Applications, Adapting RE Methods to Web Application Development, Requirement Types, Notations, Tools.

UNIT II WEB APPLICATION ARCHITECTURES & MODELLING WEBAPPLICATIONS **10**

Introduction- Categorizing Architectures, Specifics of Web Application Architectures, Components of a Generic Web Application Architecture, Layered Architectures, 2-Layer Architectures, N-Layer Architectures Data-aspect Architectures, Database-centric Architectures, Architectures for Web Document Management, Architectures for Multimedia Data Modeling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts, Access Modeling Concepts, Relation to Content Modeling, Presentation Modeling, Relation to Hypertext Modeling, Customization Modeling, Relation to Content, Hypertext, and Presentation Modeling

UNIT III WEB APPLICATION DESIGN **10**

Introduction, Web Design from an Evolutionary Perspective, Information Design, Software Design: A Programming Activity, Merging Information Design and Software Design, Problems and Restrictions in Integrated Web Design, A Proposed Structural Approach, Presentation Design, Presentation of Nodes and Meshes, Device-independent Development, Approaches, Inter action Design, User Interaction User Interface Organization, Navigation Design, Designing a Link Representation, Designing Link Internals, Navigation and Orientation, Structured Dialog for Complex Activities, Interplay with Technology and Architecture, Functional Design.

UNIT IV TESTING WEB APPLICATIONS **8**

Introduction, Fundamentals, Terminology, Quality Characteristics, Test Objectives, Test Levels, Role of the Tester, Test Specifics in Web Engineering, Test Approaches, Conventional Approaches, Agile Approaches, Test Scheme, Three Test Dimensions, Applying the Scheme to Web Applications, Test

Methods and Techniques, Link Testing, Browser Testing, Usability Testing, Load, Stress, and Continuous Testing, Testing Security, Test-driven Development, Test Automation, Benefits and Drawbacks of Automated Test, Test Tools.

UNIT V WEB PROJECT MANAGEMENT 8

Understanding Scope, Refining Framework Activities, Building a Web Team, Managing Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to node JS – web sockets

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon completion of the course, the student should be able to:

- Apply the characteristics of web applications
- Model web applications.
- Design web applications
- Test web applications

TEXT BOOKS: -

1. Gerti Kappel, Birgit Proll, “Web Engineering”, John Wiley and Sons Ltd, 2006.
2. Roger S. Pressman, David Lowe, “Web Engineering”, Tata McGraw Hill Publication, 2007.
3. Guy W. Lecky-Thompson, “Web Programming”, Cengage Learning, 2008.

REFERENCES:

1. Chris Bates, “Web Programming: Building Internet Applications”, Third Edition, Wiley India Edition, 2007
2. John Paul Mueller, “Web Development with Microsoft Visual Studio 2005”, Wiley Dream tech, 2006.

CP18005	SOFTWARE ARCHITECTURES AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
- To learn the design principles and to apply for large scale systems
- To design architectures for distributed heterogeneous systems ,environment through brokerage interaction
- To build design knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- To develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services.

UNIT I **9**

Introduction to Software Architecture-Bridging Requirements and Implementation, Design Guidelines, Software Quality attributes. Software Architecture Design Space. Agile Approach to Software Architecture Design, Models for Software Architecture Description Languages (ADL).

UNIT II **9**

Object-Oriented Paradigm -Design Principles. Data-Centered Software Architecture: Repository Architecture, Blackboard Architecture. Hierarchical Architecture Main-Subroutine, Master-Slave, Layered, Virtual Machine. Interaction-Oriented Software Architectures: Model-View-Controller (MVC), Presentation-Abstraction-Control (PAC).

UNIT III **9**

Distributed Architecture: Client-Server, Middleware, Multi-tiers, Broker Architecture – MOM, CORBA Message Broker Architecture- Service-Oriented Architecture (SOA), SOAP, UDDI, SOA Implementation in Web Services, Grid/cloud Service Computing. Heterogeneous Architecture- Methodology of Architecture Decision, Quality Attributes.

UNIT IV **9**

Architecture of User Interfaces containers, case study-web service. Product Line Architectures - methodologies, processes and tools. Software Reuse and Product Lines -Product Line Analysis, Design and implementation, configuration Models. Model Driven Architectures (MDA) –why MDA-Model transformation and software architecture, SOA and MDA. Eclipse modeling framework.

UNIT V **9**

Aspect Oriented Architectures- AOP in UML,AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture &shipping –inventory, supply chain cloud service Management, semantic web services

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon completion of this course, a student should be able to:

- Understand the need of software architecture for sustainable dynamic systems.
- Have a sound knowledge on design principles and to apply for large scale systems
- Design architectures for distributed heterogeneous systems
- Have good knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- Have a working knowledge to develop appropriate architectures through various case studies.

REFERENCES:

1. Essentials of software Architecture, Ion Gorton, Second Edition, Springer-verlag, 2011
2. Software Architecture Design Illuminated, Kai Qian Jones and Bartlett Publishers Canada, 2010

CP18006	DATA COMMUNICATION AND NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES :

The student should be made to:

- To understand the protocol layering and physical level communication.
- To analyse the performance of a network.
- To understand the various components required to build different networks.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.

UNIT I INTRODUCTION AND PHYSICAL LAYER 9

Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.

UNIT II DATA-LINK LAYER & MEDIA ACCESS 9

Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Wired LANs: Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.

UNIT III NETWORK LAYER 9

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets – Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.

UNIT IV TRANSPORT LAYER 9

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

UNIT V APPLICATION LAYER 9

WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the basic layers and its functions in computer networks.

- Evaluate the performance of a network.
- Understand the basics of how data flows from one node to another.
- Analyze and design routing algorithms.
- Design protocols for various functions in the network.
- Understand the working of various application layer protocols.

TEXT BOOKS:

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011.
5. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.

CP18007	REAL TIME SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand issues of time-critical computing
- To understand real-time scheduling approaches in uniprocessor and multiprocessors and to carry out schedulability analysis.
- To be familiar with real time operating systems.
- To provide a clear understanding on the basic concepts of Embedded System and its design.
- To develop time-critical real-time systems using C, Ada, Java as the implementation languages.

UNIT I INTRODUCTION TO REAL TIME SYSTEMS 9

Introduction to Real Time Systems - definition, applications, characteristics, types, timing constraints. Performance measure for real time systems - estimating program run times. Task scheduling - clock-driven schedulers, earliest deadline first, rate monotonic algorithm - WCET analysis.

UNIT II MULTIPROCESSOR REAL TIME SCHEDULING 9

Multiprocessor architectures, Multiprocessor task allocation – utilization balancing, next-fit algorithm for RMA, focussed addressing and bidding, buddy algorithm, Partitioned scheduling, Global scheduling, Optimal MP scheduling, MP – Resource access protocols.

UNIT III REAL TIME OPERATING SYSTEM 9

Introduction to basic concepts of RTOS, Real time kernel - Principles – Design issues – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – RTOS Lite, Full RTOS, VX works – Linux supportive RTOS – C Executive.

UNIT IV EMBEDDED SYSTEMS AND MODELS 9

Overview of embedded systems - applications, types, embedded processor – ARM architecture. Models of embedded systems – super loop model, event-driven model, process models, uniprocessor kernel and OS model, multiprocessor system model, real time system model, Design methodology for embedded system software

UNIT V PROGRAMMING LANGUAGES AND TOOLS 9

Characteristics of real-time programming languages, Run-time support, Complier optimization, Languages for RTS development – C, Ada, Java, Cross-development techniques - cross-compilers and linkers.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Schedule Real-time tasks and perform schedulability analysis, including uniprocessor and multiprocessor scheduling.
- Compare functionalities of commercial OSs and application development using RTOS
- Design real time embedded systems using the concepts of RTOS.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on real time system development.

TEXT BOOKS: -

1. C.M. Krishna, Kang G. Shin, "Real-Time Systems", McGraw-Hill International Editions, 1997.
2. K. C. Wang, "Embedded and Real-Time Operating Systems", Springer, 2017.

REFERENCES:

1. Rob Williams, "Real-Time Systems Development", Elsevier India Pvt. Ltd.-new Delhi; 1st edition (2008)
2. Philip.A.Laplante, "Real Time System Design and Analysis", Prentice Hall of India, 3rd Edition, 2004.
3. Rajib Mall, "Real-time systems: theory and practice", Pearson Education, 2009

CP18008 INFORMATION STORAGE MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the storage architecture and available technologies.
- To learn to establish & manage datacenter.
- To learn security aspects of storage & data center.

UNIT I STORAGE TECHNOLOGY **9**

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities.

UNIT II STORAGE SYSTEMS ARCHITECTURE **9**

Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment ,Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,Iligh-level architecture and working of an intelligent storage system.

UNIT III INTRODUCTION TO NETWORKED STORAGE **9**

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments.

UNIT IV INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS. **9**

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime - Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION 9

Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, a student should be able to:

- Select from various storage technologies to suit for required application.
- Apply security measures to safeguard storage & farm.
- Analyse QoS on Storage.

TEXT BOOKS:

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010

REFERENCES:

1. Marc Farley, ―Building Storage Networks‖, Tata McGraw Hill, Osborne, 2001.
2. Robert Spalding, ―Storage Networks: The Complete Reference―, Tata McGraw Hill , Osborne, 2003.

CP18009	PARALLEL PROGRAMMING PARADIGMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To familiarize the issues in parallel computing.
- To describe distributed memory programming using MPI.
- To understand shared memory paradigm with Pthreads and with OpenMP.
- To learn the GPU based parallel programming using OpenCL.

UNIT I FOUNDATIONS OF PARALLEL PROGRAMMING 9

Motivation for parallel programming – Need-Concurrency in computing – Basics of processes, multitasking and threads – cache – cache mappings – caches and programs – virtual memory – Instruction level parallelism – hardware multi-threading – Parallel Hardware- SIMD – MIMD – Interconnection networks – cache coherence –Issues in shared memory model and distributed memory model –Parallel Software- Caveats- coordinating processes/ threads- hybrid model – shared memory model and distributed memory model - I/O – performance of parallel programs-– parallel program design.

UNIT II DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMD-programs– MPI_Send and MPI_Recv – message matching – MPI- I/O – parallel I/O – collective communication – Tree-structured communication -MPI_Reduce – MPI_Allreduce, broadcast, scatter, gather, allgather – MPI derived types – dynamic process management – performance evaluation of MPI programs- A Parallel Sorting Algorithm

UNIT III SHARED MEMORY PARADIGM WITH PTHREADS 9

Basics of threads, Pthreads – thread synchronization – critical sections – busy waiting – mutex – semaphores – barriers and condition variables – read write locks with examples - Caches, cache coherence and false sharing – Thread safety-Pthreads case study.

UNIT IV SHARED MEMORY PARADIGM: OPENMP 9

Basics OpenMP – Trapezoidal Rule-scope of variables – reduction clause – parallel for directive – loops in OpenMP – scheduling loops –Producer Consumer problem – cache issues – threads safety in OpenMP – Two- body solvers- Tree Search

UNIT V GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA 9

Introduction to OpenCL – Example-OpenCL Platforms- Devices-Contexts - OpenCL programming – Built-In Functions-Programs Object and Kernel Object – Memory Objects -

Buffers and Images – Event model – Command-Queue - Event Object - case study. Introduction to CUDA programming.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Identify issues in parallel programming.
- Develop distributed memory programs using MPI framework.
- Design and develop shared memory parallel programs using Pthreads and using OpenMP.
- Implement Graphical Processing OpenCL programs.

TEXT BOOKS: -

1. A. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, ―OpenCL programming guide‖, Addison Wesley, 2011
2. M. J. Quinn, ―Parallel programming in C with MPI and OpenMP‖, Tata McGraw Hill, 2003.

REFERENCES:

1. Peter S. Pacheco, ―An introduction to parallel programming‖, Morgan Kaufmann, 2011.
2. Rob Farber, ―CUDA application design and development‖, Morgan Haufmann, 2011.
3. W. Gropp, E. Lusk, and A. Skjellum, ―Using MPI: Portable parallel programming with the message passing interface‖, Second Edition, MIT Press, 1999

CP18010 RECONFIGURABLE COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the need for reconfigurable computing
- To expose the students to various device architectures
- To examine the various reconfigurable computing systems
- To expose the students to HDL programming and familiarize with the development environment
- To expose the students to the various placement and routing protocols

UNIT I DEVICE ARCHITECTURE **9**

General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs – Device Architecture - Case Studies.

UNIT II RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS **9**

Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.

UNIT III PROGRAMMING RECONFIGURABLE SYSTEMS **9**

Compute Models - Programming FPGA Applications in HDL – Compiling C for Spatial Computing – Operating System Support for Reconfigurable Computing.

UNIT IV MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS **9**

The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bitstream Generation – Case Studies with Appropriate Tools.

UNIT V APPLICATION DEVELOPMENT WITH FPGAS **9**

Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs

TOTAL:45 PERIODS

OUTCOMES:

- Upon completion of the course, the students should be able to:
- Identify the need for reconfigurable architectures.
- Point out the salient features of different reconfigurable architectures.
- Develop applications using any HDL and appropriate tools.
- Design and build an SoPC for a particular application.

TEXT BOOKS:

1. Christophe Bobda, ―Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications‖, Springer, 2010.
2. Maya B. Gokhale and Paul S. Graham, ―Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays‖, Springer, 2005.

REFERENCES:

1. FPGA Frontiers: New Applications in Reconfigurable Computing, 2017, Nicole Hemsoth, Timothy Prickett Morgan, Next Platform.
2. Reconfigurable Computing: From FPGAs to Hardware/Software Codesign 2011 Edition by Joao Cardoso (Editor), Michael Hübne, Springer
3. Scott Hauck and Andre Dehon (Eds.), ―Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation‖, Elsevier / Morgan Kaufmann, 2008.

CP18011	CLOUD COMPUTING TECHNOLOGIES (Common to CP & NW)	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To understand the concepts of virtualization and virtual machines
- To gain knowledge on the concept of virtualization that is fundamental to cloud computing
- To understand the various issues in cloud computing
- To be able to set up a private cloud
- To understand the security issues in the grid and the cloud environment

UNIT I VIRTUALIZATION 9

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation –Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization – Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization

UNIT II VIRTUALIZATION INFRASTRUCTURE 9

Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization - Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.

UNIT III CLOUD PLATFORM ARCHITECTURE 9

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery –Architectural Design Challenges - Public Cloud Platforms : GAE,AWS – Inter-cloud Resource Management

UNIT IV PROGRAMMING MODEL 9

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus

UNIT V CLOUD SECURITY 9

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon completion of this course, a students should be able to:

- Employ the concepts of storage virtualization, network virtualization and its management
- Apply the concept of virtualization in the cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Develop services using Cloud computing
- Apply the security models in the cloud environment

TEXT BOOKS:

1. Danielle Ruest, Nelson Ruest, ―Virtualization: A Beginner‟s Guide‖, McGraw-Hill Osborne Media, 2009.
2. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.

REFERENCES:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif ,"Cloud Security and Privacy", O‘Reilly Media, Inc.,2009.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
4. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

CP18012 EMBEDDED SOFTWARE DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

- To understand the architecture of embedded processor, microcontroller and peripheral devices.
- To interface memory and peripherals with embedded systems.
- To study the embedded network environment.
- To understand challenges in Real time operating systems.
- To study, analyze and design applications on embedded systems.

UNIT I EMBEDDED PROCESSORS 9

Embedded Computers - Characteristics of Embedded Computing Applications - Challenges in Embedded Computing System Design - Embedded System Design Process- Formalism for System Design - Structural Description - Behavioural Description - ARM Processor - Intel ATOM Processor.

UNIT II EMBEDDED COMPUTING PLATFORM 9

CPU Bus Configuration - Memory Devices and Interfacing - Input/Output Devices and Interfacing - System Design - Development and Debugging – Emulator – Simulator - JTAG Design Example – Alarm Clock - Analysis and Optimization of Performance - Power and Program Size.

UNIT III EMBEDDED NETWORK ENIVIRONMENT 9

Distributed Embedded Architecture - Hardware And Software Architectures - Networks for Embedded Systems - I2C - CAN Bus - SHARC Link Supports – Ethernet – Myrinet – Internet - Network-based Design - Communication Analysis - System Performance Analysis - Hardware Platform Design - Allocation and Scheduling - Design Example - Elevator Controller.

UNIT IV REAL-TIME CHARACTERISTICS 9

Clock Driven Approach - Weighted Round Robin Approach - Priority Driven Approach - Dynamic versus Static Systems - Effective Release Times and Deadlines - Optimality of the Earliest Deadline First (EDF) Algorithm - Challenges in Validating Timing Constraints in Priority Driven Systems - Off-Line versus On-Line Scheduling.

UNIT V SYSTEM DESIGN TECHNIQUES 9

Design Methodologies - Requirement Analysis – Specification - System Analysis and Architecture Design - Quality Assurance - Design Examples - Telephone PBX - Ink jet printer - Personal Digital Assistants - Set-Top Boxes.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand different architectures of embedded processor, microcontroller and peripheral devices. Interface memory and peripherals with embedded systems.
- Work with embedded network environment.
- Understand challenges in Real time operating systems.
- Design and analyze applications on embedded systems.

TEXT BOOKS:

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" Wiley Publication, First edition, 2013
2. Andrew N Sloss, D. Symes, C. Wright, ‖ Arm system developers guide‖, Morgan Kauffman/Elsevier, 2006. 3. Arshdeep Bahga, Vijay Madisetti, " Internet of Things: A Hands-on-Approach" VPT First Edition, 2014

REFERENCES:

1. C. M. Krishna and K. G. Shin, ―Real-Time Systems‖ , McGraw-Hill, 1997
2. Frank Vahid and Tony Givargis, ―Embedded System Design: A Unified Hardware/Software Introduction‖, John Wiley & Sons.

CP18013 LANGUAGE TECHNOLOGIES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the fundamentals of natural language processing
- To appreciate the use of CFG and PCFG in NLP
- To understand the role of semantics and pragmatics

UNIT I INTRODUCTION **9**

Words - Regular Expressions and Automata - Words and Transducers - N-grams - Part-of Speech – Tagging - Hidden Markov and Maximum Entropy Models.

UNIT II SPEECH **9**

Speech – Phonetics - Speech Synthesis - Automatic Speech Recognition - Speech Recognition: - Advanced Topics - Computational Phonology.

UNIT III SYNTAX **9**

Formal Grammars of English - Syntactic Parsing - Statistical Parsing - Features and Unification - Language and Complexity.

UNIT IV SEMANTICS AND PRAGMATICS **9**

The Representation of Meaning - Computational Semantics - Lexical Semantics - Computational Lexical Semantics - Computational Discourse.

UNIT V APPLICATIONS **9**

Information Extraction - Question Answering and Summarization - Dialogue and Conversational Agents - Machine Translation.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- To tag a given text with basic Language features
- To design an innovative application using NLP components
- To implement a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast use of different statistical approaches for different types of NLP applications.

TEXT BOOKS:

1. Breck Baldwin, "Language Processing with Java and LingPipe Cookbook", Atlantic Publisher, 2015.

2. Daniel Jurafsky, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2014.

REFERENCES:

1. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman and Hall/CRC Press, 2010.
2. Richard M Reese, "Natural Language Processing with Java", O_Reilly Media, 2015.
3. Steven Bird, Ewan Klein and Edward Loper, -"Natural Language Processing with Python", First Edition, O_Reilly Media, 2009.

CP18014 **COMPUTER VISION** **L T P C**
3 0 0 3

OBJECTIVES:

- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques. .
- To study some applications of computer vision algorithms

UNIT I IMAGE PROCESSING FOUNDATIONS **9**

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.

UNIT II SHAPES AND REGIONS **9**

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

UNIT III HOUGH TRANSFORM **9**

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

UNIT IV 3D VISION AND MOTION **9**

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

UNIT V APPLICATIONS **9**

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to

- Implement fundamental image processing techniques required for computer vision.
- Perform shape analysis.
- Apply Hough Transform for line, circle, and ellipse detections.
- Apply 3D vision techniques.
- Implement motion related techniques.
- Develop applications using computer vision techniques

TEXT BOOKS:

1. D. L. Baggio et al., ―Mastering OpenCV with Practical Computer Vision Projects‖, Packt Publishing, 2012.
2. E. R. Davies, ―Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.

REFERENCES:

1. Jan Erik Solem, ―Programming Computer Vision with Python: Tools and algorithms for analyzing images‖, O'Reilly Media, 2012.
2. Mark Nixon and Alberto S. Aquado, ―Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
3. R. Szeliski, ―Computer Vision: Algorithms and Applications‖, Springer 2011.
4. Simon J. D. Prince, ―Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.

CP18015 SPEECH PROCESSING AND SYNTHESIS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the mathematical foundations needed for speech processing
- To understand the basic concepts and algorithms of speech processing and synthesis
- To familiarize the students with the various speech signal representation, coding and recognition techniques
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing

UNIT I FUNDAMENTALS OF SPEECH PROCESSING **9**

Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODINGA **9**

Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.

UNIT III SPEECH RECOGNITION **9**

Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.

UNIT IV TEXT ANALYSIS **9**

Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation

UNIT V SPEECH SYNTHESIS **9**

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to

- Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word
- Determine and apply Mel-frequency cepstral coefficients for processing all types of signals
- Justify the use of formant and concatenative approaches to speech synthesis
- Identify the apt approach of speech synthesis depending on the language to be processed
- Determine the various encoding techniques for representing speech

TEXT BOOKS:

1. Joseph Mariani, ―Language and Speech Processing‖, Wiley, 2009.
2. Lawrence Rabiner and Biing-Hwang Juang, ―Fundamentals of Speech Recognition‖, Prentice Hall Signal Processing Series, 1993.

REFERENCES:

1. Sadaoki Furui, ―Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications), Marcel Dekker, 2000.
2. Thomas F.Quatieri, ―Discrete-Time Speech Signal Processing‖, Pearson Education, 2002.
3. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, ―Spoken Language Processing – A guide to Theory, Algorithm and System Development‖, Prentice Hall PTR, 2001.

CP18016 SOCIAL NETWORK ANALYSIS L T P C
3 0 0 3

OBJECTIVES:

- To understand the components of the social network.
- To model and visualize the social network.
- To mine the users in the social network.
- To understand the evolution of the social network.
- To know the applications in real time systems.

UNIT I INTRODUCTION 9

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

UNIT II MODELING AND VISUALIZATION 9

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

UNIT III MINING COMMUNITIES 9

Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

UNIT IV EVOLUTION 9

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

UNIT V APPLICATIONS

A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection

TOTAL: 45 PERIODS

OUTCOMES:

- Work on the internals components of the social network
- Model and visualize the social network
- Mine the behaviour of the users in the social network
- Predict the possible next outcome of the social network
- Apply social network in real time applications

TEXT BOOKS:

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, ―Computational Social Network Analysis: Trends, Tools and Research Advances‖, Springer, 2012
2. Borko Furht, ―Handbook of Social Network Technologies and Applications‖, Springer, 1st edition, 2011

REFERENCES:

1. Charu C. Aggarwal, ―Social Network Data Analytics‖, Springer; 2014
2. Giles, Mark Smith, John Yen, ―Advances in Social Network Mining and Analysis‖, Springer, 2010.
3. Przemyslaw Kazienko, Nitesh Chawla,‖ Applications of Social Media and Social Network Analysis‖, Springer,2015

CP18017 FORMAL MODELS OF SOFTWARE SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To understand the goals, complexity of software systems, the role of Specification activities and qualities to control complexity.
- To understand the fundamentals of abstraction and formal systems
- To learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems
- To understand formal specification models based on set theory, calculus and algebra and apply to a case study
- To learn Z, Object Z and B Specification languages with case studies.

UNIT I SPECIFICATION FUNDAMENTALS 9

Role of Specification- Software Complexity - Size, Structural, Environmental, Application, domain, Communication Complexity, How to Control Complexity. Software specification, Specification Activities-Integrating Formal Methods into the Software Life-Cycle. Specification Qualities-Process Quality Attributes of Formal Specification Languages, Model of Process Quality, Product Quality and Utility, Conformance to Stated Goals Quality Dimensions and Quality Model.

UNIT II FORMAL METHODS 9

Abstraction- Fundamental Abstractions in Computing. Abstractions for Software Construction.
Formalism Fundamentals - Formal Systems, Formalization Process in Software Engineering Components of a Formal System- Syntax, Semantics, and Inference Mechanism. Properties of Formal Systems - Consistency.
Automata-Deterministic Finite Accepters, State Machine Modeling Nondeterministic Finite Accepters, Finite State Transducers Extended Finite State Machine. Case Study—Elevator Control. Classification of C Methods-Property-Oriented Specification Methods, Model-Based Specification Techniques.

UNIT III LOGIC 9

Propositional Logic - Reasoning Based on Adopting a Premise, Inference Based on Natural Deduction. Predicate Logic - Syntax and Semantics, Policy Language Specification, knowledge Representation Axiomatic Specification. Temporal Logic -.Temporal Logic for Specification and Verification, Temporal Abstraction Propositional Temporal Logic (PTL), First Order Temporal Logic (FOTL).Formal Verification, Verification of Simple FOTL, Model Checking, Program Graphs, Transition Systems.

UNIT IV SPECIFICATION MODELS 9

Mathematical Abstractions for Model-Based Specifications-Formal Specification Based on Set Theory, Relations and Functions. Property-Oriented Specifications- Algebraic Specification,

Properties of Algebraic Specifications, Reasoning, Structured Specifications. Case Study—A Multiple Window Environment: requirements, Modeling Formal Specifications. Calculus of Communicating Systems: Specific Calculus for Concurrency. Operational Semantics of Agents, Simulation and Equivalence, Derivation Trees, Labeled Transition Systems.

UNIT V FORMAL LANGUAGES 9

The Z Notation, abstractions in Z, Representational Abstraction, Types, Relations and Functions, Sequences, Bags. Free Types-Schemas, Operational Abstraction -Operations Schema Decorators, Generic Functions, Proving Properties from Z specifications, Consistency of Operations. Additional Features in Z. Case Study: An Automated Billing System. The Object-Z Specification Language-Basic Structure of an Object-Z, Specification. Parameterized Class, Object-Orientation, composition of Operations-Parallel Communication Operator, Nondeterministic Choice Operator, and Environment Enrichment.

The B-Method -Abstract Machine Notation (AMN), Structure of a B Specification, arrays, statements. Structured Specifications, Case Study- A Ticketing System in a Parking.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the complexity of software systems, the need for formal specifications activities and qualities to control complexity.
- Gain knowledge on fundamentals of abstraction and formal systems
- Learn the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems
- Develop formal specification models based on set theory, calculus and algebra and apply to a typical case study
- Have working knowledge on Z, Object Z and B Specification languages with case studies.

TEXT BOOKS:

1. Mathematical Logic for computer science, second edition, M.Ben-Ari ,Springer,2003.
2. Logic in Computer Science- modeling and reasoning about systems, 2nd Edition, Cambridge University Press, 2004.

REFERENCES:

1 Specification of Software Systems, V.S. Alagar, K. Periyasamy, David Grises and Fred B Schneider, Springer –Verlag London, 2011

2 The ways Z: Practical programming with formal methods, Jonathan Jacky, Cambridge University Press,1996.

CP18018	NETWORK PERFORMANCE ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To understand the mathematical basis for analyzing the performance of networks.
- To understand queuing theory and queuing models.
- To analytically model traffic control protocols, and error control protocols using these concepts.
- To model performance of wired and wireless MAC such as 802.3, 802.11 and 802.16.
- To model network traffic and study the performance of different packet scheduling algorithms.

UNIT I MARKOV CHAINS BASICS 9

Overview of Random Processes, Markov Chains – Markov matrices, State transition matrix, Markov chains at equilibrium – steady state distribution vector.

UNIT II REDUCIBLE AND PERIODIC MARKOV CHAINS 9

Reducible Markov chain – Transition matrix, Reducible Composite Markov chain, Transient analysis, Steady state, Periodic Markov chain – Transition matrix, canonical form, Strongly and weakly periodic Markov chains, Queuing Analysis –M/M/1 queues, M/M/1/B queues, D/M/1/B queues, performance, communicating Markov chains

UNIT III TRAFFIC CONTROL, ERROR CONTROL AND MAC MODELING 9

Modeling traffic control protocols – Modeling leaky bucket and token bucket algorithms, Modeling Error control protocols - Stop and wait and GBN ARQ performance, Modeling media access control protocols – 802.1p, ALOHA, 802.3.

UNIT IV WIFI AND WIMAX PERFORMANCE 9

Modeling 802.11 protocol – Basic DCF modeling, RTS/CTS modeling, Modeling 802.11e, Performance, 802.11e HCCA Performance. Modeling 802.16 protocol – system and user performance.

UNIT V NETWORK TRAFFIC AND SCHEDULING 9

Modeling network traffic – Flow traffic models – Continuous time modeling, Discrete time modeling, Pareto traffic distribution, Destination traffic. Scheduling algorithms – Analysis.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon completion of this course, a students should be able to:

- Apply markov chain models and analyse the behavior of network systems.

- Perform queuing theory based analysis of various L2 layer functions, such as flow control, error control, and MAC.
- Build network traffic models.
- Analyse QoS functions such as scheduling and traffic control.

TEXT BOOKS:

1. Anurag Kumar, D. Manjunath, Joy Kuri, Communication Networking: An analytical Approach, Elsevier, 2004.
2. Bertsekas D and Gallager R, Data Networks, 2nd Edition, Prentice-Hall, 1992.

REFERENCES:

1. Fayez Gebali, Analysis of computer networks, 2nd Edition, Springer, 2015.
2. Harrison P G and Patel N M, Performance Modelling of Communication Networks and Computer Architectures, Addison-Wesley, 1993.
3. Robertazzi T G, Computer Networks and Systems: Queuing Theory and Performance Evaluation, 2nd, Edition, Springer-Verlag, 1994.

CP18019 SOFTWARE QUALITY ASSURANCE AND TESTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of testing, test planning &design and test team organization
- To study the various types of test in the life cycle of the software product.
- To build design concepts for system testing and execution
- To learn the software quality assurance, metrics, defect prevention techniques
- To learn the techniques for quality assurance and applying for applications

UNIT I SOFTWARE TESTING - CONCEPTS, ISSUES, AND TECHNIQUES **9**

Quality Revolution, Verification and Validation, Failure, Error, Fault, and Defect, Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black, test Planning and design, Test Tools and Automation, Power of Test. Test Team Organization and Management-Test Groups, Software Quality Assurance Group ,System Test Team Hierarchy, Team Building.

UNIT II SYSTEM TESTING **9**

System Testing - System Integration Techniques-Incremental, Top Down Bottom Up Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration. Builtin Testing. functional testing - Testing a Function in Context. Boundary Value Analysis, Decision Tables. acceptance testing - Selection of Acceptance Criteria, Acceptance Test Plan, Test Execution Test. software reliability - Fault and Failure, Factors Influencing Software, Reliability Models

UNIT III SYSTEM TEST CATEGORIES **9**

System test categories Taxonomy of System Tests, Interface Tests Functionality Tests. GUI Tests, Security Tests Feature Tests, Robustness Tests, Boundary Value Tests Power Cycling Tests Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Regulatory Tests. Test Generation from FSM models- State-Oriented Model. Finite-State Machine Transition Tour Method, Testing with State Verification. Test Architectures-Local, distributed, Coordinated, Remote. system test design- Test Design Factors Requirement Identification, modeling a Test Design Process Test Design Preparedness, Metrics, Test Case Design Effectiveness. system test execution- Modeling Defects, Metrics for Monitoring Test Execution. Defect Reports, Defect Causal Analysis, Beta testing, measuring Test Effectiveness.

UNIT IV SOFTWARE QUALITY **9**

Software quality - People‘s Quality Expectations, Frameworks and ISO-9126, McCall‘s Quality Factors and Criteria – Relationship. Quality Metrics. Quality Characteristics ISO 9000:2000 Software Quality Standard. Maturity models- Test Process Improvement, Testing Maturity Model.

UNIT V SOFTWARE QUALITY ASSURANCE 9

Quality Assurance - Root Cause Analysis, modeling, technologies, standards and methodologies for defect prevention. Fault Tolerance and Failure Containment - Safety Assurance and Damage Control, Hazard analysis using fault-trees and event-trees. Comparing Quality Assurance Techniques and Activities. QA Monitoring and Measurement, Risk Identification for Quantifiable Quality Improvement. Case Study: FSM-Based Testing of Web-Based Applications.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to

- Perform functional and nonfunctional tests in the life cycle of the software product.
- Understand system testing and test execution process.
- Identify defect prevention techniques and software quality assurance metrics.
- Apply techniques of quality assurance for typical applications.

TEXT BOOKS:

1. Software Testing And Quality Assurance-Theory and Practice, Kshirasagar Nak Priyadarshi Tripathy, John Wiley & Sons Inc,2008
2. Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, Jeff Tian, John Wiley & Sons, Inc., Hoboken, New Jersey. 2005.

REFERENCES:

1. Software Quality Assurance - From Theory to Implementation, Daniel Galin, Pearson Education Ltd UK, 2004
2. Software Quality Assurance, Milind Limaye, TMH ,New Delhi, 2011

CP18020	BIO-INSPIRED COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Learn bio-inspired theorem and algorithms
- To Understand random walk and simulated annealing
- To Learn genetic algorithm and differential evolution
- To Learn swarm optimization and ant colony for feature selection
- To understand bio-inspired application in image processing

UNIT I INTRODUCTION **9**

Introduction to algorithm - Newton's method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Mataheuristics -Analysis of Algorithms -Nature Inspires Algorithms -Parameter tuning and parameter control.

UNIT II RANDOM WALK AND ANEALING **9**

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling.

UNIT III GENETIC ALOGORITHMS AND DIFFERENTIAL EVOLUTION **9**

Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA varients - schema theorem - convergence analysis - introduction to differential evolution - varients - choice of parameters - convergence analysis - implementation.

UNIT IV SWARM OPTIMIZATION AND FIREFLY ALGORITHM **9**

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - varients- Ant colony optimization toward feature selection.

UNIT V APPLICATION IN IMAGE PROCESSING **9**

Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine-Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search

TOTAL: 45 PERIODS

OUTCOMES:

- Implement and apply bio-inspired algorithms
- Explain random walk and simulated annealing

- Implement and apply genetic algorithms
- Explain swarm intelligence and ant colony for feature selection
- Apply bio-inspired techniques in image processing

TEXT BOOKS:

1. Eiben,A.E., Smith, James E, "Introduction to Evolutionary Computing", Springer 2015
2. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013

REFERENCES:

1. Xin-She Yang , Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing",Elsevier 2016
2. Xin-She Yang, "Nature Ispired Optimization Algorithm, Elsevier First Edition 2014
3. Yang ,Cui,XIao, Gandomi, Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013

CP18021	BIO INFORMATICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get exposed to the fundamentals of bioinformatics.
- To learn bio-informatics algorithm and phylogenetic concept.
- To understand open problems and issues in replication and molecular clocks.
- To learn assemble genomes and corresponding theorem.
- To study and exposed to the domain of human genomics.

UNIT I INTRODUCTION AND FUNDAMENTALS 9

Fundamentals of genes , genomics , molecular evolution – genomic technologies – beginning of bioinformatics - genetic data –sequence data formats – secondary database – examples – data retrival systems – genome browsers.

UNIT II BIOINFORMATICS ALGORITHM AND ANALYSIS 9

Sequence alignment and similarity searching in genomic databases: BLAST and FASTA – additional bioinformatics analysis involving nucleic acid sequences-additional bioinformatics analysis involving protein sequences – Phylogenetic Analysis.

UNIT III DNA REPLICATION AND MOLECULAR CLOCKS 9

Beginning of DNA replication – open problems – multiple replication and finding replication – computing probabilities of patterns in a string-the frequency array-converting patternssolving problems- finding frequents words-Big-O notation –case study-The Tower of Hanoi problem.

UNIT IV ASSEMBLE GENOMES AND SEQUENCES 9

Methods of assemble genomes – string reconstruction – De Bruijn graph – Euler‘s theorem – assembling genomes –DNA sequencing technologies – sequence antibiotics – Brute Force Algorithm – Branch and Bound algorithm – open problems – comparing biological sequences- Case Study –Manhattan tourist Problem.

UNIT V HUMAN GENOME 9

Human and mouse genomes-random breakage model of chromosome evolution – sorting by reversals – greedy heuristic approach – break points- rearrangements in tumor and break point genomes-break point graps- synteny block construction -open problems and technologies.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students should be able to:

- Deploy the genomics technologies in Bioinformatics.
- Able to distinct efficient algorithm and issues
- Deploy the replication and molecular clocks in bioinformatics
- Work on assemble genomes and sequences
- Use the Microarray technologies for genome expression.

TEXT BOOKS:

1. Ion Mandoiu and Alexander Zelikovsky , "Computational Methods for Next Generation Sequencing Data Analysis ― Wiley series 2016.
2. Istvan Miklos,Renyi Institutue, ―Introduction to algorithms in bioinformatics‖,Springer 2016

REFERENCES:

1. Philip Compeau and Pavel pevzner, ―Bioinformatics Algorithms: An Active Learning Approach‖ Second edition volume I , Cousera, 2015.
2. Supratim Choudhuri, ―Bioinformatics For Beginners‖, Elsevier, 2014.

CP18022 DATA VISUALIZATION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

To develop skills to both design and critique visualizations.

- To introduce visual perception and core skills for visual analysis.
- To understand visualization for time-series analysis.
- To understand visualization for ranking analysis.
- To understand visualization for deviation analysis.
- To understand visualization for distribution analysis.
- To understand visualization for correlation analysis.
- To understand visualization for multivariate analysis.
- To understand issues and best practices in information dashboard design.

UNIT I CORE SKILLS FOR VISUAL ANALYSIS **9**

Information visualization – effective data analysis – traits of meaningful data – visual perception –making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

UNIT II TIME-SERIES, RANKING, AND DEVIATION ANALYSIS **9**

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

UNIT III DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS **9**

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

UNIT IV INFORMATION DASHBOARD DESIGN **9**

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence

UNIT V INFORMATION DASHBOARD DESIGN 9

Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparkliness – Dashboard Display Media –Critical Design Practices – Putting it all together Unveiling the dashboard.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to:

- Explain principles of visual perception
- Apply core skills for visual analysis
- Apply visualization techniques for various data analysis tasks
- Design information dashboard

TEXT BOOKS:

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001

REFERENCES:

1. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
2. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
3. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
4. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014

CP18023	NEXT GENERATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To learn the technical, economic and service advantages of next generation networks.
- To learn the evolution of technologies of 4G and beyond.
- To learn Software defined Mobile Network issues and integrating challenges with LTE.
- To explore the NGN framework catering the services of end user with QoS provisioning.
- To learn about the NGM management and standards.

UNIT I INTRODUCTION 9

Evolution of public mobile services -motivations for IP based services, Wireless IP network architecture –3GPP packet data network architecture. Introduction to next generation networks - Changes, Opportunities and Challenges, Technologies, Networks, and Services, Next Generation Society, future Trends.

UNIT II 4G and BEYOND 9

Introduction to LTE-A –Requirements and Challenges, network architectures –EPC, E-UTRAN architecture-mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT III SDMN-LTE INTEGRATION 9

SDN paradigm and applications, SDN for wireless-challenges, Leveraging SDN for 5G networks-ubiquitous connectivity-mobile cloud-cooperative cellular network-restructuring mobile networks to SDN-SDN/LTE integration benefits.

UNIT IV NGN ARCHITECTURE 9

Evolution towards NGN-Technology requirements, NGN functional architecture- Transport stratum, service stratum, service/ content layer and customer terminal equipment function. NGN entities, Network and Service evolution -fixed, mobile, cable and internet evolution towards NGN.

UNIT V NGN MANAGEMENT AND STANDARDIZATION 9

NGN requirements on Management-Customer, third party, Configuration, Accounting, performance, device and information management. Service and control management- End-to-End QoS and security. ITU and GSI-NGN releases, ETSI-NGN concept and releases, NGMN alliance and NGMN.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon completion of this course, a students should be able to:

- To be able to understand the issues and challenges of wireless domain in future generation network design.
- To be able to explore the LTE concepts and technologies.
- To be able to understand the integration of SDN with LTE.
- To be able to understand the NGN management and standardizations.

TEXT BOOKS:

1. Jingming Li Salina, Pascal Salina "Next Generation Networks-perspectives and potentials" Wiley, January 2008.
2. Madhusanga Liyanage, Andrei Gurtov, Mika Ylianttila, "Software Defined Mobile Networks beyond LTE Network Architecture", Wiley, June 2015

REFERENCES:

1. Martin Sauter,"3G,4G and Beyond bringing networks, devices and web together", Wiley, 2nd edition-2013.
2. Savo G Glisic," Advanced Wireless Networks- Technology and Business models", Wiley, 3rd edition- 2016.
3. Thomas Plavyk, ―Next generation Telecommunication Networks, Services and Management‖, Wiley & IEEE Press Publications, 2010.

CP18024	HIGH SPEED SWITCHING ARCHITECTURES (Common to CP & NW)	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To learn the basics of switching
- To explore the various space division switches
- To evaluate the performance of various switching architectures
- To study the architecture of IP routers
- To study about MPLS switches

UNIT I SWITCHING BASICS 9

Circuit switching, Message switching and Packet switching – Datagrams and Virtual circuits – Cell switching – Label switching – L2 switching Vs L3 switching – VLANs – Switching and Bridging – Loop resolution, Spanning tree algorithms – Cut through and Store and forward switches – Head of line blocking – Back pressure – Switch design goals

UNIT II SWITCHING ARCHITECTURES 9

Shared medium switches – Shared memory switches – Space division switches – Cross bar based switching architecture – Input queued, Output queued and Combined input-output queued switches – Non blocking and blocking cross bar switches – Banyan networks – Batcher Banyan networks –Optical switches – Unbuffered and buffered switches – Buffering strategies – Optical packet switches and Optical burst switches – MEMS optical switches

UNIT III PACKET QUEUES AND DELAY ANALYSIS 9

Littles theorem – Birth and death processes – Queuing disciplines – Markovian FIFO queuing – Non Markovian – PollaczekKhinchine formula –M/M/1, M/G/1 and M/D/1 models – Self similar models and Batch arrivals models – Network of queues – Burkes theorem and Jackson theorem.

UNIT IV PROUTER ARCHITECTURE 9

Bus based router architecture with single processor and multiple processors – Architecture with multiple parallel forwarding engines – Switch based router architecture with multiple processors – Switch based router architecture with multiple processors – Switch based architecture with fully distributed processors – Critical and non critical data path processing – fast and slow path.

UNIT V MPLS ROUTERS 9

MPLS – Layer 2.5 - Labels – Switching and Distribution –Label Switched Path – Label Forwarding Instance Base – Label Stacking - IP Lookup vs Label lookup – Label Distribution

Protocol – MPLS based VPNs– Label switching – Label switched path – Comparison with ATM technology.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon completion of this course, a students should be able to:

- Apply switching concepts to build networks.
- Deploy the network with appropriate type of switches.
- Select and configure the appropriate type of IP router.
- Design and implement MPLS networks.

TEXT BOOKS

1. Damitri P Bertsekas and Gallager, ―Data Networks‖, 2nd edition, PHI, 1992
2. Elhanany, Itamar, Hamdi and Mounir, ―High Performance Packet Switching Architectures‖, Springer 2007

REFERENCES:

1. H.Jonathan Chao and Bin Liu, ―High Performance Switches and Routers‖, John Wiley and Sons, 2007
2. Howard C Berkowitz, ―Designing Routing and Switching Architectures for Enterprise Networks‖, Sams, 1999
3. Luc De Ghein, ―MPLS Fundamentals‖, Cisco Press 2014.

CP18025 SOFTWARE DEFINED NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES :

- To understand the concepts of software defined networks
- To learn the interface between networking devices and the software controlling them
- To learn network virtualization and tools
- To explore modern approaches like vmware, openflow, openstack

UNIT I SOFTWARE DEFINED NETWORK (SDN) 9

Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework

UNIT II VIRTUALIZATION BASICS 9

Primer on Virtualization, Benefits of virtual machines, Hypervisors, Managing Virtual resources, Virtualized cloud/data center

UNIT III NETWORK FUNCTIONS VIRTUALIZED 9

Virtualize a Network, virtualizing appliances, virtualizing core networking functions, scalability and performance

UNIT IV MODERN NETWORKING APPROACHES 9

Openflow, VMware NSX, OpenDayLight project-ODL architecture & controller platform, control network, Business case for SDN

UNIT V SECURITY & VISIBILITY 9

Security-Preventing Data leakage, Logging and auditing, Encryption in Virtual Networks Visibility-Overlay networks, Network management tools, Monitoring Traffic

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon completion of this course, a students should be able to:

- To identify/design software defined network for the required application/platform
- To deploy network virtualization tool & design
- To equip in various network security measures and tackle

REFERENCES:

1. Jim Doherty,"SDN and NFV Simplified", Addison Wesley, 2016

2. SiamakAzodoimolky, "Software Defined Networking with OpenFlow", Packt Publishing Limited, 2013
3. Thomas D.Nadeau and Ken Gray, ―SDN – Software Defined Networks‖, O‟Reilly Publishers, 2013

CP18026	MULTIMEDIA COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To understand the multimedia communication models
- To study the multimedia transport in wireless networks
- To explore real-time multimedia network applications

UNIT I MULTIMEDIA COMMUNICATION MODELS 9

Common Multimedia applications - VoIP- Video Conferencing- Military Surveillance- Interactive TV- Video on Demand- Smart Phone - Requirements and Design challenges of multimedia communications-Architecture of Internet Multimedia Communication- Protocol Stack-H.323.

UNIT II BEST EFFORT AND GUARANTEED SERVICE MODEL 9

Best effort service model and its limitations-Resource allocation-Metrics-Max and Min fair sharing Queuing-FIFO-Priority queue-Fair queue- Waited fair queue-Traffic policing-Token bucket-leaky bucket-Admission control-Packet classification and scheduling.

UNIT III MULTIMEDIA ON IP NETWORKS 9

QoS aware routing-RSVP-Integrated and Differentiated services-MPLS-Multicasting-IGMP-PIMDVMRP

UNIT IV TRANSPORT LAYER SUPPORT FOR MULTIMEDIA 9

Multimedia over TCP-Significance of UDP- Multimedia Streaming- Audio and Video StreamingInteractive and non Interactive Multimedia-RTP/RTCP-SIP-RTSP.

UNIT V MULTIMEDIA QOS ON WIRELESS NETWORKS 9

IEEE 802.11e, IEEE 802.16, 3G networks-UMTS, 3GPP, 4G networks-LTE-IMS

TOTAL (L:45): 45 PERIODS

OUTCOMES:

Upon completion of this course, a students should be able to:

- To select suitable multimedia communication model for the required application
- Deploy the right Multimedia Communication models
- Apply QoS to multimedia network applications with efficient routing techniques
- Develop the real-time multimedia network applications

TEXT BOOKS:

1. James F. Kurose and Keith W. Ross, ―Computer Networking-A Top-Down Approach Featuring the Internet‖, Pearson, 2012.
2. Larry L. Peterson and Bruce S. Davie, ―Computer Networks- A Systems Approach‖, Morgan Kaufmann Publishers, 2007.

REFERENCES:

1. Mario Marques da Silva, ―Multimedia Communications and Networking‖, CRC Press, 2012.
2. Mark Wuthnow, Jerry Shih, Matthew Stafford, ―IMS: A New Model for Blending Applications‖, Auerbach Publications, 2009.