SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CURRICULUM FOR M.E. CSE COURSE

SEMESTER 1:

S.NO	CATEGORY	SUBJECT CODE	SUBJECT NAME	L	T	P	C	MAX MARKS
1	FCBS	15PH218	Theoretical Foundations of Computer Science	3	2	0	4	100
2	PC	15PQ401	Advanced Data Structures	3	2	0	4	100
3	PC	15PQ402	Advanced Operating Systems	3	2	0	4	100
4	PC	15PQ403	Advanced Computer Architecture	3	0`	0	3	100
5	PE		PE – 1	3	0	0	3	100
6	PE		PE – 2	3	0	0	3	100
7	PC Lab	15PQ451	Data Structures & Operating System Laboratory	0	0	4	2	100
			Total	18	6	4	23	800

SEMESTER 2:

S.NO	CATEGORY	SUBJECT CODE	SUBJECT NAME	L	T	P	C	MAX MARKS
1	PC	15PQ404	Advanced Database Technology	3	2	0	4	100
2	PC	15PQ405	Computer Network Engineering and Management	3	2	0	4	100
3	PC	15PQ406	Cloud computing	3	2	0	4	100
4	PE		PE - 3	3	0	0	3	100
5	PE		PE – 4	3	0	0	3	100
6	PSC		PSC – 1	3	0	0	3	100
7	PC Lab	15PQ452	Database & Computer Networks Laboratory	0	0	4	2	100
8		15PQ801	Technical Seminar	0	0	2	1	100
			Total	18	4	6	24	800

FCBS - Foundation Compulsory Basic Science
PC - Programme Core
PSC - Programme Soft Core
PE - Programme Elective

SEMESTER 3:

S.NO	CATEGORY	SUBJECT CODE	SUBJECT NAME	L	T	P	C	MAX MARKS
1	PSC		PSC – 2	3	0	0	3	100
2	PE		PE – 5	3	0	0	3	100
3	PE		PE – 6	3	0	0	3	100
4	Project	15PQ901	Project Work & Viva-voce – Phase I	0	0	12	6	100
5		15PQ802	Comprehensive Viva – Voce	0	0	2	1	100
			Total	9	0	14	16	500

SEMESTER 4:

S.NO	CATEGORY	SUBJECT CODE	SUBJECT NAME	L	T	P	C	MAX MARKS
1	Project	15PQ902	Project Work & Viva-voce – Phase II	0	0	24	12	100
			Total	0	0	24	12	100

FCBS - Foundation Compulsory Basic Science
PC - Programme Core
PSC - Programme Soft Core
PE - Programme Elective

Programme Soft Core Group (PSC):

S.No	SUBJECT CODE	SUBJECT NAME
1	15PQ501	Theory of Computation
2	15PQ502	Object Oriented System Design
3	15PQ503	Soft Computing
4	15PQ504	Wireless Sensor Networks
5	15PQ505	Web Technology
6	15PQ506	Secure Computing

Programme Elective (PE) Groups:

S.no	GROUP NAME	SUBJECT CODE	SUBJECT NAME
1	Image Processing	15PQ601	Digital Image Processing
		15PQ602	Computer Vision & Applications
		15PQ603	Pattern Classification & Analysis
2	Artificial Intelligence	15PQ604	Artificial Intelligence
		15PQ605	Natural Language Processing
		15PQ606	Semantic Web
3	Distributed Computing	15PQ607 / 15PN607	Distributed Computing
		15PQ608 / 15PN608	Service Oriented Architecture
		15PQ609 / 15PN609	XML and Web Services
4	Social Network Engineering	15PQ610 / 15PN610	Mobile Application Development
		15PQ611 / 15PN611	User Interface Design
		15PQ612 / 15PN612	Social Network Analysis
5	Data Analytics	15PQ613 / 15PN613	Data Warehousing & Mining
		15PQ614 / 15PN614	Internet of Things
		15PQ615 / 15PN615	Big Data Analytics

Note :

1. **Programme Electives (PE) must be framed by having 5 domains, each possessing 3 subjects. Students should get specialized in any two or three domains.**
2. **List of subjects must be given in Programme Soft Core (PSC), so that students can choose any 2 subjects.**
3. **Students can earn extra credits by doing certification courses.**

Curriculum Structure - Sample

S.No	Category Name	Actual Credit Break Up
1	Foundation Compulsory Basic Science (FCBS)	4
2	Programme Core(PC)	27
3	Programme Elective(PE)	18
4	Programme Soft Core(PSC)	6
5	Project	18
6	Technical Seminar	1
7.	Comprehensive Viva – Voce	1
	Total	**75**

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ401	ADVANCED DATA STRUCTURES	3	2	0	4

1. ***Course objectives:***
   - *To understand the implementation and use of advanced data structures*
   - *To learn how to analyze the space and time requirements of a given algorithm.*
   - *To design efficient algorithms using algorithmic techniques*

2. **Course pre-requisites** **:** Data Structures and Algorithms, C++ Programming

Module – I FOUNDATIONS AND SORTING ORDER STATISTICS 9

Growth of Functions: Asymptotic notations – Standard notations and common functions - Divide-and-Conquer: The maximum-subarray problem – Strassen's algorithm for matrix multiplication – solving recurrences:- substitution method, recursion-tree method. Probabilistic Analysis and Randomized Algorithms: The hiring problem – Indicator random variables - Randomized algorithms Heap sort- Quick sort - Sorting in Linear Time

Module – II DATA STRUCTURES 9

Elementary Data Structures: Stacks and queues - Linked lists - Implementing pointers and objects - Representing rooted trees. Hash Tables: Direct-address tables - Hash tables - Hash functions - Open addressing. Binary Search Trees: Querying a binary search tree - Insertion and deletion - Randomly built binary search trees .Red-Black Trees - Augmenting Data Structures

Module – III ADVANCED DESIGN AND ANALYSIS TECHNIQUES 9

Dynamic Programming: Matrix-chain multiplication - Elements of dynamic programming – Optimal binary search trees .Greedy Algorithms: An activity-selection problem - Elements of the greedy strategy. Amortized Analysis: Aggregate analysis - accounting method, potential method -Dynamic tables

Module – IV ADVANCED DATA STRUCTURES 9

B-Trees: Definition of B-trees - Basic operations on B-trees - Deleting a key from a B-tree - Fibonacci Heaps: Structure of Fibonacci heaps - Mergeable-heap operations - Decreasing a key and deleting a node - Bounding the maximum degree .Data Structures for Disjoint Sets: Disjoint-set operations- Linked-list representation of disjoint sets - Disjoint-set forests

Module – V GRAPH ALGORITHMS 9

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 algorithm - 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 - Johnson's algorithm - Maximum Flow : Flow networks - The Ford-Fulkerson method - Maximum bipartite matching

STATE OF ART (Not for Exam)

Solving all kind of Storage, Accessing, Searching Problems, Design approaches in Cloud Computing.

Total Hours: 45+ 30

3. Course outcomes:

- *Understand the algorithmic foundations and sorting order statistics*
- *Understand the properties of various basic data structures*
- *Analyze different algorithm design techniques.*
- *Understand the properties of advanced data structures and graph algorithms.*
- *Design and employ appropriate data structures for solving real time applications.*

REFERENCES:

1. T.H. Cormen, C.E. Leiserson,R.L. Rivest and C. Stein, " Introduction to Algorithms", Prentice Hall of India ,third edition ,2012
2. Mark Allen Weiss, Data Structures and Algorithms in C++, Pearson, 2009.
3. E. Horowitz, S. Sahni and S. Rajasekaran, Computer Algorithms / C++, University Press, 2007.
4. Adam Drozdex, Data Structures and algorithms in C++. New Delhi: Thomson learning, 2006.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ402	ADVANCED OPERATING SYSTEMS	3	2	0	4

1. **Course objectives:**
   - *To provide a modern and forward-looking perspective of computer system design, based on enforcing modularity.*
   - *To provide a solid foundation about the mechanisms that underlie operating systems, database systems, computer security, distributed systems, fault-tolerant computing, and concurrency*
   - *To understand the engineering of many aspects of computer systems to information management*
   - *To prepared the students to read and understand current professional literature about systems, and know what questions to ask and where to find the answers.*

2. **Course pre-requisites:** **S**oftware design and Computer hardware organization

Module - I COMPUTER SYSTEM ORGANIZATION AND NAMING SCHEMES 9

Systems : Systems and complexity - Sources of complexity- Coping with complexity Computer systems are the same, but different - Coping with complexity II . **Elements of Computer System Organization:** The three fundamental abstractions - Naming in computer systems - Organizing computer systems with names and layers - Looking back and ahead -Case study: Unix® file system layering and naming. **The Design of Naming Schemes :** Considerations in the design of naming schemes - Case study: The uniform resource locator (URL)- War stories: Pathologies in the use of names.

Module -II COMMUNICATION MODELS, FILE SYSTEM AND VIRTUALIZATION 9
Enforcing Modularity with Clients and Services: Client/service organization- Communication between client and service - Summary and the road ahead - Case study: The Internet Domain Name System (DNS) - Case study: The Network File System (NFS) . **Enforcing modularity with virtualization:** Client/server organization within a computer using virtualization - Virtual links using SEND , RECEIVE, and a bounded buffer - Enforcing modularity with domains-Virtualizing memory - Virtualizing processors using threads - Thread primitives for sequence coordination - Case study: Evolution of enforced modularity in the Intel x86 - Application: Enforcing modularity using virtual machines

Module - III FAULT TOLERANCE 9

Fault Tolerance: Reliable Systems from Unreliable Components: Faults, failures, and fault-tolerant design - Measures of reliability and failure tolerance - Tolerating active faults - Systematically applying redundancy - Applying redundancy to software and data - Wrapping up reliability Application: A fault tolerance model for CMOS RAM - War stories: fault-tolerant systems that failed

Module - IV **TRANSACTIONS AND CONSISTENCY 9**

Atomicity: All-or-nothing and Before-or-after: Atomicity - All-or-nothing atomicity I: Concepts - All-or-nothing atomicity II: Pragmatics - Before-or-after atomicity I: Concepts - Before-or-after

atomicity II: Pragmatics - Atomicity across layers and multiple sites - Case studies: machine language atomicity - A more complete model of disk failure (Advanced topic) **Consistency :**Constraints and interface consistency - Cache coherence - Durable storage revisited: geographically separated replicas - Reconciliation - Perspectives

Module - V SECURITY AND TRUSTED COMPUTING 9

Information Security : Introduction to secure systems - Authenticating principals - Authenticating messages - Message confidentiality - Security protocols - Authorization: controlled sharing - Advanced topic: Reasoning about authentication - Cryptography as a building block (Advanced topic) Case Study: Transport Layer Security (TLS) for the Web - War stories: security system breaches

STATE OF ART (Not for Exam)
Ubiquitous and Pervasive Computing, Grid Computing and Cloud Computing

Total Hours: 45+30=75

3. Course outcomes:

- *Understand the application of naming, layering, and abstraction in the file system*
- *Understand the concept of modularity using Client -Server model, Virtual memory and Virtual Processors.*
- *Understand the design principles and techniques for creating reliable systems from unreliable components, based on modularity.*
- *Able to make flawless updates to data in the presence of concurrent threads, system failures and replication.*
- *Understand cryptographic techniques, which are the basis for most network security.*

REFERENCES

1. Saltzer and Kaashoek. Morgan Kaufmann ,"Principles of Computer Systems Design " Morghan Kauffmann Publication, 2009
2. Andrew S. Tanenbaum. Modern Operating Systems. Prentice-Hall, third edition, 2008.
3. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, " Operating Sytem Principles" 9th Edition, John Wiley &Sons, 2013.
4. Pradeep K. Sinha, "Distributed Operating Systems-Concepts and Design" 2nd Edition IEEE 1197.
5. Michael N. Nelson, Brent B. Welch, and John K. Ousterhout. Caching in the Sprite network file system. ACM Transactions on Computer Systems, 6(1):134-154, February 1988.
6. Mahadev Satyanarayanan. Scalable, secure, and highly available distributed file access. IEEE Computer, 23(5):9-21, May 1990.
7. Mendel Rosenblum and John K. Ousterhout. The design and implementation of a log-structured file system. ACM Transactions on Computer Systems, 10(1):26-52, February 1992.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ403	ADVANCED COMPUTER ARCHITECTURE	3	0	0	3

1. ***Course objectives:***
   - *To know the fundamental concepts of Computer architecture and its organization*
   - *To learn the working concepts of ALU and control unit*
   - *To learn memory management and its hierarchy*
   - *To study about pipelining and handling hazards.*
   - *To understand the parallel processing in a single and multiple processors.*

2. Course pre-requisites : Computer Architecture/Microprocessor and interfacing

Module- I COMPUTER ORGANIZATION & ARCHITECTURE 9

Introduction-functional units - measuring and reporting performance- Quantitative principles of computer design. Instruction set principles and examples- classifying instruction set Architectures - memory addressing.

Module- II ALU & CONTROL UNIT 9

ALU design – Addition –Subtraction- Multiplication-division- Multiple bus organization-Hardwired control – Micro programmed control- examples.

Module- III MEMORY HIERARCHY DESIGN 9

Introduction- Basic concepts of Main memory – types –organization - Speed – Size and cost – Cache memories – Improving cache performance – reducing cache miss penalty reducing miss rate – reducing hit time-Virtual memory – Memory management requirements.

Module- IV INSTRUCTION-LEVEL PARALLELISM AND ITS EXPLOITATION 9

Pipelining-Basic concepts –Basic Compiler Techniques for Exposing ILP -Reducing Branch Costs with Prediction -Overcoming Data Hazards with Dynamic Scheduling -Hardware-Based Speculation - Exploiting ILP Using Multiple Issue and Static Scheduling -Exploiting ILP Using Dynamic Scheduling, Multiple Issue, and Speculation.

Module- V INTRODUCTION TO PARALLEL PROCESSING 9

Flynn's classification, SIMD and MIMD operations, Symmetric Shared Memory Multiprocessors, Distributed shared memory and Directory-Based Coherence-Synchronization-RAID.

STATE OF ART (Not for Exam)

Parallel Computer Architecture, Hyper-Threading Technology

Total Hours: 45

3. Course outcomes:

- *Understand the merits and pitfalls in computer performance measurements.*
- *Design Arithmetic and Logic unit , Control unit*
- *Understand memory hierarchy and its impact on computer cost/performance.*
- *Understand ways to take advantage of instruction level parallelism for high performance processor design.*

REFERENCES:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, 5th Edition "Computer Organization", McGraw-Hill, 2002.
2. John P Hayes , "Computer Organization and architecture", Pearson edition 2003.
3. John L. Hennessey and David A. Patterson, "Computer Architecture: A Quantitative Approach", Morgan Kaufmann, 2006.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ451	DATA STRUCTURES AND OPERATING SYSTEMS LABORATORY	0	0	2	2

DATA STRUCTURES

1. **Course learning objectives :**
   - *To learn to implement iterative and recursive algorithms.*
   - *To learn to design and implement algorithms using hill climbing and dynamic programming techniques*
   - *To learn to implement randomized algorithms.*

2. **Course pre-requisites :** JAVA

3. **Expected Level of Output : Practical**

4. **Department Offered :** Computer Science and Engineering

5. **Nature of the Course :** Group 5 - Practical

   (Please choose any one)

   A. Group 1 – 100 % Descriptive
   B. Group 2 – 100% Analytical
   C. Group 3 –__% Descriptive & __%Analytical
   D. Group 4 – Programming
   E. Group 5 – Practical
   F. Group 6 – Project
   G. Group 7 – 20 % Descriptive & 80% Programming
   H. Group 8 –
   I. Group 9 –

Continuous Internal Assessment (CIA) : 40 Marks
Semester End Examination (SEE) : 60 Marks

6. **List of Experiments:**
   1. Implementation of Iterative Sorting Algorithms
   2. Implementation of Recursive Sorting Algorithms
   3. Implementation of Iterative Depth first Search algorithm
   4. Implementation of Recursive Depth first Search algorithm
   5. Implementation of Iterative Breadth first Search algorithm
   6. Implementation of Dijkstra's Shortest path algorithm
   7. Implementation of algorithm using dynamic programming technique for Longest Common Sequence problem
   8. Implementation of Randomized Quicksort
   9. Implementation of randomized algorithm for primality test
   10. Implementation of hill climbing algorithm for Network flow problem.
   11. Implementation of recursive backtracking algorithm for n-Queens Problem

7. Expected outcome of the course:

- *Design and apply iterative and recursive algorithms.*
- *Design and implement algorithms using the hill climbing and dynamic programming and recursive backtracking techniques.*
- *Design and implement optimization algorithms for specific applications.*
- *Design and implement randomized algorithms.*

Course Code	Course Name	Contact Hours			
		L	T	P	C
15CP111	DATA STRUCTURES AND OPERATING SYSTEMS LABORATORY	0	0	2	2

OPERATING SYSTEMS

1. ***Course learning objectives*** **:**
   - *To understand the Multi-Processor and multi-threading, Real-time operating system concepts and IPC*
   - *To study distributed server with RPC, RMI, CORBA and Web services.*
   - *To implement Virtualization concept.*

2. ***Course pre-requisites*** **: JAVA**

3. ***Expected Level of Output*** **: Practical**

4. ***Department Offered*** **:** Computer Science and Engineering

5. ***Nature of the Course*** **:** Group 5 - Practical
   (Please choose any one)

   A. Group 1 – 100 % Descriptive
   B. Group 2 – 100% Analytical
   C. Group 3 –__% Descriptive & __%Analytical
   D. Group 4 – Programming
   E. Group 5 – Practical
   F. Group 6 – Project
   G. Group 7 – 20 % Descriptive & 80% Programming
   H. Group 8 –
   I. Group 9 –

   Continuous Internal Assessment (CIA) : 40 Marks
   Semester End Examination (SEE) : 60 Marks

6. ***List of Experiments:***
   1. Implementation of producer consumer problem
   2. Implementing semaphores in multiprocessor operating systems.
   3. Implementing multiple sleeping barbers problem in multiprocessor operating systems based on multi-threading concept.
   4. Implementing an alarm clock in real time operating systems
   5. Implementing transactions and concurrency in database operating systems.
   6. Designing a RMI lottery application in distributed operating systems
   7. Designing a RPC lottery application in distributed operating systems
   8. Designing a CORBA lottery application in distributed operating systems
   9. Install Virtual Box and Hypervisor
   10. Implement Virtualization using Xen / VMware.

7. Expected outcome of the course:

- *Use Semaphore to perform IPC.*
- *Understand the Multi-Processor and multi-threading, Real-time operating system concepts.*
- *Implement various distributed server technologies like CORBA, RPC and RMI.*
- *Demonstrate Virtualization.*

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ404	ADVANCED DATABASE TECHNOLOGY	3	2	0	4

1. ***Course objectives:***
   - *To understand database systems, data models, database languages*
   - *To be able to design a database system by understanding the concepts of functional dependencies and normalization*
   - *To acquire knowledge on parallel and distributed databases and its query processing.*
   - *To understand the principles of object oriented databases.*
   - *To gain knowledge about the emerging database technologies.*

2. **Course pre-requisites** **:** NIL

Module- I INTRODUCTION TO DATABASE SYSTEMS AND RELATIONAL MODEL 9

File systems - Database systems - Database systems architecture - Database Languages - Data Dictionary - Database Administration and control-Data models - Entity-Relationship model – entities, entity types, various types of attributes, relationships, relationship types and extended E-R features, ER diagram notation, examples- Reduction of ER model to relational schema.

Module- II STRUCTURED QUERY LANGUAGE AND NORMALIZATION 9

Fundamentals of SQL- Domains and Integrity constraints-Views-Triggers -Procedures and functions - Normalization and database design-Functional Dependencies-Desirable properties of Decomposition - First, Second, Third Normal Forms, Boyce/Codd Normal Form- Multi-valued Dependencies and Fourth Normal Form.

Module- III PARALLEL AND DISTRIBUTED DATABASES 9

Database System Architectures: Centralized and Client-Server Architectures -Parallel Systems- Distributed Systems. Parallel Databases: I/O Parallelism - Inter and Intra Query Parallelism - Inter and Intra operation Parallelism- Distributed Database Concepts - Distributed Data Storage-Distributed Transactions-Commit Protocols - Concurrency Control - Distributed Query Processing- Recovery Concepts. Query optimization-Database Tuning.

Module- IV OBJECT ORIENTED AND OBJECT RELATIONAL DATABASES 9

Concepts for Object Databases: Object Identity - Object structure - Type Constructors-Methods-Type and Class Hierarchies -Inheritance - Complex Objects- Object Oriented Languages -ODMG Model - Object Relational Databases - Nested Relations- Complex Types and Object Orientation- Querying With Complex Types.

Module- V INTELLIGENT DATABASES 9

Introduction to intelligent databases - Temporal - Spatial databases - Multimedia databases – Embedded database – NoSQL database – In-memory database

STATE OF ART (Not for Exam)

Challenges in NoSQL database.

Total Hours: 45+30

3. Course outcomes:

- *Ability to understand and model database systems*
- *Ability to design a database system*
- *Ability to design parallel and distributed databases*
- *Apply the object oriented concepts in databases*
- *Ability to understand and analyze various intelligent databases*

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan- "Database System Concepts", Sixth Edition, McGraw-Hill, 2010.
2. Ramez Elmasri and Shamkant B. Navathe, "Fundamental Database Systems", Fifth Edition, Pearson Education, 2006.
3. C.J.Date, A.Kannan, S.Swamynathan -"An Introduction to Database System", Eighth Edition, Pearson education, 2006.
4. Won Kim, MIT Press , "Introduction to Object Oriented Databases", MIT Press,2003.
5. Thomas Cannolly and Carolyn Begg, Database Systems, A Practical Approach to Design, Implementation and Management. New Delhi: Pearson Education, 2009.
6. V.S.Subramanian, "Principles of Multimedia Database Systems", Harcourt India Pvt Ltd., 2001.
7. Raghu Ramakrishnan,Johannes Gehrke," Database Management Systems",Third Edition,Mc.Graw Hill,2008.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ405	Computer Network Engineering and Management	**3**	**2**	**0**	**4**

1. Course objectives:

- *To understand the fundamental concepts of computer networks.*
- *To understand the working principles of different protocols in various layers.*
- *To learn the overview of wireless and optical networks.*
- *Introduce the student to advanced networking concepts like virtual private networks and multimedia networks.*

2. **Course pre-requisites** **:** Computer Networks

Module – I NETWORKING PROTOCOLS AND DEVICES 9

Foundation of Networking Protocols: 5-layer TCP/IP Model, 7-layer OSI Model, Internet Protocols and Addressing, Equal-Sized Packets Model: ATM -Networking Devices: Router Structure.

Module –II LINK LAYER AND NETWORK ROUTING 9

The Link Layer and Local Area Networks: Link Layer: Introduction and Services, Error-Detection and Error-Correction techniques,- Multiple Access Protocols, Link Layer Addressing, Ethernet, Interconnections: Hubs and Switches, PPP: The Point-to-Point Protocol, Link Virtualization - Routing and Internetworking: Network-Layer Routing, Least-Cost-Path algorithms, Non-Least-Cost-Path algorithms, Intradomain Routing Protocols, Interdomain Routing Protocols, Congestion Control at Network Layer.

Module – III INTERNET AND MULTICAST PROTOCOLS 9

Internet Protocol: Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6 - Multicasting Techniques and Protocols: Basic Definitions and Techniques, Intradomain Multicast Protocols, Interdomain Multicast Protocols, Node-Level Multicast algorithms

Module – IV WIRELESS NETWORKS AND OPTICAL NETWORKS 9

Wireless Networks and Mobile IP: Infrastructure of Wireless Networks, Wireless LAN Technologies, IEEE 802.11 Wireless Standards, Cellular Networks, Mobile IP, Wireless Mesh Networks (WMNs) - Optical Networks and WDM Systems: Overview of Optical Networks, Basic Optical Networking Devices, Large-Scale Optical Switches, Optical Routers, Wavelength Allocation in Networks.

Module - V VIRTUAL PRIVATE NETWORKS AND MULTIMEDIA NETWORKS 9

VPNs, Tunneling and Overlay Networks: Virtual Private Networks (VPNs), Multiprotocol Label Switching (MPLS), Overlay Networks-VoIP and Multimedia Networking: Overview of IP Telephony, VoIP Signaling Protocols, Real-Time Media Transport Protocols, Distributed Multimedia Networking, Stream Control Transmission Protocol.

STATE OF ART (Not for Exam)

Mobile Ad-hoc networks and Wireless sensor networks.

Total Hours: 45+ 30

3. Course outcomes:

- *Students can acquire knowledge about computer networks.*
- *Identify the different types of network devices and their functions within a network*
- *Students will get an overview of the various protocols in different layers.*
- *Students can understand and analyze the importance of various protocols in computer design.*

REFERENCES:

1. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, Keith W. Ross, Third Edition, Pearson Education, 2007
2. Computer and Communication Networks, Nader F. Mir, Pearson Education. 2007
3. Data Communications and Networking, Behrouz A. Forouzan, Fourth Edition, Tata McGraw Hill, 2007
4. Computer Networks, Andrew S. Tanenbaum, Fourth Edition, Prentice Hall.

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Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ406	CLOUD COMPUTING	3	2	0	4

1. ***Course objectives:***
   - *To understand the key dimensions of the challenges of Cloud Computing.*
   - *To identify the architecture and infrastructure of cloud computing.*
   - *To understand virtualization concepts.*
   - *To learn the core issues of cloud computing such as security, privacy, and interoperability.*
   - *To learn the concepts of map reduce programming.*
   - *To know intelligent cloud services and application.*

2. **Course pre-requisites** **:** Distributed Computing

Module – I INTRODUCTION TO CLOUD COMPUTING 9

Introduction: Distributed Computing and Enabling Technologies, Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Applications, deployment models, and service models. Virtualization: Issues with virtualization, virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, virtualization of data centers, and Issues with Multi-tenancy.

Module –II CLOUD COMPUTING SYSTEMS 9

Implementation: Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine, and Microsoft Azure, Build Private/Hybrid Cloud using open source tools, Deployment of Web Services from Inside and Outside a Cloud Architecture. MapReduce and its extensions to Cloud Computing, HDFS, and GFS.

Module – III INTEROPERABILITY AND FAULT TOLERANCE 9

Interoperability and Service Monitoring: Issues with interoperability, Vendor lock-in, Interoperability approaches. SLA Management, Metering Issues, and Report generation. Migration and Fault Tolerance: Broad Aspects of Migration into Cloud, Migration of virtual Machines and techniques. Fault Tolerance Mechanisms.

Module – IV SECURITY IN THE CLOUD 9

Security: Vulnerability Issues and Security Threats, Application-level Security, Data level Security, and Virtual Machine level Security, Infrastructure Security, and Multi-tenancy Issues. IDS: host-based and network-based, Security-as-a-Service. Trust Management, Identity Management, and Access Controls Techniques

Module – V OPEN SOURCE SUPPORT FOR CLOUD 9

Introduction – Open Source Tools for IaaS : Eucalyptus, OpenStack. Open Source Tools for PaaS: Paasmaker, Cloudify. Open Source Tools for SaaS: Google Drive, Dropbox. OpenSource Tools for Research: CloudSim, GreenCloud.

STATE OF ART (Not for Exam)

Distributed Computing Tools: Cassandra, Hadoop, MongoDB, NGrid, Ganglia

Total Hours: 45+30

3. Course outcomes:

- *Understanding of the technical foundations of cloud computing such as data center infrastructures and virtualization.*
- *Understanding of different cloud computing service models, and their role for modern application development.*
- *Understanding the map-reduce paradigm.*
- *Understanding of the core security with cloud infrastructures.*

REFERENCES:

1. Rajkumar Buyya,James Broberg, Andrzej Goscinski, "Cloud Computing Principles and Paradigms", Wiley Publishers, 2011.
2. K. Chandrasekaran, "Essentials of Cloud Computing", CRC Press, 2014.
3. Barrie Sosinsky, "Cloud Computing Bible", Wiley Publishers, 2010.
4. Michael Miller, "Cloud Computing: Web-based Applications that change the way you work and collaborate online", Pearson Education, 2008.
5. Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, "Mastering Cloud computing", McGraw Hill, 2013.
6. David S. Linthicum, "Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide", 2010.
7. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", O'Reilly, 2010.
8. Toby Velte, Antohy T Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", McGraw Hill, 2009.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ452	DATABASE & COMPUTER NETWORKS LABORATORY	0	0	4	2

DATABASE

1. ***Course learning objectives*** **:**

- *To understand the concept of designing a database with the necessary attributes.*
- *To know the methodology of Accessing, Modifying and Updating data & information from the relational databases.*
- *To understand the purpose of views and triggers*
- *To develop procedures, functions in SQL.*
- *To develop an application*

2. ***Course pre-requisites*** **: NIL**

3. ***Expected Level of Output*** **:** Practical

4. ***Department Offered*** **:** Computer Science and Engineering

5. ***Nature of the Course*** **:** Group 5 - Practical

(Please choose any one)

A. Group 1 – 100 % Descriptive
B. Group 2 – 100% Analytical
C. Group 3 –__% Descriptive & __%Analytical
D. Group 4 – Programming
E. Group 5 – Practical
F. Group 6 – Project
G. Group 7 – 20 % Descriptive & 80% Programming
H. Group 8 –
I. Group 9 –

Continuous Internal Assessment (CIA) : 40 Marks

Semester End Examination (SEE) : 60 Marks

6. ***List of Experiments*****:**

1. Study of SQL commands-DDL, DML, Nested Queries & Join Queries, and Views.
2. Working with Triggers, Procedures and Functions
3. Database Design using ER diagram and Normalization
4. Database implementation (Mini Project)
5. Working with NoSQL Databases (PIG/HIVE)

7. Expected outcome of the course:

- Construct an Entity Relationship (E-R) diagram for an application.
- Create a normalized relational database model and write queries to retrieve information.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15CP211	DATABASE & COMPUTER NETWORKS LABORATORY	0	0	4	2

COMPUTER NETWORKS

1. ***Course learning objectives*** **:**

   i. To understand the fundamental concepts of socket programming.
   ii. To understand the state-of-the-art in network protocols and applications.
   iii. To learn network simulation tools.
   iv. To develop different applications in networking

2. ***Course pre-requisites*** **:** NIL

3. ***Expected Level of Output*** **:** Practical

4. ***Department Offered*** **:** Computer Science and Engineering

5. ***Nature of the Course*** **:** Group 5 - Practical

(Please choose any one)

A. Group 1 – 100 % Descriptive
B. Group 2 – 100% Analytical
C. Group 3 –__% Descriptive & __%Analytical
D. Group 4 – Programming
E. Group 5 – Practical
F. Group 6 – Project
G. Group 7 – 20 % Descriptive & 80% Programming
H. Group 8 –
I. Group 9 –

Continuous Internal Assessment (CIA) : 40 Marks

Semester End Examination (SEE) : 60 Marks

6. ***List of Experiments*****:**

1. Applications using TCP Sockets / UDP Sockets like
   - Echo client and echo server
   - File transfer
   - Remote command execution
   - SMTP
2. Study of Network simulator (NS)
3. Some Network protocol simulation using NetSim, NS2, etc. for
   - Implementation of Sliding Window Protocol.
   - Implementation of Routing Protocols.
4. Programs using RPC.
5. Development of applications such as DNS/ HTTP/ E – mail/ Multi - user Chat.

7. ***Expected outcome of the course*****:**
   - *Demonstrate various socket programming*
   - *Implement different routing protocols.*
   - *Develop various applications by using advanced concepts of computer networks.*

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ501	THEORY OF COMPUTATION	3	0	0	3

1. ***Course objectives:***
   - *To have an understanding of Computational languages*
   - *To have a knowledge of finite automata, regular languages and context free languages and its properties*
   - *To know the relation between context free language and Pushdown Automata.*
   - *To study the concept of Turing machines.*
   - *To learn the concepts of Church Turing Thesis.*

2. **Course pre-requisites** **:** System Software.

Module – I INTRODUCTION TO FINITE AUTOMATA 9

Alphabets - Strings and Languages; Automata and Grammars; Deterministic Finite Automata (DFA)- Formal Definition - Language of DFA - Nondeterministic finite Automata (NFA) - NFA with epsilon transition - Equivalence of NFA and DFA - Minimization of Finite Automata - Distinguishing one string from other.

Module – II REGULAR EXPRESSION 9

Definition - Operators of regular expression and the precedence - Algebraic laws for Regular expressions - Kleen‟s Theorem - Regular expression to FA - DFA to Regular expression – Arden Theorem - Pumping Lemma for regular Languages - Application of Pumping Lemma; Closure properties of Regular Languages - Decision properties of Regular Languages - FA with output: Moore and Mealy machine - Equivalence of Moore and Mealy Machine - Applications and Limitation of FA.

Module – III CONTEXT FREE GRAMMER AND CONTEXT FREE LANGUAGES 9

Definition – Examples - Derivation - Derivation trees - Ambiguity in Grammar - Inherent ambiguity - Ambiguous to Unambiguous CFG - Useless symbols - Simplification of CFGs - Normal forms for CFGs: CNF and GNF - Closure properties of CFLs - Decision Properties of CFLs: Emptiness, Finiteness and Membership - Pumping lemma for CFLs.

Module – IV PUSH DOWN AUTOMATA & TURING MACHINES 9

Description and definition - Instantaneous Description - Language of PDA: Acceptance by Final state, Acceptance by empty stack - Deterministic PDA - Equivalence of PDA and CFG: CFG to PDA and PDA to CFG - Two stacks PDA - Turing machines (TM): Basic model - definition and representation - Instantaneous Description - Language acceptance by TM - Variants of Turing Machine - TM as Computer of Integer functions.

Module – V CHURCH TURING THESIS 9

Recursive and recursively enumerable languages - Halting problem- Introduction to Undecidability: Undecidable problems about TMs - Post correspondence problem (PCP) - Modified PCP - Reducibility: Undecidable problems from Language theory – A simple Undecidable problem – Mapping Reducibility. Advanced topics in Computability Theory: The Recursion Theorem – Decidability of logical theories – Turing Reducibility

STATE OF ART (Not for Exam)

L-Systems- Biological Motivation- Array Grammars -Digital Pictures- Cellular Automata

Total Hours: 45

3. Course outcomes:

- *Understand and manipulate formal descriptions of languages, automata and grammars with focus on Regular and Context Free Languages, Finite State Automata and Regular Expressions.*
- *Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.*
- *Understand basic properties of Turing machines and computing with Turing machines.*
- *Be familiar with thinking analytically and intuitively for problem-solving situations in related areas of Computer Science.*

REFERENCES

1. J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", Third Edition, Pearson Education, 2006.
2. Micheal Sipser, "Introduction of the Theory and Computation", Second edition, Thomson Brokecole, 2005.
3. K.L.P. Mishra and N.Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", Third edition, PHI, 2008.
4. Martin J. C., "Introduction to Languages and Theory of Computations", TMH, 2003.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ502	OBJECT ORIENTED SYSTEM DESIGN	3	0	0	3

1. ***Course objectives:***
   - *To apply the process of object-oriented analysis and design for software development*
   - *To develop the skills to determine which processes & OOAD techniques should be applied to a given project.*
   - *Use the widely adopted graphical modeling language - the Unified Modeling Language (UML)*

   .
2. **Course pre-requisites** **:** Software Engineering

Module - I INTRODUCING OBJECT ORIENTED SOFTWARE DEVELOPMENT PROCESS **9**

The inherent complexity of software, The structure of complex systems bringing order to chaos, on designing complex systems categories of analysis & design methods Object-Oriented Software Development (OOSD) process Structure Analysis Vs OO Analysis Modeling and OOSD process Requirements Gathering, Requirements Analysis

Module - II CLASS DIAGRAM **9**

Identify a set of candidate key abstractions ,Identify the key abstractions using CRC analysis , Constructing the Problem Domain Model , Components of a UML Class diagram , Construct a Domain model using a Class diagram , Components of a UML Object diagram , Validate the Domain model with one or more Object diagrams

Module - III USE CASE DIAGRAMS **9**

Use Case diagram ,Components of UML Use Case diagram ,Develop a Use Case diagram for a software system ,Recognize and document use case dependencies using ,UML notation for extends, includes, and generalization ,UML packaged views ,Identify and document scenarios for a use case ,Create a Use Case form describing a summary of the scenarios in the main and alternate flows ,Describe how to reference included and extending use cases.Identify and document non-functional requirements (NFRs), business rules, risks, and priorities for a use case

Module - IV TRANSITIONING FROM ANALYSIS TO DESIGN USING INTERACTION, STATE MACHINE & ACTIVITY DIAGRAMS **9**

Purpose and elements of the Design model ,Components of a UML Communication diagram ,Create a Communication diagram view of the Design model ,Components of a UML Sequence diagram , Create a Sequence diagram view of the Design model ,Model object state ,Components of a UML State Machine diagram ,Components of a UML Activity diagram ,Model a Use Case flow of events using an Activity diagram

Module - V APPLYING DESIGN PATTERNS TO THE DESIGN MODE **9**

Define the essential elements of a software pattern, Describe the Creational pattern, Describe the Structural pattern ,Describe the Behavioral pattern

STATE OF ART (Not for Exam)

Story driven modeling, Object Oriented Operating System, Object role Modeling

Total Hours: 45

3. Course outcomes:

- *Knowledge on how to choose which metrics to collect and use them to make predictions.*
- *Ken on product and quality metrics.*
- *Understand how to detect, classify, prevent and remove defects.*
- *Choose appropriate quality assurance models and develop quality.*
- *Ability to conduct formal inspections, record and evaluate results of inspections*

REFERENCES:

1. Grady Booch, James Rambaugh, Ivar Jacobson," The Unified Modeling Language User Guide", Pearson Education.
2. Grady Booch," Object Oriented Analysis & Design with Applications", Third Edition,Pearson Education.
3. Ali Bahrami,"Object Oriented System Development", McGraw Hill International Edition
4. Gamma, Belm, Johnson, "Design Patterns: Elements of Reusable Object Oriented Software"
5. Alan Dennis, Barabara Haley Wixom , Roberta M. Roth: "Systems Analysis and Design- An Applied Approach". John Wiley Publication

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ503	SOFT COMPUTING	3	0	0	3

1. ***Course objectives:***
   - *To understand the concept of soft computing*
   - *To study the ideas of Neural networks, fuzzy logic and use of heuristics based on human experience.*
   - *To learn the concepts of Genetic algorithm and its applications.*

2. **Course pre-requisites** **:** Artificial Intelligence

Module – I SOFTCOMPUTING AND CONVENTIONAL AI **9**

Evolution of Computing – Soft Computing Constituents – From Conventional AI to Computational Intelligence – Derivative based optimization: Descent Methods, Newton's method- Step size determination- Derivative free optimization.

Module –II FUZZY SYSTEMS **9**

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions – Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making.

Module –III ARTIFICIAL NEURAL NETWORKS **9**

Machine Learning Using Neural Network, Adaptive Networks – Feed forward Networks –Supervised Learning Neural Networks – Radial Basis Function Networks – Reinforcement Learning – Unsupervised Learning Neural Networks.

Module –IV NEURO - FUZZY MODELING **9**

Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rulebase Structure Identification – ANFIS Applications.

Module –V GENETIC ALGORITHMS **9**

Evolutionary Computation – Genetic Algorithms – Terminologies and Operators of GA – Classification of GA : Simple GA, Parallel and Distributed GA, Adaptive GA – Ant Colony Optimization – Particle Swarm Optimization – Application of GA : Machine Learning, Image Processing, Data Mining and Wireless networks.

STATE OF ART (Not for Exam)

Soft computing techniques for Process control applications, intrusion detection and web mining.

Total Hours: 45

3. Course outcomes:

- *Identify and describe soft computing techniques and their roles in building intelligent machines.*
- *Recognize the feasibility of applying a soft computing methodology for a particular problem.*
- *Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.*
- *Apply genetic algorithms to combinatorial optimization problems.*
- *Apply neural networks to pattern classification and regression problems.*
- *Evaluate and compare solutions by various soft computing approaches for a given problem.*

REFERENCES

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", 1st Edition, Prentice Hall of India, 2003.
2. S.N.Sivanandam, S.N.Deepa, "Introduction to Genetic Algorithms", 1st Edition, Springer, 2007.
3. S.N.Sivanandam, S.N.Deepa, "Principles of Soft Computing", Wiley & Sons, 2nd Edition, 2007.
4. Agoston E.Eiben, J.E.Smith, "Introduction to Evolutionary Computing", 1st Edition, Springer, 2008.
5. S.N.Sivanandam, S.Sumathi and S.N.Deepa, "Introduction to Fuzzy Logic using MATLAB", 1st

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ504	WIRELESS SENSOR NETWORKS	3	0	0	3

1. Course objectives:

- *To learn the basics of sensor networks.*
- *To impart knowledge on the design and development of the data link and network layers in the WSN protocol stack.*
- *To understand the working of protocols in different layers of sensor networks.*
- *To learn the establishment of wireless sensor networks.*
- *To study about the issues relate to major obstacles in developing and managing sensor networks.*
- *To familiarize the students with the hardware and software platforms used in the design of WSN.*

2. **Course pre-requisites** **:** Computer Networks

Module – I INTRODUCTION **9**

Overview of sensor networks- Constraints and challenges – Advantages of sensor networks- Applications- Collaborative processing – Key definitions in sensor networks – Tracking scenario – Problem formulation – Distributed representation and interference of states – Tracking multiple objects – sensor models- Performance comparison and metrics.

Module –II MAC PROTOCOLS FOR WIRELESS SENSOR NETWORKS **9**

MAC protocols –fundamentals of wireless MAC protocols– Low duty cycle protocols and wakeup concepts – Contention-Based protocols – Schedule-Based protocols- IEEE 802.15.4 standard and ZigBee - General Issues - Geographic, Energy – Aware Routing - Attribute based routing.

Module – III INFRASTRUCTURE ESTABLISHMENT **9**

Topology control – Clustering -Time Synchronization – Localization and Positioning – Task driven sensing – Role of sensor nodes – Information based tasking - Routing and aggregation.

Module – IV ROUTING PROTCOLS FOR WIRELESS SENSOR NETWORKS **9**

Issues in designing a routing protocol -Gossiping and agent-based uni-cast forwarding, Energy-efficient unicast, Broadcast and multicast, geographic routing, mobile nodes, Data-centric routing – SPIN, Directed Diffusion, Gradient-based routing – COUGAR, ACQUIRE, Hierarchical Routing – LEACH, PEGASIS, Location Based Routing – GAF, GEAR.

Module – V SENSOR NETWORK DATABASE AND TOOLS **9**

Sensor Database Challenges – Querying the physical environment – Interfaces – In-network aggregation – Data centric storage – Data indices and range queries – Distributed Hierarchical aggregation – Temporal data. Sensor Node Hardware– Node level software platforms – Operating system TinyOS – Node level simulators – State centric programming.

STATE OF ART (Not for Exam)

Mobile Ad-hoc Networks.

Total Hours: 45

3. Course outcomes:

- *Students can acquire knowledge about wireless sensor networks.*
- *Students will get an overview of the various network level protocols for MAC, routing and aggregation.*
- *Analyze various protocols and its issues.*
- *Students will learn the various hardware, software platforms for sensor networks*

REFERENCES:

1. Feng Zhao, Leonidas Guibas, “Wireless sensor networks an information processing approach”, Mogan kanufmann publishers, 2004
2. Edgar Hcallaway,Jr “Wireless sensor networks:Architectures and protocols” Auerbach Publications
3. Holger Karl, Andreas willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, Inc .2005.
4. Robert Faludi,”Building Wireless Sensor Networks”, O'Reilly Media
5. Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks: Theory and Practice”, Wiley | 2010
6. Anna Hac, "Wireless Sensor Network Designs," John Wiley & Sons, December 2003
7. KazemSohraby, Daniel Minoli,TaiebZnati, “Wireless Sensor Networks: Technology, Protocols, and Applications” , John Wiley & Sons, Inc .2007.
8. Erdal Cayirci, Chunming Rong, “Security in Wireless Ad Hoc and Sensor Networks”, John Wiley and Sons, 2009.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ505	WEB TECHNOLOGY	3	0	0	3

1. ***Course objectives:***
   - *To understand the fundamentals of HTML5 and CSS.*
   - *Students will gain a brief knowledge of how to design dynamic and interactive web pages by embedding Java Script code in HTML.*
   - *To provide an understanding of the server side programming languages.*
   - *To introduce the various steps involved in designing a creative and dynamic website.*

2. **Course pre-requisites** **:** NIL

Module – I INTRODUCTION TO WEB AND MARKUP LANGUAGE 9

Web Essentials: History of Internet & WWW - Web System Architecture – Basic Internet Protocols – Markup Language: HTML5 - Introduction - Basic Tags- Lists-Tables -Images - Forms - Links & Navigation - Image Maps – Input and Data List and Page Structure Elements – Canvas.

Module – II STYLE SHEETS AND CLIENT SIDE PROGRAMMING 9

Style Sheets: CSS - Introduction to Cascading Style Sheets – Features - Core Syntax - Style Sheets and HTML Style Rule Cascading and Inheritance - Text Properties - Box Model - Normal Flow Box Layout - Beyond the Normal Flow - Other Properties. Client Side Programming: The Java Script Language - Basics - Control structures - Functions - Arrays - Objects – DOM - Event Handling.

Module – III JAVA PROGRAMMING 9

Java Programming: Fundamentals - Classes - Inheritance - Packages - Interfaces - Exceptions Handling – Applets - AWT.

Module – IV XML 9

Representing Web Data: XML - Documents and Vocabularies - Versions and Declaration - Namespaces - JavaScript and XML: Ajax - DOM based XML processing - Event-oriented Parsing: SAX - Transforming XML Documents-Selecting XML Data: XPATH - Template based Transformations: XSLT - Displaying XML Documents in Browsers - Case Study.

Module - V SERVER SIDE PROGRAMMING 9

Separating Programming and Presentation: JSP Technology: Introduction - Running JSP Applications - JavaBeans Classes and JSP - Support for the Model-View-Controller Paradigm – Related Technologies. Servlets: Servlet container - Exceptions - Sessions and Session Tracking - Dynamic Content Generation - Servlet Chaining and Communications – Databases and Java Servlets.

STATE OF ART (Not for Exam)

Web Services: JAX-RPC, WSDL, XML Schema, and SOAP.

Total Hours: 45

3. ***Course outcomes:***
   - *Students will have clear understanding of hierarchy of objects in HTML and XML DOM.*
   - *Students will create a fully functional website (for eg., online book store) using MVC architecture and also understand the fundamentals of Web Hosting.*

REFERENCES:

1. Jeffrey C. Jackson, "Web Technologies - A Computer Science Perspective", Pearson Education, 2007.
2. Thomas A Powell, “HTML and CSS : The Complete Reference”, 5th Edition, Tata Mc Graw Hill, 2010.
3. Internet & World Wide Web How to Program, 5/e Paul J. Deitel, Harvey M.Deitel, Abbe, Pearson Higher Education, 2012.
4. Herbert Schildt, “Java: The complete Reference”, Seventh Edition, Tata McGraw Hill, 2009.
5. Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, Pearson Education, 2007.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ506	SECURE COMPUTING	3	0	0	3

1. **Course objectives:**
   - *To introduce the breadth of network issues and understand the nature of threats and countermeasures in order to address new threats.*
   - *To provide insight into all aspects of computer security, including users, software, devices, operating systems, networks, and data.*
   - *To know how to use cryptographic technologies to protect their data, as well as breakthrough technologies likely to be used widely in the coming years.*
   - *To introduce the mathematical and theoretical sources upon which cryptographic algorithms are based.*
   - *To give detailed practical guidance and tools for administering secure systems.*

2. **Course pre-requisites:** Computer Networks, Database Management Systems

Module – I INTRODUCTION TO SECURITY 9

Introduction: what is computer security? Threats- Harm-Vulnerabilities – Controls. Program security: Unintentional (Nonmalicious) Programming Oversights - Malicious Code -Malware – Countermeasures. The Web-User Side : Browser Attacks - Web Attacks Targeting Users-Obtaining User or Website Data - Email Attacks.

Module - II TRUSTED OPERATING SYSTEMS 5

Operating Systems: Security in Operating Systems-Security in the Design of Operating Systems -Root kit

Module - III DATA BASE, NETWORK AND CLOUD SECURITY 12

Data base: Introduction to Data Bases, Security Requirements- Reliability and Integrity- Database Disclosure-Data Mining and Big Data. Networks: Network Concepts-Threats to Network Communications-Wireless Network Security-Denial of Service - Distributed Denial-of-Service-Cryptography in Network Security – Firewalls - Intrusion Detection and Prevention Systems -Network Management. Cloud: Cloud Computing Concepts-Moving to the Cloud-Cloud Security Tools and Techniques-Cloud Identity Management-Securing IaaS

Module - IV PRIVACY, SECURITY MANAGEMENT, LAW 10

Privacy: Privacy Concepts-Privacy Principles and Policies-Authentication and Privacy-Data Mining-Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies. Management and Incidents: Security Planning - Business Continuity Planning - Handling Incidents - Risk Analysis - Dealing with Disaster. Legal Issues and Ethics**:** Protecting Programs and Data - Information and the Law - Rights of Employees and Employers - Redress for Software Failures-Computer Crime-Ethical Issues in Computer Security-Incident Analysis with Ethics

Module - V CRYPTOGRAPHY 9

Toolbox: Authentication, Access Control, and Cryptography. Cryptology-Symmetric Encryption Algorithms - Asymmetric Encryption with RSA - Message Digests - Digital Signatures -Quantum Cryptography.

STATE OF ART (Not for Exam)
The Internet of Things-Economics-Electronic Voting- Cyber Warfare**.**

Total Hours: 45

3. Course outcomes:

- *Understand the security issues in programming and web attacks.*
- *Know the techniques for securing, Operating systems, databases, networks and Clouds.*
- *Awareness in Privacy, Management and Legal issues and ethics in Computing.*
- *Able to implement cryptographic algorithms for protecting the data.*

REFERENCES:

1. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies "Security in Computing (5th Edition)", Prentice Hall, 2015.
2. Willian Stallings, "Cryptography and Network Security Principles and Practice, 5th Edition, Prentice Hall, 2012.
3. Brian Chess and Jacob West**,"** Secure Programming with Static Analysis",Tata McGraw Hill 2009.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ601	DIGITAL IMAGE PROCESSING	3	0	0	3

1. ***Course objectives:***
   - *Students will understand the digital image processing covering all the sub branches of this subject.*
   - *Students will know the basics of MATLAB Image Processing Toolbox.*

2. **Course pre-requisites** **:** Data Structures

Module – I FUNDAMENTALS OF DIGITAL IMAGES 9

Graphics/Image data type, Fundamental steps in digital image processing, Components of an image processing system, Light and electromagnetic spectrum, Simple image formation model, Image sampling and quantization, Relationship between pixels, Mathematical tools used in digital image processing.

Module – II HISTOGRAMS, SPATIAL FILTERS AND FREQUENCY DOMAIN FILTERS 10

Histogram processing, Histogram equalization, Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Frequency domain filtering - Preliminary concepts, Sampling theorem, 1D DFT, 2D DFT, Ideal lowpass filter for smoothing under frequency domain, Ideal highpass filter for sharpening under frequency domain.

Module – III IMAGE RESTORATION, COLOR MODELS AND WAVELETS 8

Image restoration – Restoration process model, Noise model, Restoration in the presence of noise only-spatial filtering, Mean filters, Order-statistic filters, Periodic noise reduction by frequency domain filtering – Bandreject filters, Bandpass filters. Color image processing – Fundamentals and Models. Wavelets – Image pyramids and Subband coding.

Module – IV IMAGE COMPRESSION AND MORPHOLOGY 8

Image compression – Fundamentals, Redundancy, Measuring image information, Fidelity criteria, Compression models, Compression methods, Huffman coding, LZW coding, Block transform coding. Morphology – Preliminaries, Erosion, Dilation and Duality.

Module – V SEGMENTATION, REPRESENTATION, DESCRIPTION AND MATLAB IMAGE PROCESSING TOOLBOX 10

Image segmentation – Fundamentals of Point, Line and Edge detection, Line detection, Edge models, Basic edge detection. Thresholding – Foundation and Basic global thresholding. Representation and Description – Boundary following, Chain codes, Simple boundary descriptors and shape numbers.
Introduction to MATLAB Image Processing Toolbox – Digital image representation, Reading images, Displaying images and Data classes of images.

Total Hours: 45

3. ***Course outcomes:***
   - *Students will understand the digital image processing covering all the sub branches of this subject.*
   - *Students will know the basics of MATLAB Image Processing Toolbox.*
   - *Students will be able to do projects in digital image processing.*

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Third edition, Pearson Education, 2009.
2. Ze-Nian Li, Mark S. Drew, “Fundamentals of Multimedia”, PHI Learning Private Limited, 2004.
3. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing using MATLAB”, Fifth impression, Pearson Education, 2009.
4. John C. Russ, “The Image Processing Handbook”, Sixth Edition, CRC Press, 2011.
5. Anil K. Jain, “Fundamentals of Digital Image Processing”, Prentice Hall of India, 2002.
6. William K.Pratt, “ Digital Image Processing”, John Wiley, New York, 2002.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ602	COMPUTER VISION & APPLICATIONS	3	0	0	3

1. ***Course objectives:***
   - *Students will understand the basics of machine vision and its design for a specific application.*
   - *Students will be able to analyze the basic mathematical elements used in vision algorithms.*

2. **Course pre-requisites** **:** Data Structures

Module – I INTRODUCTION AND BINARY IMAGE PROCESSING 9

Machine vision, Relationship to other fields, Role of knowledge, Image geometry, Sampling and quantization, Image definitions, Levels of computation - Binary image processing: Thresholding, Geometric properties, Projections, Run-length encoding, Binary algorithms, Morphological operators, Optical character recognition.

Module – II IMAGE ANALYSIS BASICS, REGIONS AND IMAGE FILTERING 9

Data structures for image analysis: Levels of image data representation, Traditional image data structures and Hierarchical data structures - Regions: Regions and edges, Region segmentation, Region representation, Split and merge - Image filtering: Histogram modification, Linear systems, Linear filter and Median filter.

Module – III OBJECT RECOGNITION 9

Knowledge representation, Statistical pattern recognition: Classification principles, Classifier setting, Classifier learning, Cluster analysis. Neural nets: Feed-forward networks, unsupervised learning, Hopfield neural nets. Syntactic pattern recognition: Grammars and languages, Syntactic analysis and classifier, Syntactic classifier learning & grammar inference - Recognition as graph matching: Isomorphism of graphs and sub-graphs, Similarity of graphs.

Module – IV COMPUTER VISION ANALYSIS 9

Basics of 3D vision, Edge detection: Gradient, Steps in edge detection. Contours: Geometry of curves, Digital curves. Textures: Texture and statistical texture description. Mathematical Morphology – Concepts, Principles, Binary dilation and erosion.

Module – V APPLICATIONS 9

Motion analysis – Differential motion analysis methods, Optical flow. Case study: Optical music recognition system, Automated image analysis in cardiology, Automated identification of airway trees, Passive surveillance.

Total Hours: 45

3. ***Course outcomes:***
   - *Students can design vision algorithm for a specific application.*
   - *Students will be able to analyze the basic mathematical elements used in vision algorithms.*
   - *Students can learn about 3D vision and object recognition techniques.*

REFERENCES:

1. E. R. Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, Thomson Learning Inc., 2001.
3. Ramesh Jain, Rangachar Kasturi, Brian G. Schunck, “Machine Vision”, McGraw-Hill International Editions, 1995.
4. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Third Edition, Academic Press, 2012.
5. D. L. Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, 2012.
6. David A. Forsyth, Jean Ponce, “Computer Vision – A Modern Approach”, Pearson Education, 2003.
7. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Digital Image Processing and Computer Vision”, Cengage Learning, 2008.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ603	PATTERN CLASSIFICATION AND ANALYSIS	3	0	0	3

1. ***Course objectives:***
   - *To Study the fundamental algorithms for pattern recognition*
   - *To instigate the various Pattern classification techniques*
   - *To originate the various structural pattern recognition and feature extraction techniques*

2. ***Course pre-requisites*** **:** Image Processing, Computer Vision

Module - I PATTERN CLASSIFIER **9**

Overview of pattern recognition - Discriminant functions - Supervised learning - Parametric estimation - Maximumlikelihood estimation - Bayesian parameter estimation - Perceptron algorithm - LMSE algorithm - Problems withBayes approach - Pattern classification by distance functions - Minimum distance pattern classifier.

Module –II UNSUPERVISED CLASSIFICATION **9**

Clustering for unsupervised learning and classification - Clustering concept - C-means algorithm – Hierarchicalclustering procedures - Graph theoretic approach to pattern clustering - Validity of clustering solutions.

Module – III STRUCTURAL PATTERN RECOGNITION **9**

Elements of formal grammars - String generation as pattern description - Recognition of syntactic description -Parsing - Stochastic grammars and applications - Graph based structural representation

Module – IV FEATURE EXTRACTION AND SELECTION **9**

Entropy minimization - Karhunen - Loeve transformation - Feature selection through functions approximation -Binary feature selection.

Module – V RECENT ADVANCES **9**

Neural network structures for pattern recognition - Neural network based pattern associators – Unsupervised learning in neural pattern recognition - Self organizing networks - Fuzzy logic - Fuzzy pattern classifiers –Pattern classification using Genetic Algorithms.

STATE OF ART (Not for Exam)

Image Transforms: DFT, DCT, Haar, SVD and KL-Introduction to Matlab Toolbox.

Total Hours: 45

3. ***Course outcomes:***
   - *Understand and apply various algorithms for pattern recognition*
   - *Realize the clustering concepts and algorithms*
   - *Bring out structural pattern recognition and feature extraction techniques*

REFERENCES:

1. Robert J.Schalkoff, *Pattern Recognition : Statistical, Structural and Neural Approaches*, John Wiley &Sons Inc., New York, 2007.
2. Tou and Gonzales, *Pattern Recognition Principles*, Wesley Publication Company, London, 1974.
3. Duda R.O., and Hart.P.E., *Pattern Classification and Scene Analysis*, Wiley, New York, 1973.
4. Morton Nadier and Eric Smith P., *Pattern Recognition Engineering*, John Wiley & Sons, New York, 1993.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ604	ARTIFICIAL INTELLIGENCE	3	0	0	3

1. ***Course objectives:***
   - *To have basic knowledge in the fundamental concepts of Artificial Intelligence, applications of Artificial Intelligence*
   - *To have a thorough understanding about the agent design.*
   - *To understand problem solving, knowledge representation, planning and learning methods of Artificial Intelligence and learning methods of Artificial Intelligence.*
   - *To be able to apply and design an intelligent system or any applications by. understanding the concepts of knowledge representation, reasoning, planning and learning methods in solving engineering and computational problems.*
   - *To develop an interest in the field sufficient to take more advanced subjects.*

2. ***Course pre-requisites*** **:** NIL

Module – I INTRODUCTION AND PROBLEM SOLVING 9

Definition of AI-Intelligent Agents- Problem Solving-Searching-Uninformed and Informed Search Strategies-Heuristic Search-Constraint Satisfaction Problems-Game Playing.

Module – II KNOWLEDGE REPRESENTATION AND REASONING 9

First order logic- Syntax and Semantics of FOL- Using FOL - Inference in FOL- Reasoning: Unification and Lifting – Forward Chaining - Backward Chaining- Resolution.

Module – III PLANNING 9

Planning- Representation for planning-Partial order planning-Conditional planning- Execution monitoring and Replanning – Continuous Planning – Multi-Agent Planning.

Module IV LEARNING 9

Learning from Observations: Forms of Learning - Inductive Learning – Learning Decision Trees - Ensemble Learning - Knowledge in Learning - Logical Formulation of Learning – Explanation based Learning - Relevance based Learning - Reinforcement learning: Passive & Active Reinforcement learning.

Module – V APPLICATIONS 9

Natural Language Processing for communication - Probabilistic Language Processing - Information Retrieval - Information Extraction - Machine Translation.

STATE OF ART (Not for Exam)

Ambient Intelligence- Semantic Web – Challenges in Semantic Web

Total Hours: 45

3. Course outcomes:

- *Ability to understand the problem solving in AI*
- *Ability to apply problem solving methods to solve engineering and computational problems.*
- *Ability to design an intelligent system by using knowledge representation techniques, reasoning, planning and learning methods.*
- *Ability to develop interest in learning advanced application oriented subjects of Artificial Intelligence.*

REFERENCES:

1. Stuart Russel and Peter Norvig. " Artificial Intelligence-A Modern Approach ", Second Edition, Prentice Hall International. 2010.
2. Nils J.Nilsson, " Artificial Intelligence - A New Synthesis ", Harcourt Asia PTE Ltd, Morgan Kaufmann, 2003.
3. Elain Rich and Kevin Knight, " Artificial Intelligence",Tata McGraw Hill, Second Edition, 2003.
4. Patrick Henry Winston, " Artifical Intelligence ", Third Edition, ISE reprint,Addison Wesley, 2004.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ605	NATURAL LANGUAGE PROCESSING	3	0	0	3

1. Course objectives:

- *To gain knowledge about the fundamentals and applications of natural language processing.*
- *To have a thorough understanding about Computational framework for natural language.*
- *To understand and analyze the syntax and semantics of natural language processing.*
- *To learn to apply the concepts of natural language processing in the tool for various applications of NLP.*

2. Course pre-requisites **:** Artificial Intelligence

Module - I INTRODUCTION **9**

Introduction: Knowledge in speech and language processing – Ambiguity – Models and Algorithms – Language, Thought and Understanding. Regular Expressions and automata: Regular expressions – Finite-State automata

Module – II SYNTAX 9

Word classes and part-of-speech tagging: English word classes – Tagsets for English – Part-of-speech tagging – Rule-based part-of-speech tagging – Stochastic part-of-speech tagging – Transformation-based tagging –Context-Free Grammars for English: Constituency – Context-Free rules and trees – Sentence-level constructions – The noun phrase -The verb phase and sub categorization– Spoken language syntax – Grammars equivalence and normal form – Finite-State and Context-Free grammars – Grammars and human processing. Parsing with Context-Free Grammars: Parsing as search – A Basic Top-Down parser – Problems with the basic Top-Down parser – The early algorithm – Finite-State parsing methods.

Module – III ADVANCED FEATURES AND SYNTAX **9**

Features and Unification: Feature structures – Unification of feature structures – Features structures in the grammar – Implementing unification – Parsing with unification constraints – Types and Inheritance. Lexicalized and Probabilistic Parsing: Probabilistic context-free grammar – problems with PCFGs – Probabilistic lexicalized CFGs – Dependency Grammars – Human parsing.

Module – III SEMANTICS **9**

Representing Meaning: Computational desiderata for representations – Meaning structure of language – First order predicate calculus – Related representational approaches – Alternative approaches to meaning. Semantic Analysis: Syntax-Driven semantic analysis – Attachments for a fragment of English – Integrating semantic analysis into the early parser – Idioms and compositionality – Robust semantic analysis. Lexical semantics: relational among lexemes and their senses – WordNet: A database of lexical relations – The Internal structure of words – Creativity and the lexicon.

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Module – V APPLICATIONS AND TOOLS **9**

Information Retrieval –Summarization –Question Answering -Case Study of NLTK Toolkit.

STATE OF ART (Not for Exam)

Applied Natural Language Processing.

Total Hours: 45

3. Course outcomes:

- *Ability to understand the fundamentals and applications of NLP.*
- *Ability to apply natural language techniques to solve engineering and computational problems.*
- *Ability to design an NLP system for various applications by using the tools for NLP.*

REFERENCES:

1. Daniel Jurafsky & James H.Martin, "Speech and Language Processing", Pearson Education (Singapore) Pte. Ltd., 2008.
2. James Allen, "Natural Language Understanding", Pearson Education, 2003.
3. Lucja M Iwanska, "Natural Language Processing and Knowledge Representation: Language For Knowledge And Knowledge For Language", University Press, 2008.
4. Daniel Bikel and Imed Zitouni, Multilingual Natural Language Processing Applications: From Theory to Practice, IBM Press, 2012.
5. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python", O'Reilly Media, 2009.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ606	SEMANTIC WEB	3	0	0	3

1. ***Course objectives:***
   - *To gain basic knowledge about the Semantic Web and the different languages used in the context of semantic web.*
   - *To understand and apply the semantic web technologies and methodologies for structuring web.*
   - *To know about ontology management and tools used for Ontology annotation.*
   - *To comprehend and analyze the role of semantics using logic and inference.*
   - *To understand the applications of semantic web and to gain knowledge about the tools for the development of semantic web.*

2. ***Course pre-requisites*** **:** Artificial Intelligence

Module – I INTRODUCTION **9**

Introduction to syntactic web and semantic web– Evolution of the web-The visual and syntactic web – Levels of Semantics – Metadata for web information - The semantic web architecture and technologies – Contrasting Semantic with Conventional Technologies– Semantic Modeling -Potential of semantic web solutions and challenges of adoption.

Module – II STRUCTURING AND DESCRIBING WEB RESOURCES **9**

Structured Web Documents-XML: Structuring – Namespaces – Addressing – Querying – Processing RDF and Semantic Web – Basic Ideas - RDF Specification – RDF Syntax: XML and Non- XML - RDF elements – RDF relationship: Reification, Container, and collaboration – RDF Schema – Editing, Parsing, and Browsing RDF/XML-RQL-RDQL-SPARQL.

Module – III ONTOLOGY **9**

Why Ontology – Ontology movement – OWL – OWL Specification - OWL Elements – OWL constructs: Simple and Complex – Ontology Engineering : Introduction – Constructing ontologies – Reusing ontologies – On-To-Knowledge Semantic Web Architecture.

Module – IV LOGIC AND INFERENCE **9**

Logic – Description Logics - Rules – Monotonic Rules: Syntax, Semantics and examples – Non-Monotonic Rules – Motivation, Syntax, and Examples – Rule Markup in XML: Monotonic Rules, and Non-Monotonic Rules- Rule Languages – RuleML.

Module – V SEMANTIC WEB TOOLS AND APPLICATIONS **9**

Case Study on Development Tools for Semantic Web –Protégé - Jena Framework –Applications-Semantic Desktop – Semantic Wikis –E-learning – Application in Science –Business.

STATE OF ART (Not for Exam)

Semantic Web Mining, Internet of Things.

Total Hours: 45

3. Course outcomes:

- *Ability to understand and apply the semantic web technologies and methodologies.*
- *Ability to design semantic web applications using semantic web tools.*
- *Ability to use RDF and OWL to structure, query and infer from semantic web applications.*

REFERENCES:

1. Grigorous Antoniou and Van Hermelen - "A Semantic Web Primer"-The MIT Press , 2nd Edition, 2008.
2. Liyang Yu, A Developer's Guide to the Semantic Web, Springer; 1st Edition. Edition,119, 2011.
3. "Spinning the Semantic Web: Bringing the World Wide Web to its full potential" – The MIT Press – 2004.
4. Karen K Breitman, Marco Antonio Casanova and Walter Truszkowski- Semantic Web: Concepts, Technologies and Applications" – Springer – 2007.
5. Shelley Powers – "Practical RDF" – O'reilly publishers – First Indian Reprint: 2003.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ607 / 15PN607	DISTRIBUTED COMPUTING	3	0	0	3

1. ***Course objectives:***
   - *To list the principles underlying the functioning of distributed systems, describe the problems and challenges associated with these principles, and evaluate the effectiveness and shortcomings of their solutions.*
   - *To recognize how the principles are applied in contemporary distributed systems, explain how they affect the software design, and be able to identify features and design decisions that may cause problems.*
   - *To design a distributed system that fulfills requirements with regards to key distributed computing properties (such as scalability, transparency, etc.), be able to recognize when this is not possible, and explain why.*
   - *To build distributed system software using basic OS mechanisms as well as higher-level middleware and languages.*

2. **Course pre-requisites :** Operating Systems, Computer Networks

Module – I INTRODUCTION TO DISTRIBUTED SYSTEMS 8

Characterization of Distributed Systems- Introduction, Examples of Distributed systems, Resource sharing and web, challenges, System models- Introduction, Architectural and Fundamental models, Networking and Internetworking, Interprocess Communication. Distributed objects and Remote Invocation-Introduction, Communication between distributed objects, RPC, Events and notifications, Case study-Java RMI.

Module – II OPERATING SYSTEM SUPPORT AND DISTRIBUTED FILE SYSTEMS 8

Operating System Support- Introduction, OS layer, Protection, Processes and Threads, Communication and Invocation, Operating system architecture, Distributed File Systems-Introduction, File Service architecture, case study- SUN network file systems. Name Services-Introduction; Name Services and the Domain Name System, Case study of the Global Name Service, Case study of the X.500 Directory Service.

Module – III TIME AND GLOBAL STATES 10

Peer to Peer Systems-Introduction, Napster and its legacy, Peer to Peer middleware, Routing overlays, Overlay case studies-Pastry, Tapestry, Application case studies-Squirrel, OceanStore. Time and Global States-Introduction, Clocks, events and Process states, Synchronizing physical clocks, logical time and logical clocks, global states, distributed debugging. Coordination and Agreement - Introduction, Distributed mutual exclusion, Elections, Multicast communication, consensus and related problems.

Module – IV DISTRIBUTED TRANSACTIONS 10

Transactions and Concurrency control - Introduction, Transactions, Nested Transactions, Locks, Optimistic concurrency control, Timestamp ordering, Comparison of methods for concurrency controls. Distributed Transactions - Introduction, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery, Replication-Introduction, System model and group communication, Fault tolerant services, Transactions with replicated data.

Module – V SECURITY TECHNIQUES 9

Security - Introduction, Overview of Security techniques, Cryptographic algorithms, Digital signatures, Case studies-Kerberos, TLS, 802.11 WiFi. Distributed shared memory, Design and Implementation issues, Sequential consistency and Ivy case study, Release consistency and Munin case study, other consistency models, CORBA case study- Introduction, CORBA RMI, CORBA Services.

STATE OF ART (Not for Exam)

Designing distributed systems: Google case study

Total Hours: 45

3. Course outcomes:

- *Identify models of distributed computing.*
- *Analyze algorithms for coordination, communication, security and synchronization in distributed systems.*
- *Classify distributed shared memory models.*
- *Design and implement distributed file systems.*
- *Design distributed algorithms for deadlocks.*

REFERENCES:

1. G Coulouris, J Dollimore and T Kindberg, "Distributed Systems Concepts and Design", Fourth Edition, Pearson Education.
2. S.Ghosh, Chapman & Hall/CRC, "Distributed Systems", Taylor & Francis Group, 2010.
3. S.Mahajan and S.Shah, "Distributed Computing", Oxford University Press.
4. Pradeep K.Sinha, "Distributed Operating Systems Concepts and Design", PHI.
5. M Singhal, N G Shivarathri, "Advanced Concepts in Operating Systems", Tata McGraw-Hill Edition.
6. K.P.Birman, "Reliable Distributed Systems", Springer.
7. A.S. Tanenbaum and M.V. Steen, "Distributed Systems – Principles and Paradigms", Pearson Education.
8. R.Chow, T.Johnson, "Distributed Operating Systems and Algorithm Analysis", Pearson.
9. A.S.Tanenbaum, "Distributed Operating Systems", Pearson education.
10. Ajay D. Kshemakalyani & Mukesh Singhal, "Distributed Computing, Principles, Algorithms and Systems", Cambrigde, rp 2010

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ608 / 15PN608	SERVICE ORIENTED ARCHITECTURE	3	0	0	3

1. ***Course objectives:***
   - *To gain understanding of the basic principles of service orientation*
   - *To learn service oriented analysis techniques*
   - *To learn technology underlying the service design*
   - *To learn advanced concepts such as service composition, orchestration and Choreography*
   - *To know about various WS-* specification standards*

2. **Course pre-requisites** **:** Internet Programming, OOPS

MODULE I SOA Evolution – Architecture **9**

Roots of SOA – Characteristics of SOA - Comparing SOA to client-server and distributed internet architectures – Anatomy of SOA- How components in an SOA interrelate - Principles of service orientation

MODULE II Web services and Primitive SOA **9**

Web services – Service descriptions – Messaging with SOAP –Message exchange Patterns – Coordination –Atomic Transactions – Business activities – Orchestration – Choreography - Service layer abstraction – Application Service Layer – Business Service Layer – Orchestration Service Layer.

MODULE III Service Oriented Analysis **9**

Service oriented analysis – Business-centric SOA – Deriving business services- service modeling - Service Oriented Design – WSDL basics – SOAP basics – SOA composition guidelines – Entity-centric business service design – Application service design – Taskcentric business service design

MODULE IV SOA platforms **9**

SOA platform basics – SOA support in J2EE – Java API for XML-based web services (JAX-WS) - Java architecture for XML binding (JAXB) – Java API for XML Registries (JAXR) - Java API for XML based RPC (JAX-RPC)- Web Services Interoperability Technologies (WSIT) - SOA support in .NET – Common Language Runtime - ASP.NET web forms – ASP.NET web services – Web Services Enhancements (WSE).

MODULE V WS Extensions **9**

WS-BPEL basics – WS-Coordination overview - WS-Choreography, WS-Policy, WS Security

STATE OF ART (Not for Exam)

Study of Web application that use SOA – redbus,expedia,tripadvisor

Total Hours: 45

3. ***Course outcomes:***
   - *Know the SOA concepts and architecture*
   - *Understand principles of Web services and SOA.*
   - *Steps in Service oriented Analysis*
   - *Study the concepts SOA platforms and WS standard extensions.*

REFERENCES:

1. Thomas Erl, "Service-Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2005.
2. Thomas Erl, "SOA Principles of Service Design "(The Prentice Hall Service-Oriented Computing Series from Thomas Erl), 2005.
3. Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2005.
4. Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services, An Architect's Guide", Pearson Education, 2005.
5. Dan Woods and Thomas Mattern, " Enterprise SOA Designing IT for Business Innovation" O'REILLY, First Edition, 2006.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ609 / 15PN609	XML AND WEB SERVICES	3	0	0	3

1. Course objectives:

- *To provide an in-depth knowledge of XML and Web Services.*
- *To gain knowledge about SOAP, UDDI and XML to create Web Services.*
- *To design Web service Architecture.*
- *To Study Building Blocks of Web services.*
- *To understand XML security issues.*
- *To develop and deploy Web Service Applications.*

2. Course pre-requisites **:** Computer Networks

Module – I INTRODUCTION TO XML TECHNOLOGY 9

XML – benefits – Advantages of XML over HTML – EDL –Databases – XML based standards – DTD – XML Schemas – X- Files – XML processing – DOM –SAX.

Module – II PRESENTATION TECHNOLOGIES 9

Presentation technologies – XSL – XFORMS – XHTML – voice XML – Transformation – XSLT – XLINK – XPATH –XQ.

Module – III WEB SERVICES BUILDING BLOCK 9

Transport protocols for web services – messaging with web services – protocols – SOAP – describing web services – WSDL – Anatomy of WSDL – manipulating WSDL – web service policy – Discovering web services – UDDI – Anatomy of UDDI- Web service inspection – Ad-Hoc Discovery – Securing web services.

Module – IV IMPLEMENTING XML IN E-BUSINESS 9

B2B - B2C Applications – Different types of B2B interaction – Components of e-business XML systems – ebXML – Rosetta Net Applied XML in vertical industry – Web services for mobile devices.

Module – V DEPLOY WEBSERVICES USING .NET/JAVA 9

Develop and Deploy Web Services – Global Weather Forecast - Current weather and weather conditions for major cities around the world. Translate Service - Convert text from one language to another language. ISBN Information Retrieval - Book Information web services by ISBN. Country Details - Get Currency, Currency code, International Dialing code, ISO country code for all countries.

STATE OF ART (Not for Exam)

Responsive Web Design - Twitter Bootstrap and Zurb Foundation.

Total Hours: 45

3. Course outcomes:

- *Understand the fundamental elements in Web Technology and XML services.*
- *Understand Web Services and its Infrastructure.*
- *Building a Web Service.*
- *Deploying and Publishing Web Services.*

REFERENCES:

1. Ron schmelzer et al, “XML and Web Services”, Pearson Education, 2002.
2. Sandeep Chatterjee and James Webber, “Developing Enterprise Web Services: An Architect’s Guide”, Prentice Hall, 2004.
3. Frank P. Coyle, “XML, Web Services and the Data Revolution”, Pearson Education, 2002.
4. Keith Ballinger, “.NET Web Services Architecture and Implementation”, Pearson Education,2003.
5. Henry Bequet and Meeraj Kunnumpurath, “Beginning Java Web Services”, Apress, 2004.
6. Russ Basiura and Mike Batongbacal, “Professional ASP.NET Web Services”, Apress,2.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ610 / 15PN610	MOBILE APPLICATION DEVELOPEMENT	3	0	0	3

1. Course objectives:

- Understand system requirements for mobile applications
- Generate suitable design using specific mobile development frameworks
- Generate mobile application design
- Implement the des ign using specific mobile development frameworks
- Deploy the mobile applications in marketplace for distribution

***2.* Course pre-requisites : NIL**

UNIT I INTRODUCTION 5

Introduction-Need for mobile applications – Cost of Development – Importance of Mobile strategies in the Business world-Market and business drivers for mobile application- Requirements gathering and validation for mobile applications- –Mobile Myths, Third party framework – Publishing and delivery of Mobile Applications-Marketing.

UNIT II BASIC DESIGN 8

Introduction –Basics of embedded system design - Embedded OS - Design constrains for mobile applications, both hardware and software related-Architecting mobile applications- Understanding Mobile Application Users - Effective Use of Screen Real Estate – User interface for mobile applications-touch events and gestures-Using the Tools of Mobile Interface Design

UNIT III ADVANCED DESIGN 8

Designing applications with multimedia and web access capabilities – Integration with GPS and Social media networking applications-Accessing applications hosted in a cloud computing environment – Design pattern for mobile applications.

UNIT IV TECHNOLOGY I -A NDROID 12

Introduction– Establishing the development environment –Android architecture-Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment- Interaction with server side applications- Using Google Maps, GPS and Wifi –Integration with social media applications.

UNIT V TECHNOLOGY II - IOS 12

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi -iPhone marketplace.

STATE OF ART (NOT FOR EXAM)
Testing Methodologies for Mobile Application.

Total Hours: 45

3. Course outcomes:

- Describe the requirements for mobile applications
- Explain the challenges in mobile application design and development
- Develop design for mobile applications for specific requirements
- Implement the design using Android SDK
- Implement the design using Objective C and iOS
- Deploy mobile applications in Android and iPhone marketplace for distribution

REFERENCES:

1. http://developer.android.com/develop/index.html
2. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012
3. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, DreamTech, 2012
4. Wei-Meng Lee “Beginning iPhone SDK Programming with Objective-C”, Wrox, 2010

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ611 / 15PN611	USER INTERFACE DESIGN	3	0	0	3

1. Course objectives:

- *To understand the basics of User Interface Design.*
- *To design the user interface, design, menu creation and windows creation*
- *To understand the concept of menus, windows, interfaces, business functions, various problems in windows design with colour, text, Non-anthropomorphic Design.*
- *To study the design process and evaluations.*

2. Course pre-requisites : Software Engineering

Module - I INTERACTIVE SOFTWARE AND INTERACTION DEVICE 9

Human–Computer Interface – Characteristics Of Graphics Interface –Direct Manipulation Graphical System – Web User Interface –Popularity –Characteristic & Principles.

Module - II HUMAN COMPUTER INTERACTION 9

User Interface Design Process – Obstacles –Usability –Human Characteristics In Design –Human Interaction Speed –Business Functions –Requirement Analysis – Direct – Indirect Methods – Basic Business Functions – Design Standards – General Design Principles –Conceptual Model Design – Conceptual Model Mock-Ups

Module - III WINDOWS 9

Characteristics– Components– Presentation Styles– Types– Managements– Organizations– Operations– Web Systems– System Timings - Device– Based Controls Characteristics– Screen – Based Controls — Human Consideration In Screen Design – Structures Of Menus –Functions Of Menus– Contents Of Menu– Formatting – Phrasing The Menu – Selecting Menu Choice– Navigating Menus– Graphical Menus. Operate Control – Text Boxes– Selection Control– Combination Control– Custom Control– Presentation Control.

Module - IV MULTIMEDIA 9

Text For Web Pages – Effective Feedback– Guidance & Assistance– Internationalization– Accessibility– Icons– Image– Multimedia – Coloring- Case Study: Addressing usability in Ecommerce sites

Module - V DESIGN PROCESS AND EVALUATION 9

User Interface Design Process - Usability Testing - Usability Requirements and Specification procedures and techniques- User Interface Design Evaluation

STATE OF ART (Not for Exam)

GUI hardware options- Smart systems design- Expert system design,

***Total Hours*: 45**

3. Course outcomes:

- *Knowledge on development methodologies, evaluation techniques and user interface building tools.*
- *Explore a representative range of design guidelines.*
- *Gain experience in applying design guidelines to user interface design tasks.*
- *Ability to design their own Human Computer.*

REFERENCES

1. Wilbent. O. Galitz ,"The Essential Guide To User Interface Design", John Wiley& Sons, 2001.
2. Deborah Mayhew, The Usability Engineering Lifecycle, Morgan Kaufmann, 1999Ben.
3. Shneiderman, "Design The User Interface", Pearson Education, 1998.
4. Alan Cooper, "The Essential Of User Interface Design", Wiley – Dream Tech Ltd., 2002.
5. Sharp, Rogers, Preece, 'Interaction Design', Wiley India Edition, 2007
6. Alan Dix et al, " Human - Computer Interaction ", Prentice Hall, 1993.
7. Ben Schneiderman, " Designing the User Interface ", Addison Wesley, 2000.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ612 / 15PN612	SOCIAL NETWORK ANALYSIS	3	0	0	3

1. ***Course 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 mine the interest of the user*
2. **Course pre-requisites** **:** NIL

Module – 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

Module – 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.

Module – 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.

Module – 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

Module – V TEXT AND OPINION MINING **9**

Text Mining in Social Networks -Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time

STATE OF ART (Not for Exam) :

Social Roles of Social Network Analysis

Total Hours: 45

3. ***Course outcomes:***

- *Work on the internals components of the social network Model and visualize the social network*
- *Mine the behavior of the users in the social network Predict the possible next outcome of the social network Mine the opinion of the user*

REFERENCES:

1. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2011
2. Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition, 2007.
3. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 1st edition, 2010.
4. Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer, 1st edition, 2011.
5. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.
6. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2009.
7. Toby Segaran, "Programming Collective Intelligence", O'Reilly, 2012

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ613 / 15PN613	DATA WAREHOUSING AND MINING	3	0	0	3

1. ***Course objectives:***
   - *To understand data warehousing and various data mining techniques*
   - *To acquire knowledge in pattern mining.*
   - *To perform data classification and clustering.*
   - *To detect outliers based on classification and clustering.*
   - *To gain knowledge about the emerging trends in data mining.*

2. **Course pre-requisites** **:** NIL

Module – I DATA WAREHOUSING CONCEPTS **9**

Basic Concepts – Architecture – Data warehouse modeling – Data cube and OLAP – Data warehouse design and usage – Framework for data warehouse design – Data warehouse design process - Data warehouse implementation – Efficient data cube computation – Indexing OLAP data – Efficient processing of OLAP queries – OLAP server architectures.

Module – II FUNDAMENTALS OF DATA MINING AND PATTERN MINING **9**

Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration– Data Reduction – Data Transformation and Data Discretization - Mining frequent patterns, associations and correlations – Basic concepts – Frequent itemset mining – Pattern evaluation methods – Advanced pattern mining – Pattern mining in multilevel, multidimensional space – Constraint based frequent pattern mining.

Module – III CLASSIFICATION METHODS **9**

Decision Tree Induction – Bayesian Classification – Bayesian belief networks - Rule Based Classification – Classification by Back propagation – Support Vector Machines – Classification using frequent patterns – Lazy Learners – Other Classification Methods – Model evaluation and selection – Techniques to improve classification accuracy.

Module IV CLUSTER ANALYSIS AND OUTLIER DETECTION **9**

Cluster Analysis - Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Evaluation of clustering - Clustering High-Dimensional Data – Constraint- Based Cluster Analysis - Outliers and outlier analysis – Outlier detection methods – Proximity based approaches – Clustering based approaches – Classification based approaches

Module – V CURRENT TRENDS **9**

Mining complex data types - Graph mining – Temporal data mining – Spatial data mining – Distributed data mining – Privacy, security and legal aspects of data mining – Data mining applications – Financial data analysis – Telecommunication industry – Retail industry – Health care and biomedical research.

STATE OF ART (Not for Exam)

Machine Learning - Big data

Total Hours: 45

3. Course outcomes:

- *Ability to design a data warehouse*
- *Ability to perform data preprocessing*
- *Ability to evaluate classification and clustering methods*
- *Ability to mine various complex data*

REFERENCES:

1. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining Concepts and Techniques" Third Edition, Elsevier, 2012.
2. M. Kantardzic, "Data Mining: Concepts, Models, Methods, and Algorithms", 2nd edition, Wiley-IEEE Press, 2011.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", Pearson Education, 2007.
4. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.
5. K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ614 / 15PN614	INTERNET OF THINGS	3	0	0	3

1. Course objectives:

- *To get acquainted with the building blocks of Internet of Things (IoTs), characteristics and taxonomy of IoT levels*
- *To learn a generic design methodology and programming aspects of IoT.*
- *To gain knowledge on the real world applications of IoT.*
- *To know about various packages, frameworks and cloud services*
- *To get acquainted with data analytics for IoT.*

2. **Course pre-requisites :** Web Technology, Internet Programming

Module – I INTRODUCTION TO IoT **9**

Definition and Characteristics – Physical Design Things – Protocols - Logical Design – Functional Blocks – Communication Models – Communication APIs – Introduction to measure the physical quantities – IoT Enabling Technologies – Wireless Sensor Networks - Cloud Computing – Big Data Analytics – Communication Protocols – Embedded Systems – IoT Levels and Deployment Templates

Module –II DEVELOPING INTERNET OF THINGS **9**

Introduction to Smart Systems using IoT – IoT Design Methodology – Case Study: Weather Monitoring – Logical Design using Python – Data types & Data Structures – Control Flow – Functions – Modules – Packages – File Handling – Date/Time Operations – Classes – Python Packages of Interest for IoT

Module – III DOMAIN SPECIFIC IoTs **9**

Home Automation – Cities – Environment – Energy – Retail – Logistics – Agriculture – Industry – Health and Lifestyle – IoT and M2M

Module – IV IoT PHYSICAL DEVICES, ENDPOINTS AND CLOUD OFFERINGS **9**

IoT Device – Raspberry Pi – Interfaces – Programming Raspberry Pi with Python – Other IoT Devices – IoT Physical Servers and Cloud Offerings – Cloud Storage Models and communication APIs – WAMP – Xively Cloud – Django – Amazon Web Services for IoT – SkyNet IoT Messaging Platform – Basics of Secure IoT Programming – Case Study: Home Automation.

Module – V DATA ANLYTICS FOR IoT **9**

Introduction – Apache Hadoop –Using Hadoop MapReduce for Batch Data Analysis –Apache Oozie – Apache Spark – Apache Strom – Using Apache Strom for Real-time Data Analysis – Case Study: Structural Health Monitoring.

STATE OF ART (Not for Exam)

The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments

Total Hours: 45

3. Course outcomes:

- *Identify and design the new models for market strategic interaction*
- *Design business intelligence and information security for WoB*
- *Analyze various protocols for IoT*
- *Design a middleware for IoT*

REFERENCES:

1. Arshadeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-On Approach”, Published by Arshdeep Bahga & Vijay Madisetti, 2014
2. Smart Things: Ubiquitous Computing User Experience Design. Mike Kuniavsky. Morgan Kaufmann Publishers. 2010.
3. Meta Products: Building the Internet of Things. Sara Cordoba, Wimer Hazenberg, Menno Huisman. BIS Publishers. 2011.
4. Getting Started with Arduino (Make: Projects). Massimo Banzi. O'Reilly Media. 2008.
5. Emotional Design: Why We Love (or Hate) Everyday Things. Donald A. Norman. Basic Books, 2004.
6. Physical Computing: Sensing and Controlling the Physical World with Computers. Tom Igoe, Dan O'Sullivan. Premier Press. 2004.

Course Code	Course Name	Contact Hours			
		L	T	P	C
15PQ615 / 15PN615	BIG DATA ANALYTICS	3	0	0	3

1. ***Course objectives:***
   - *To understand the fundamental concepts of big data analytics.*
   - *To learn to use various techniques for mining data stream.*
   - *To explore the technologies associated with big data analytics such as NoSQL, Hadoop and Map Reduce*

2. **Course pre-requisites** **:** Database Management System & Data mining

Module – I INTRODUCTION **9**

Big data overview – State of the Practice in Analytics - Key Roles – **Data Analytics Lifecycle –** Discovery - Data Preparation - Model Planning - Model Building - Communicate Results – Operationalize

Module – II MINING DATA STREAMS **9**

Stream Data Model - Sampling Data in a Stream–Filtering Streams–Counting Distinct Elements in a Stream–Estimating Moments–Counting Ones in a Window–Decaying Window

Module – III LARGE –SCALE FILE SYSTEMS AND MAP-REDUCE **9**

Distributed File Systems – MapReduce - Algorithms Using MapReduce - Extensions to MapReduce - Communication Cost Model - Complexity Theory for MapReduce

Module IV NoSQL DATA MANAGEMENT **9**

Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models – sharding – master-slave replication – peer-peer replication – sharding and replication – consistency – relaxing consistency

Module – V OVERVIEW OF HADOOP **9**

Hadoop Introduction - Data format – Analyzing data with Hadoop – Scaling out – Hadoop streaming – Hadoop pipes – Hadoop Distributed File System (HDFS) – HDFS Design – HDFS Concepts – Hadoop I/O – Data integrity – compression – serialization – sequence file – map file

STATE OF ART (Not for Exam)

Real time data analytics

Total Hours: 45

3. Course outcomes:

- *Ability to understand the concepts of big data analytics.*
- *Ability to mine data streams*
- *Ability to design schemaless database*
- *Ability to perform map reduce using hadoop*

REFERENCES:

1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley, 2015.
2. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
3. P.J.Sadalage and M.Flower, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison – Wesely Professional, 2013.
4. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilly, 2012.
5. Paul C. Zikopoulos,Chris Eaton,Dirk deRoos,Thomas Deutsch ,George Lapis, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGraw-Hill, 2012.