

I SEMESTER

15ZC01 MATHEMATICAL STRUCTURES AND STOCHASTIC PROCESSES

2 2 0 3

NUMBER THEORY: Divisibility: properties of divisibility, fundamental theorem of arithmetic, division algorithm, Euclidean algorithm, extended Euclidean algorithm. Arithmetical functions - Möbius function, Euler totient function. Congruence - basic properties of congruence, residue classes and complete residue system, linear congruences, reduced residue systems and Euler-Fermat theorem, polynomial congruences modulo p , Lagrange's theorem, simultaneous linear congruences, Chinese remainder theorem. (6+6)

ALGEBRAIC STRUCTURES: Groups, cyclic groups, modulo groups - group homomorphism, cosets, Lagrange's theorem - primitive roots, discrete logarithms - finite fields, prime field. (4+4)

APPLICATIONS OF ALGEBRA AND NUMBER THEORY: Pseudo random bit generators, linear congruential generator, Blum Blum-Shub generator - block and stream ciphers - public key encryption - RSA cryptosystem - elliptic curve cryptosystems. (6+6)

GRAPH THEORY: Graphs - directed and undirected, sub graphs, graph models, degree of a vertex, degree sequence, hand-shaking lemma, walk, trail, path, connectedness, distance, diameter. Common classes of graphs – regular, complete Petersen, cycle, path, tree, k -partite, planar, hypercube, mesh - Isomorphic graphs. Representation of graphs – adjacency list, incidence list, adjacency matrix and incidence matrix, Eulerian graphs – Chinese postman problem and its solution – Hamiltonian graphs – travelling salesman problem – nearest neighbour algorithm. (7+7)

STOCHASTIC PROCESSES: Introduction – classification of Stochastic processes. Markov chain: Introduction - transition probability matrices – Chapman Kolmogorov equations - classification of states, limiting probabilities, Poisson process - Continuous time Markov chains: birth-death processes, Queueing Models – Introduction – characteristics - M/M/1, M/M/1/K, M/M/c, M/M/c/K. (7+7)

Total L: 30+T: 30=60

REFERENCES:

1. Tom M Apostol, "Introduction to analytic Number theory", Narosa Publishing House, New Delhi, 1998.
2. Douglas R Stinson, "Cryptography: Theory and practice", Chapman Hall, Boca Raton, 2011.
3. Alfred J Menezes, Paul C Van Oorschot and Scott A Vanstone, "Handbook of Applied Cryptography", CRC Press, Boca Raton, 2010.
4. Yellen J and Gross J, "Graph Theory and its Applications", Chapman & Hall, Boca Raton, 2006.
5. Gross D and Harris C M, "Fundamentals of Queuing Theory", John Wiley and Sons, New York, 2002.
6. Saeed Ghahramani, "Fundamentals of Probability with Stochastic Processes", Pearson, New Delhi, 2012.

15ZC02/15ZS02 DATA STRUCTURES

2 2 0 3

ALGORITHM ANALYSIS: Algorithm: Definition - Analysis of Complexity - Asymptotic Notation - P, NP, NP Hard and NP Complete- Amortized Analysis. Data Structures - Abstract Data Types - Types of Data Structures. (6+6)

ARRAYS AND LISTS: Representation - 2D Array - Sparse Matrix Representation - Representation and Operation: Singly Linked List, Doubly Linked List, Circular Linked Lists, Multi Lists - Applications: Sparse Matrix. (6+6)

STACKS AND QUEUES: Representation of stacks - Operations on stacks - Applications: Infix to Postfix Conversion of Arithmetic Expression - Evaluation of Postfix Expressions - Stacks and Recursive Algorithms. Representation of queues - Operations on queues - Simple Queue - Circular Queue - Deque - Priority Queues. (5+5)

TREES: Binary Trees: Types - Representation - Traversals - Application: Expression Trees - Threaded Binary Trees - Binary Search Trees: Operations - B Trees – Tries. (7+7)

GRAPHS AND SETS: Representation - Traversals - Applications: Single Source Shortest Path - All Pairs Shortest Path - Minimum Spanning Trees - Topological Sort. Representation of sets - Operations on sets - Maintaining a Collection of Disjoint Sets: Union - Find - Path Compression. (6+6)

Total L: 30+T: 30=60

REFERENCES:

1. Venkatesan R and Lovelyn Rose S, "Data Structures", Wiley India Pvt. Ltd., New Delhi, 2015.
2. Mark Allen Weiss, "Data structures and Algorithm Analysis in C++", Pearson Education, New Delhi, 2011.
3. Jean Paul Tremblay and Sorenson, "An Introduction to Data Structures with Applications", McGraw Hill Publishing Company, New Delhi, 2007.

4. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press, England, 2009.
5. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Publications, New Delhi, 2009.

15ZC03/15ZS03 DATABASE DESIGN AND MANAGEMENT

3 2 0 4

INTRODUCTION TO DATABASE: File system organization: Sequential, Pointer, Indexed, and Direct - Purpose of Database System - Database System Terminologies - Database Characteristics - Types of Data models - Components of DBMS - Codd's rules - Integrity Constraints - Keys - Relational Algebra - Relational Calculus - Aspects of ER Modelling - ER Model - Extended ER Model - Transformation of ER Model to Relational Model - Schema Refinement: Design considerations - Functional Dependency - Normalization and Normal forms - Denormalization. (10+7)

SQL & QUERY OPTIMIZATION: SQL Standards - Data Types - Database Objects - DDL - DML - DCL - TCL - Embedded SQL - Static Vs Dynamic SQL - Overview of Physical Storage Media: Magnetic Disk - RAID - Tertiary Storage. File Organization - Organization of Records in Files - Indexing and Hashing - Order Indices - B+ tree Index Files - B tree Index Files - Static Hashing - Dynamic Hashing - Query Processing and Optimization - Overview of Database Administration and Tuning. (10+7)

TRANSACTION PROCESSING AND CONCURRENCY CONTROL: Transaction Concepts - ACID Properties - Transaction States - Concurrency Control problems - Serializability - Recoverability - Pessimistic and Optimistic Concurrency Control Schemes. (9+6)

DATABASE BACKUP, RECOVERY AND SECURITY: Introduction - Major Causes of Database Failure - Backup types - Recovery and Buffer Management - Types of Recovery Techniques - Security Violations- Identification and Authentication - Access Control Mechanisms - Statistical Database - Audit Policy. (8+5)

ADVANCED TOPICS: Overview: Parallel Database - Spatial Database - Multimedia Database - Mobile Database - Web Database - Multidimensional Database - Data Warehouse. OLTP versus OLAP. (8+5)

Total L: 45+T: 30=75

REFERENCES:

1. Abraham Silberchatz, Henry F Korth and Sudarshan S, "Database System Concepts", Tata McGraw-Hill, New Delhi, 2010.
2. Ramez Elmasri and Shamkant B Navathe, "Fundamentals of Database Systems", Addison Wesley, USA. 2010.
3. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", Tata McGraw-Hill, New Delhi, 2008.
4. Gupta G K, "Database Management System", Tata McGraw-Hill, New Delhi, 2011.
5. Atul Kahate, "Introduction to Database Management Systems", Pearson Education, New Delhi, 2009.

15ZC04 SOFTWARE ENGINEERING METHODOLOGIES

3 2 0 4

INTRODUCTION: Software Characteristics - Comparison with other Engineering Disciplines - Software Crisis and Myths - Software life cycle models - Selection of process models for projects - Agile methods - Software Engineering paradigms. (8+5)

REQUIREMENTS GATHERING: Process - Difficulties in Requirements Gathering - Qualities of Good Requirements - Types of Requirements - Requirements Elicitation – JAD Methodology – Requirements validation - Requirements Documentation - SRS Document - IEEE Standards. (8+5)

ANALYSIS AND DESIGN: Functional Decomposition - Context Diagram - Data flow diagrams - Data Dictionary - Factoring - Functional Independence - Modular Design -Coupling - Cohesion - IEEE Standard for Software Design Descriptions - Objects and Classes - Object Identification - Relationship among objects - Classification of Objects - Use cases - UML Diagrams to Support Object Oriented Analysis and Design - Reengineering -Reverse Engineering. (10+7)

CONSTRUCTION AND TESTING: Structured flow charts - Structured Programming - Coding Standards - Maintainability of Code. Testing Strategies - Testing Techniques -Verification and Validation - Test Cases – Test Documentation. (10+7)

SOFTWARE CONFIGURATION MANAGEMENT AND SOFTWARE MAINTENANCE: Need for Configuration Management - Check in Check out Process - Versions and Variations - Baselines - Software Configuration Audit - Software Maintenance - Software Supportability –ReengineeringBusiness Process Reengineering - Reverse Engineering – Restructuring - Forward Engineering - Economics of Reengineering. (9+6)

Total L: 45 + T: 30 = 75

REFERENCES:

1. Roger Pressman S, "Software Engineering: A Practitioners", Tata McGraw Hill, New Delhi, 2010.
2. Sommerville I, "Software Engineering, Pearson Education", New Delhi, 2010.
3. James Peter and Pedrycz W, "Software Engineering: An Engineering Approach", John Wiley& Sons,2007.

4. Shari Lawrence Pfleeger, "Software Engineering: Theory and Practices", Pearson Education, New Delhi, 2009.
5. Rumbaugh, Jacobson and Booch, "The Unified Modeling Language Reference Manual", Pearson, India, 2009.

15ZC05 ADVANCED COMPUTER ARCHITECTURE

3 0 0 3

REVIEW OF COMPUTER DESIGN: Review of Fundamentals of CPU, Memory and IO - Performance Evaluation - Instruction Set Principles - CISC/ RISC - Design Issues. (9)

MEMORY AND I/O: Introduction - Memory Technology - Cache Performance - Reducing Cache Miss Penalty and Miss Rate - Reducing Hit Time - Cache Optimizations - Main Memory and Performance. I/O: Types of Storage Devices - Buses - RAID - I/O Performance. (9)

INSTRUCTION LEVEL PARALLELISM: Pipelining and Handling Hazards - Instruction Scheduling - Static and Dynamic Branch Prediction - Hardware Based Speculation - Limitations of ILP. (9)

DATA LEVEL PARALLELISM: Vector Architecture - SIMD Instruction Set - GPU Architecture - Detecting and Enhancing Loop Level Parallelism. (9)

MULTIPROCESSORS AND THREAD LEVEL PARALLELISM: Symmetric and Distributed Shared Memory Architectures - Performance Issues -Synchronization - Models of Memory Consistency. (9)

Total L: 45

REFERENCES:

1. John L Hennessey and David A Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufmann, USA, 2012.
2. Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", McGraw-Hill International Edition, Singapore, 2000.
3. Sayed Roosta, "Parallel Processing and Parallel Algorithms", Springer series, USA, 2012.
4. Sima D, Fountain T and Kacsuk P, "Advanced Computer Architectures: A Design Space Approach", Addison Wesley, USA, 2000.

15ZC51/15ZS51 ENTERPRISE COMPUTING LABORATORY

0 0 4 2

LIST OF EXPERIMENTS:

1. Java enterprise application creation and testing.
2. Development of a Servlet with session management.
3. Servlet session tracking and servlet filter implementation.
4. Web application development using JavaServer Faces.
5. JavaServer faces web application: validation and navigation implementation.
6. Session beans: Stateless and Stateful session beans implementation.
7. Java Messaging and Message driven bean implementation.
8. Enterprise persistence implementation using Entity.
9. Web Socket implementation.

Total P: 60

REFERENCES:

1. Jendrock E, Cervera-Navarro R, Evans I, Haase K and Markito W, "Java EE 7 Tutorial", Oracle, USA, 2014.
2. Rubinger A L and Burke B, "Enterprise JavaBeans 3.1", O'Reilly Media, USA, 2010.
3. Gupta A, "Java EE 6 Pocket Guide: A Quick Reference for Simplified Enterprise Java Development", O'Reilly Media, USA, 2012.
4. Kogent Learning Solutions Inc., "Java Server Programming Tutorial Java EE6 (J2EE 1.6) Black Book", Dreamtech Press, New Delhi, 2011.
5. Schildt H, "Java the Complete Reference", Tata McGraw-Hill Education Private Ltd., India, 2011.

15ZC61/15ZS61 INDUSTRY VISIT AND TECHNICAL SEMINAR

0 0 2 1

The student will make at least two technical presentations on current topics related to the programme. The same will be assessed by a committee appointed by the department. The students are expected to submit a report at the end of the semester covering the various aspects of his/her presentation together with the observation in industry visits. A quiz covering the above will be held at the end of the semester.

Total P: 30

II SEMESTER

15ZC06/15ZS06 ADVANCED DATA STRUCTURES AND ALGORITHMS

3 2 0 4

EFFICIENT BINARY SEARCH TREES: AVL Trees - Red-black Trees - AA Trees - Splay Trees. (8+5)

HEAPS: Binary Heaps - d-heaps - Leftist Heaps - Binomial Heaps - Fibonacci Heaps - Pairing Heaps. (9+6)

MULTIDIMENSIONAL DATA STRUCTURES: k-d trees - Point Quad trees - MX-Quad trees - R-trees - TV trees. (10+7)

ALGORITHM DESIGN TECHNIQUES: Divide and Conquer - Greedy method - Dynamic Programming - Backtracking - Branch and Bound. (10+7)

RANDOMIZED ALGORITHMS: Random number generators - Skip lists - Primality Testing –Treaps. (8+5)

Total L: 45+T: 30 = 75

REFERENCES:

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press, Massachusetts, 2009.
2. Subrahmanian V S, "Principles of Multimedia Database Systems", Morgan Kaufman, USA, 2013.
3. Mark Allen Weiss, "Data structures and Algorithm Analysis in C++", Pearson Education, New Delhi, 2011.
4. Ellis Horowitz, Sartaj Sahni, Dinesh P Mehta, "Fundamentals of Data Structures in C++", Universities Press (India) Pvt. Ltd, 2008.
5. Venkatesan R and Lovelyn Rose S, "Data Structures", Wiley India Pvt. Ltd., New Delhi, 2015.

15ZC07/15ZS36 OPERATING SYSTEMS

3 0 0 3

INTRODUCTION: Operating Systems - Objectives and Functions - Evolution of Operating Systems - Structure of Operating System. (8)

PROCESS MANAGEMENT: Process Creation - Process States - Threads -Process Scheduling - Synchronization - Deadlock. (9)

MEMORY MANAGEMENT: Contiguous and non-contiguous allocation - Buddy Systems - Paging - Segmentation - Virtual Memory Management. (9)

FILE AND I/O MANAGEMENT: File System - Implementing File System - Secondary Storage Structure - I/O Systems. (9)

LINUX KERNEL: Introduction –POSIX APIs and System Calls - Process Communication: Pipes-FIFOs-POSIX Message Queues. (10)

Total L: 45

REFERENCES:

1. Silberschatz A, Galvin PB and Gagne G, "Operating System Concepts", John Wiley and Sons, Singapore, 2008.
2. Bovet D P and Cesati M, "Understanding the Linux Kernel", O'Reilly, USA, 2005.
3. Bach M J, "The Design of the UNIX Operating Systems", Prentice Hall of India/ Pearson Education, New Delhi, India, 2004.
4. Dhamdhare D M, "Operating Systems- A Concept based Approach", Tata McGraw Hill, New Delhi, India, 2006.
5. Love R, "Linux Kernel Development", Addison-Wesley, Boston, 2010.

15ZC08 THEORETICAL COMPUTER SCIENCE

3 0 0 3

REGULAR LANGUAGES AND FINITE AUTOMATA: Basics of Automata Theory- Chomsky Hierarchy of Grammars and the Corresponding Acceptors. Regular Expression - Deterministic FA - Non deterministic FA - Minimization of DFA - Pumping Lemma of Regular Languages - Decision Problems. (9)

PUSH DOWN AUTOMATA AND TURING MACHINES: Context Free Grammars - Non Deterministic PDA - Decision properties Turing Machines - Variants of TMs - Programming Techniques for TMs - Non Deterministic TMs - TMs and Computers - Recursive and Recursively Enumerable Languages. (10)

COMPUTABILITY THEORY: Hilbert's Problem - Computable Functions - The Recursion Theorem - Decidable Language - Universal Turing Machines - Undecidability - Halting Problem - Rice Theorem - Post Correspondence Problem - Church Turing thesis. (9)

TIME COMPLEXITY THEORY: Tractable and Intractable Problems - Time of Tractable Problems – P, NP, NP-Complete Classes - Boolean Satisfiability Problem - Polynomial Time Reductions - Proof of NP-completeness : Vertex Cover Problem - Clique Problem - Hamiltonian Circuit problem - TSP - NP hard, Cook Levin Theorem. (9)

SPACE COMPLEXITY THEORY: Space Complexity of tractable problems – Savitch's theorem – Class PSPACE – PSPACE Completeness – Class L and NL – NL Completeness – coNL. (8)

Total L: 45

REFERENCES:

1. John E Hopcroft and Rajeev Motwani and Jeffrey D Ullman, "Introduction to Automata theory, Languages and Computation", Pearson Education Asia, New Delhi, 2006.
2. Michael Sipser, "Introduction to the Theory of Computation", Thomson course Technology, USA, 2012.
3. Harry R Lewis, Christos H Papadimitriou, "Elements of the Theory of Computation", Prentice Hall of India/Pearson Education, New Delhi, 2003.
4. John C Martin, "Introduction to Languages and the Theory of Computation", Tata McGraw Hill Publishing Company, New Delhi, 2007.
5. Peter Linz, "An Introduction to Formal Language and Automata", Narosa Publishers, New Delhi, 2006.
6. Christos H Papadimitriou, "Computational Complexity", Addison-Wesley, New York, 1994.

15ZC09 ADVANCED COMPUTER NETWORKS

3 0 0 3

CONGESTION CONTROL ALGORITHMS: Introduction - TCP Sliding Windows - Congestion Control and Queuing - TCP Congestion Control - Analysis of TCP: Buffer Sizing - Throughput - Fairness - Random Early Detection Gateways for Congestion Avoidance. DRR - Core-Stateless Fair Queuing - Congestion Control for High Bandwidth - Delay Product Networks - Variations of TCP. (9)

ROUTING ALGORITHMS AND QUALITY OF SERVICE: Inter Domain-Routing: BGP - BGP Traffic Engineering. Routing Convergence - NAT Traversal - Multicast: Address Assignments - Multicast Routing (DVMRP, PIM) - Session Discovery. Need for QoS - End to End QoS - QoS Levels - Performance Measure: Bandwidth - Delay and Jitter - Packet Loss - Throughput. Routing Overheads - Example Problems. (9)

HIGH-SPEED NETWORKS: Packet Switching Networks - Frame Relay Networks - ATM Networks: ATM Protocol Architecture - Logical Connections - ATM Cells - Service Categories - ATM Adaptation Layer - Traffic and Congestion Control In Frame Relay and ATM Networks. High-Speed LANS - Fast Ethernet - Gigabit Ethernet. (10)

WIRELESS AND SENSOR NETWORKS: Wireless Networks: 802.11 - Mobility - Multichannel - Bluetooth - WIFI - WIMAX - Mobile IP - Mobile TCP. Cellular Networks: GSM - UMTS. WSN- Characteristics - Architecture - Applications. (9)

NETWORK SECURITY AT VARIOUS LAYERS: Secure-Http - SSL - ESP - Authentication Header - Key Distribution Protocols - Digital Signatures - Digital Certificates - IP Security. (8)

Total L: 45

REFERENCES:

1. Larry L Peterson and Bruce S Davie, "Computer Networks: A systems approach", Morgan Kaufmann Publishers Burlington, USA, 2011.
2. James F Kurose, Keith W Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", Pearson Education, India, 2012.
3. Andrew S Tanenbaum, "Computer Networks", Prentice Hall, USA, 2010.
4. William Stallings, "High-Speed Networks and Internets: Performance and Quality of Service", Pearson Education, India, 2002.
5. Holger Karl, Andreas Willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley Publication, 2002.
6. William Stallings, "Cryptography and Network Security", Prentice Hall, USA, 2013.

15ZC10 EMBEDDED SYSTEMS

3 2 0 4

INTRODUCTION: Types of Embedded System - Challenges for Embedded Systems -Components of Embedded Systems - Examples of Embedded Systems - Languages for Programming of Embedded System - Embedded Processors. (8+5)

MEMORY MANAGEMENT AND INTERRUPTS: Memory Technologies - Memory Management in Embedded Real-time systems - Interrupts and Interrupt Service Routines. (8+5)

PERIPHERALS & INTERFACING: Parallel Ports - Timers/Counters - Serial Ports - RTC - SPI - I2C bus - DMA Controllers - ADC Techniques. (10+7)

REAL-TIME OPERATING SYSTEMS: Introduction - Multi-tasking Operating Systems - Priority Inversion - Tasks, Threads and Processes - Inter Task Communication – Exceptions - Memory Models - Commercial Operating Systems: VxWorks. (10+7)

IMPLEMENTATION, EMULATION & DEBUGGING TECHNIQUES: Compilation process - Native vs Cross Compilers - Run-time libraries - Porting Kernels - Downloading Software to Target Board - Emulation Techniques - Debugging Techniques. (9+6)

Total L: 45+T: 30=75

REFERENCES:

1. Heath S, "Embedded Systems Design", Butterworth-Heinemann, Newton, MA, USA, 2002.
2. Iyer V S and Gupta P, "Embedded Real-Time Systems Programming", Tata McGraw Hill, New Delhi, 2007.
3. Berger A S, "Embedded Systems Design- An Introduction to Processes, Tools and Techniques", CMP Books, USA, 2002.
4. Simon D E, "An Embedded Software Primer", Pearson Education, New Delhi, 2008.
5. Rajkamal, "Embedded Systems", Tata McGraw Hill, New Delhi, 2008.

15ZC52 SOFTWARE DEVELOPMENT LABORATORY

0 0 2 1

The students will create an application/prototype using the concepts learnt in various courses in the programme. The student will choose a problem in the domain/technology of his choice. The student will make two presentations and submit a consolidated report on the work done at the end of the semester.

Total P: 30

III SEMESTER

15ZC53 OPEN SOURCE SYSTEMS LABORATORY

0 0 4 2

LIST OF EXPERIMENTS:

1. Linux System Administration: Process Management with Linux, Memory Management, File System management, User Administration, Linux Startup and Shutdown, Software package Management.
2. Kernel configuration, compilation and installation.
3. Virtualization environment.
4. Compiling from source.
5. Installing various software packages.
6. GUI programming.
7. Version Control System.
8. Text processing with Perl.
9. Simple programs with PHP.
10. Simple programs with Python.

Total P: 60

REFERENCES:

1. Negus C and Bresnahan C, "Linux Bible", 2012.
2. Richard Petersen, "Linux: The Complete Reference", Tata McGraw Hill, USA, 2007.
3. Brian D Foy, "Mastering Perl: Creating Professional Programs", Perl O'Reilly Media, USA, 2014.
4. Tatroe K, MacIntyre P and Lerdorf R, "Programming PHP: Creating Dynamic Web Pages", O'Reilly Media, USA, 2013.
5. Elkner J, Downey A, and Meyers C, "How to Think Like a Computer Scientist: Learning with Python", Green Tea Press, Massachusetts, USA, 2012.
6. Julie Meloni, "Teach Yourself PHP, MySQL and Apache All in One", Pearson Education, USA, 2012.
7. Sandeep Koranne, "Handbook of Open Source Tools, Springer Science & Business Media", Heidelberg, 2010.

15ZC71/15ZS71 PROJECT WORK I

0 0 6 3

Identification of real time problem in the field of computers.
Developing a mathematical model for solving the identified problem.
Finalization of system requirements and specification.

Proposing different solutions for the problem based on literature survey.
Future trends in providing alternate solutions.
Consolidated report preparation on the work done.

Total P: 90

SEMESTER IV

15ZC72/15ZS72 PROJECT WORK II

0 0 28 14

The project involves the following:

- ❖ **Preparing a project - brief proposal including**
 - ❖ Problem Identification.
 - ❖ A statement of system / process specifications proposed to be developed.
 - ❖ List of possible solutions including alternatives and constraints.
 - ❖ Cost benefit analysis.
 - ❖ Time Line of activities.
- ❖ **A report highlighting the design finalization [based on functional requirements & standards (if any)].**
- ❖ **A presentation including the following:**
 - ❖ Implementation Phase (Hardware / Software / both).
 - ❖ Testing & Validation of the developed system.
 - ❖ Learning in the Project.
- ❖ **Consolidated report preparation.**

Total P: 420

ELECTIVE THEORY COURSES

Group-I

15ZC21 DATA MINING

2 0 2 3

INTRODUCTION: Definition- Motivating Challenges - Tasks - Types of Data - Data Quality - Data Preprocessing - Measures of Similarity and Dissimilarity. (6+6)

EXPLORING DATA: Summary Statistics - Visualization - OLAP and Multidimensional Data Analysis. (6+6)

ASSOCIATION ANALYSIS: Frequent Itemset Generation - Rule Generation - Compact Representation of Frequent Itemsets - Alternative Methods for Generating Frequent Itemsets - FP Growth Algorithms - Evaluation of Association Patterns - Infrequent Patterns. (6+6)

CLASSIFICATION: Decision Tree Induction - Model Overfitting - Evaluating The Performance of a Classifier - Methods for Comparing Classifiers - Rule Based Classifiers - Bayesian Classifiers - Nearest Neighbour Classifiers - ANN - SVM - Ensemble Methods - Class Imbalance Problem - Multiclass Problem – Prediction. (6+6)

CLUSTER ANALYSIS: Overview - K-Means - Agglomerative Hierarchical Clustering - DBSCAN - Cluster Evaluation - Anomaly Detection Preliminaries. (6+6)

LABORATORY COMPONENT:

1. Data preprocessing techniques.
2. Using measures of similarity.
3. Data visualization.
4. Association rule mining techniques.
5. Classification techniques.
6. Clustering techniques.

Total L: 30+P: 30=60

REFERENCES:

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson Education, New Delhi, 2007.
2. Jiawei Han, MichelineKamber, "Data Mining Concepts and Techniques", Elsevier, New Delhi, 2007.
3. Ian Witten, Eibe Frank and Mark A Hall, "Data Mining - Practical Machine Learning Tools and Techniques", Morgan Kaufmann, USA, 2012.

15ZC22 BIG DATA ANALYTICS

2 0 2 3

INTRODUCTION TO BIG DATA AND DATA ANALYTICS: Big Data: Definition - Characteristics - Architecture - Technologies - Challenges - Applications. Data Analytics Lifecycle: Discovery - Data Preparation - Model Planning - Model Building - Communicating Results - Operationalizing - Role of the Data Scientist. (6+6)

PREDICTIVE ANALYTICS: Data Collection - Sampling - Preprocessing - Linear Regression - Logistic Regression - Decision Trees - Neural Networks - Support Vector Machines - Ensemble Methods - Multiclass Classification Techniques - Evaluating Predictive Models. (6+6)

DESCRIPTIVE AND SURVIVAL ANALYTICS: Association Rules - Sequence Rules - Segmentation - Survival Analysis Measurements - Kaplan Meier Analysis - Parametric Survival Analysis - Proportional Hazards Regression - Extensions of Survival Analysis Models - Evaluating Survival Analysis Models. (6+6)

SOCIAL NETWORK ANALYTICS: Social Network Definitions - Social Network Metrics - Social Network Learning - Relational Neighborhood Classifier - Probabilistic Relational Neighborhood classifier - Relational Logistic Regression - Collective Inferencing - Egonets - Bigraphs. (6+6)

FRAMEWORKS, TOOLS AND APPLICATIONS: Map Reduce Framework - Hadoop, Twister. Tools: Pig - Hive - Mahout - Sqoop - Flume. NoSQL Databases: Need - Characteristics - Properties - Key-value Stores - Column Family Stores. Open Source Databases :Hbase - MongoDB. - Neo4j. Applications: Churn Prediction - Recommendation Systems - Social Media Analysis. (6+6)

LABORATORY COMPONENT:

1. Statistically analyse and explore data using R.
2. Map Reduce using Hadoop.
3. Predict using RHadoop.
4. Predict using Apache Mahout.
5. Data visualization and optimization in R.
6. Package development using NoSQL DB.

Total L: 30+P: 30=60

REFERENCES:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley, USA, 2014.
2. Ohlhorst and Frank J, "Big Data Analytics: Turning Big Data into Big Money", Wiley, USA, 2012.
3. Michael Minelli, Michele Chambers and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", John Wiley and Sons, New Delhi, 2013.
4. Thomas A Runkler, "Data Analytics - Models and Algorithms for Intelligent Data Analysis, Springer Verlag", Germany, 2012.
5. Sarah Stowell, "Instant R: An Introduction to R for Statistical Analysis", Jotunheim Publishing, Norway, 2012.

15ZC23 XML AND WEB SERVICES

2 0 2 3

XML TECHNOLOGY: Benefits – XML Documents - Well-Formed XML – Validation - DTD – XML Schemas - Relax NG – Schematron. (6+6)

XMLPROCESSING: Parsing XML – Updating XML – Extracting Data from XML – XPATH - XSLT – Xquery. (6+6)

WEBSERVICES: Architecture – Messaging – Service Description – Service Discovery – Service Transport – Security. (6+6)

WEBSERVICES IMPLEMENTATION: SOAP Protocol - WSDL – UDDI – Web Service Clients and Service Invocation – WS-* Standards. (6+6)

REST BASED WEB SERVICES: Principles - Comparison with SOAP-XML Based Web Services – Design and Implementation of REST Services – Resource Oriented Architecture –best practices. (6+6)

LABORATORY COMPONENT:

1. Creating Simple Well formed XML document.
2. Validating XML document.
3. Using Document Type Definitions.
4. Creating XML Schemas.
5. Accessing the data using XQUERY.

6. Usage of XSLT.
7. Implementing JAX-RPC.
8. Implementing JAX-WS.
9. Developing applications using REST based Services.
10. Developing applications using SOAP.

Total L: 30+P: 30=60

REFERENCES:

1. Fawcett J, Ayers D, Liam and REQ, "Beginning XML", Wrox, 2012.
2. Hansen M D, "SOA Using Java Web Services", Prentice Hall, USA, 2007.
3. Kalin M, "Java Web Services: Up and Running", O'Reilly Media, USA, 2008.
4. Richardson L and Ruby S, "Restful Web Services", O'Reilly, USA, 2007.

15ZC24 SEMANTIC WEB TECHNOLOGY

2 0 2 3

SEMANTIC WEB VISION: Transition to the Semantic Web - Transition Examples - Semantic Web Technologies - Recommended Layered Architectures. Structured web documents- The XML Language: Structuring - Namespaces - Addressing and Querying XML Documents - Processing. (7+7)

RESOURCE DESCRIPTION: RDF- RDF Schema: Axiomatic Semantics for RDF and RDF Schema - Direct Inference System for RDF and RDFS, Querying in SPARQL. (6+6)

WEB ONTOLOGY LANGUAGE: OWL Language - Ontology Examples - OWL in OWL - Future Extensions to OWL- Ontology engineering: Constructing Ontologies Manually - Reusing Existing Ontologies - Using Semiautomatic Methods - On-To-Knowledge Semantic Web Architecture. (7+7)

LOGIC AND INFERENCE: Rules - Monotonic Rules: Syntax - Semantics - Representing Family Relationships. Nonmonotonic Rules: Syntax - Brokered Trade as an Example - Monotonic and Nonmonotonic Rule Markup. (5+5)

APPLICATIONS: Horizontal Information Products at Elsevier - Data Integration at Audi - Skill Finding at Swiss Life - Think Tank Portal at EnerSearch - e-Learning - Web Services. (5+5)

LABORATORY COMPONENT:

1. Study of Protege.
2. Creation of Ontology using protege.
3. Representing ontology using XML and RDF.
4. Querying an Ontology using SPARQL.
5. Querying an Ontology using Jena.
6. Using reasoners in Protege.
7. Extending ontology using OWL.

Total L: 30+P: 30=60

REFERENCES:

1. Antoniou G and Van Harmelen F, "Semantic Web Primer", MIT press, USA, 2008.
2. Daconta, M C, J Obrst L and Smit K T, "The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management", Wiley, USA, 2003.
3. Davies J, Studer R and Warren P, "Semantic Web Technologies: Trends and Research in Ontology-based Systems", Wiley, USA, 2006.
4. Ducharme B, "Learning SPARQL", O'Reilly Media, USA, 2011.

Group-II

15ZC25 COMPILER DESIGN

3 0 0 3

LEXICAL ANALYSIS: Introduction to Compilers- Analysis of the Source Program ,The Phases of A Compiler, The Grouping of Phases , Compiler Construction Tools,a Simple One-Pass Compiler, Language Design.The Role of the Lexical Analyzer - Input Buffering, Specification of Tokens, Recognition of Tokens, Regular Expressions and Finite Automata. LEX Specification – Example. (9)

SYNTAX ANALYSIS: The Role of the Parser- Context Free Grammars -Top Down Parsing - Bottom Up Parsing - Recursive Descent Parser-Predictive Parser - Shift Reduce Parser - SLR Parser - LR Parser - LALR Parser - Error Handling and Recovery in Syntax Analyzer- YACC Specification - Example. (9)

SYNTAX DIRECTED TRANSLATION: Syntax Directed Definitions: Inherited and Synthesized Attributes -Construction of Syntax Trees-Bottom-Up Evaluation of S-Attributed and L-Attributed Definitions-Top Down Translation-Bottom Up Evaluation. (9)

INTERMEDIATE CODE GENERATION: Intermediate Languages- Declarations, Assignment Statements, Boolean Expressions, Case Statements, Back Patching.Storage Management - Runtime Storage Management, Activation Record, Symbol Table-Organization. (9)

CODE OPTIMIZATION AND CODE GENERATION: Principal Sources of Optimization - Basic Blocks and Flow Graphs - DAG Representation -Optimization of Basic Blocks - Introduction to Global Data Flow Analysis - Peephole Optimization - Issues in the Design of Code Generator - A Simple Code Generator. (9)

Total L: 45

REFERENCES:

1. Alfred V Aho, Monica S Lam, Ravi Sethi and Jeffrey D Ullman, "Compilers - Principles, Techniques and Tools", Pearson Education, New Delhi, 2008.
2. SudhaSadasivam G, "Compiler Design", Scitech Publications, Chennai, 2008.
3. Dhamdhare D M, "Compiler Construction Principles & Practice", Macmillan India Ltd., New Delhi, 2001.
4. Jean Paul Tremblay and Paul G Serenson, "The Theory& Practice of Compiler Writing", McGrawHill, New Delhi, 2001.
5. Dick Grone, Henri E Bal, Cerial J H Jacobs and Koen G Langendoen, "Modern Compiler Design" , John Wiley &Sons, New Delhi, 2000.

15ZC26 MACHINE LEARNING

3 0 0 3

SUPERVISED LEARNING: Definition of Machine Learning - Examples of Machine Learning Applications. SUPERVISED LEARNING:Learning a Class from Examples - VC Dimension - PAC Learning - Noise - Learning Multiple Classes - Regression - Model Selection and Generalization - Dimensions of a Supervised Machine Learning Algorithm. Dimensionality Reduction: Introduction - Subset Selection - PCA - FA - MDS - LDA - Isomap - Locally linear Embedding. (10)

MULTILAYER PERCEPTRONS: Introduction - The Perceptron - Training a Perceptron - Learning Boolean Functions - Multilayer Perceptrons - MLP as a Universal Approximator - Backpropagation Algorithm - Training Procedures - Tuning the Network Size - Dimensionality Reduction - Learning Time. (9)

KERNEL MACHINES: Introduction - Optimal Separating Hyperplane - Soft Margin Hyperplane - ν -SVM - Kernel Trick - Vectorial Kernels - Defining Kernels - Multiple Kernel Learning - Multiclass Kernel Machines - One class Kernel Machines - Kernel Dimensionality Reduction. (9)

HIDDEN MARKOV MODELS: Introduction - Discrete Markov Processes - HMM - Basic Problems of HMMs - Evaluation Problem - Finding the State Sequence - Learning Model Parameters - Continuous Observations - The HMM with Input - Model Selection in HMM. (9)

REINFORCEMENT LEARNING: Introduction - Single State Case-Elements of Reinforcement Learning - Model-Based Learning - Temporal Difference Learning - Generalization - Partially Observable States . Design of Machine Learning Experiments: Introduction - Factors, Response, and Strategy of Experimentation - Response Surface Design - Randomization, Replication, and Blocking - Guidelines for Machine Learning Experiments. (8)

Total L: 45

REFERENCES:

1. Etham Alpaydin, "Introduction to Machine Learning", The MIT Press, Cambridge, 2010.
2. Drew Conway and John Myles White, "Machine Learning for Hackers", O'Reilly, USA, 2012.
3. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, Heidelberg, 2006.
4. Tom M Mitchell, "Machine Learning", Mc-Graw Hill, New York, 1997.
5. Kevin P Murphy, "Machine Learning A Probabilistic Perspective", The MIT Press, Cambridge, 2012.

15ZC27 EVOLUTIONARY COMPUTING TECHNIQUES

3 0 0 3

INTRODUCTION: Challenges in Solving Complex Problems - Evolutionary algorithms: Principles, Historical development, Features, Classification and Components, Advantages, Applications. (8)

HEURISTIC SEARCH: Problem representation as search - Generate and Test - Breadth First Search - Depth First Search - Hill Climbing: Principles, Local and Global maxima, Ridges, Plateau - Steepest Ascent - Simulated annealing: Annealing schedule, Parameter Selection. (8)

GENETIC ALGORITHM: Biological Background - Simple Genetic Algorithm (SGA) - Representation types - Recombination Types - Mutation types - GA Algorithm - Schema Theorem - Variations of GA: Adaptive GA, Real Coded GA - Differential Evolution: Principles, Mutation, Crossover, Selection. (10)

SWARM INTELLIGENCE: Particle Swarm Optimization: Swarms, Operating principles, PSO Algorithm, Neighborhood Topologies - Variations of PSO: Binary, weighted - Ant Colony Optimization: Ant foraging behavior, Theoretical Considerations, ACO Algorithm, Variations of ACO: Elitist Ant System (EAS), MinMax Ant System (MMAS) and Rank Based Ant Colony System (RANKAS). (10)

MULTI-OBJECTIVE OPTIMIZATION: Principles - Classical Methods - Challenges - Evolutionary algorithms for multi-objective optimization - Multimodal function optimization - Non-Dominated Sorting Genetic Algorithm (NSGA): Non-elitist, elitist - Controlled elitism in NSGA. (9)

Total L: 45

REFERENCES:

1. Eiben A E and Smith J E, "Introduction to Evolutionary Computing", Springer, Heidelberg, 2007.
2. Rich E and Knight K, "Artificial Intelligence", Tata McGraw Hill Education Private Limited, India, 2011.
3. Goldberg D E, "Genetic Algorithms in search: Optimization and machine learning", Pearson, India, 2009.
4. Kennedy J and Eberhart R C, "Swarm Intelligence", Morgan Kaufmann Publishers, USA, 2001.
5. Dorigo M and Stutzle T, "Ant Colony optimization", Prentice Hall of India, New Delhi, 2005.
6. Deb K, "Multi-Objective Optimization Using Evolutionary Algorithms", Wiley-Blackwell, USA, 2008.
7. DeJong K A, "Evolutionary Computation: A Unified Approach", Prentice Hall of India, New Delhi, 2006.

15ZC28 INFORMATION RETRIEVAL

3 0 0 3

INTRODUCTION: Mathematical basics - Vector spaces and similarity - Probabilities and Statistics. Overview of text retrieval systems: System architecture - Boolean models - Inverted Indexes - Document ranking - IR Evaluation. (8)

INDEX CONSTRUCTION AND COMPRESSION: Blocked Sort-Based Indexing - Single-Pass In-Memory Indexing - Distributed Indexing - Dynamic Indexing - Statistical Properties - Dictionary Compression - Postings File Compression. (10)

RETRIEVAL MODELS AND IMPLEMENTATION: Vector space models: TF-IDF weighting - Retrieval axioms - Implementation issues. Probabilistic models - statistical language models: Okapi/BM25 - Language models - KL divergence - Smoothing. (10)

QUERIES AND WEB SEARCH ENGINES: Query reformulation - Relevance feedback - Pseudo-relevance feedback - Language model based feedback; Models of the Web - Web crawling - Static ranking – Page Rank - HITS - Query log analysis - Adversarial IR. (8)

TEXT CLASSIFICATION AND CLUSTERING: Naïve Bayes - k-nearest neighbors - Feature selection - Semi-supervised Learning. Text clustering: Vector space clustering - K-means - EM algorithm - Text shingling. (9)

Total L: 45

REFERENCES:

1. Manning C, Raghavan P, and Schütze H, "Introduction to Information Retrieval" Cambridge University Press, New Delhi, 2008.
2. Bruce Croft W, Metzler D, and Strohman T, "Search Engines: Information Retrieval in Practice", Addison Wesley, USA, 2009.
3. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, "Modern Information Retrieval: The Concepts and Technology behind Search", Addison Wesley, USA, 2011.
4. Gerald K, "Information Retrieval Architecture and Algorithms", Springer, Heidelberg, 2013.

15ZC29 NATURAL LANGUAGE PROCESSING

3 0 0 3

INTRODUCTION: Knowledge in Speech and Language Processing - Ambiguity - Models and Algorithms - Language, Thought and Understanding. (9)

WORDS: Regular Expressions and Automata - Words and Transducers - N-grams - Part of Speech Tagging - Hidden Markov and Maximum Entropy Models. (9)

SYNTAX: Formal Grammars of English - Syntactic Parsing - Statistical Parsing - Features and Unification - Language and Complexity. (9)

SEMANTICS AND PRAGMATICS: Representing Meaning- Computational Semantics - Lexical semantics- Computational Lexical semantics- Computational Discourse. (9)

APPLICATIONS: Information Extraction - Question Answering and Summarization. (9)

Total L: 45

REFERENCES:

1. Daniel Jurafsky, James H Martin, "Speech and Language Processing", Pearson Education, Singapore, 2008.
2. James Allen, "Natural Language Understanding", Pearson Education, New Delhi, 2003.
3. Christopher D Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing", MIT Press, Cambridge, 2003.
4. <http://nlp.stanford.edu:8080/parser/index.jsp>.

15ZC30 ADVANCED DATABASES

3 0 0 3

PARALLEL AND DISTRIBUTED DATABASES: Database System Architectures: Centralized and Client-Server Architectures – Server System-Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems- Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies. (9)

OBJECT RELATIONAL DATABASES: Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems: Object Relational features in SQL/Oracle – Case Studies. (9)

INTELLIGENT DATABASES: Active Databases: Syntax and Semantics (Starburst, Oracle, DB2) - Taxonomy- Applications- Design Principles for Active Rules - Temporal Databases: Overview of Temporal Databases-TSQL2- Deductive Databases: Logic of Query Languages – Datalog- Recursive Rules-Syntax and Semantics of Datalog Languages- Implementation of Rules and Recursion- Recursive Queries in SQL- Spatial Databases- Spatial Data Types- Spatial Relationships- Spatial Data Structures- Spatial Access Methods- Spatial DB Implementation. (9)

IN – MEMORY DATA MANAGEMENT AND NOSQL: Impact of In – Memory - Blueprint for an In – Memory enterprise database system-Technical Foundations of SanssouciDB – Overview of Organizing and accessing data in SanssouciDB - Application development NoSQLAn Overview of NoSQL - Characteristics of NoSQL- NoSQL Storage Types - Advantages and Drawbacks- Comparative Study of NoSQL Products - Case Study. (9)

EMERGING TECHNOLOGIES: XML Databases: XML-Related Technologies-XML Schema- XML Query Languages- Storing XML in Databases-XML and SQL- Native XML Databases- Web Databases- Geographic Information Systems- Biological Data Management- Cloud Based Databases: Data Storage Systems on the Cloud- Cloud Storage Architectures-Cloud Data Models- Query Languages- Introduction to Big Data-Storage-Analysis. (9)

Total L: 45

REFERENCES:

1. Elmasri R and Navathe S B, "Fundamentals of Database Systems", Pearson Education, India, 2007.
2. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Pearson Education/ Addison Wesley, England, 2005.
3. Henry F Korth, Abraham Silberschatz and Sudharshan S B, "Database System Concepts", McGraw Hill, USA, 2010.
4. Date C J, Kannan A and Swamynathan S, "An Introduction to Database Systems" Pearson Education, India, 2006.
5. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", McGraw Hill, India, 2004.
6. Gaurav Vaish, "Getting Started with NoSQLYour guide to the world and technology of NoSQL", Packt Publishing Ltd., India, 2013.
7. Hasso Plattner and Alexander Zeier, "In – Memory Data Management Technology and applications", Springer, Heidelberg, 2011.

15ZC31 VIRTUALIZATION

3 0 0 3

ARCHITECTURE AND EMULATION: Computer architecture - Virtual Machine (VM): Basics and types – Taxonomy- Interpretation - Different types - Interpreting Complex Instruction Set - Binary Translation - Code Discovery and Dynamic Translation - Control Transfer Optimizations - Instruction Set Issues - Dynamic Program Behavior - Profiling - Optimization: Translation Blocks, Framework, Code Reordering and Optimization. (10)

VM TYPES: Process VM: Issues, Emulation Types, Code Cache Management, System Environment - High Level Language (HLL) VM: Object Oriented HLL VMs, Java Virtual Machine (JVM), Common Language Infrastructure, Implementation and Issues, High Performance Emulation - Code Signed VM: Mapping, Code Issues and Caching, Traps, I/O. (10)

SYSTEM VIRTUAL MACHINES: Key Concepts - Resource Virtualization: Processors, Memory, I/O - Performance Enhancement. (8)

MULTIPROCESSOR VIRTUALIZATION: Partitioning of Multiprocessor Systems - Partitioning: Physical, Logical - Different Host and Guest Instruction Set Architectures - Security - Migration of Computing Environments. (9)

VM APPLICATIONS AND CASE STUDIES: Grid & Cloud Technologies - VMWare, Hyper-V, XEN, Linux KVM, VirtualBox. (8)

Total L: 45

REFERENCES:

1. Smith J E and Nair R, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier, India, 2005.
2. Wolf C and Halter E M, "Virtualization: From the Desktop to the Enterprise", Apress, USA, 2005.
3. Portnoy M, "Virtualization Essentials", Sybex, USA, 2012.
4. Ruest N and Ruest D, "Virtualization, A Beginner's Guide", McGraw-Hill Osborne Media, USA, 2009.
5. Craig I D, "Virtual Machines", Springer Verlag, Heidelberg, 2006.

15ZC32 CLOUD COMPUTING

3 0 0 3

INTRODUCTION TO CLOUD COMPUTING: The Vision of Cloud Computing - Defining a Cloud- A Cloud Computing Reference Model - Characteristics and Benefits -Challenges Ahead - Historical Developments - Building Cloud Computing Environments - Computing Platforms and Technologies. (9)

VIRTUALIZATION: Introduction - Hypervisors - Main Categories Of Virtualization: Full, Para, Application Server, Application, Network, Storage, Service - Benefits of Virtualization - Cost of Virtualization - Virtualization Drawbacks. (9)

CLOUD COMPUTING ARCHITECTURE AND SERVICE MANAGEMENT: Introduction - Cloud Reference Model - Types Of Clouds- Economics Of The Cloud- Storage As A Service - Database As A Service - Information As A Service - Process As A Service - Application As A Service - Platform As A Service - Integration As A Service- Security As A Service - Management As A Service - Testing As A Service. Cloud Service Management: Reliability - Availability - Security of Services - Performance and Scalability of Services - Tools and Technology. (10)

CLOUD APPLICATIONS: Scientific Applications - Healthcare: ECG Analysis in the Cloud- Biology: Gene Expression Data Analysis for Cancer Diagnosis - Geoscience: Satellite Image Processing - Business and Consumer Applications - Social Networking- Media Applications. (9)

OPEN CHALLENGES: Energy Efficiency in Clouds - Federated Clouds / Intercloud - Third Party Cloud Services - Cloud Security - Infrastructure Security - Data Security and Storage - Identity and Access Management - Scalability and Fault Tolerance- - Organizational Aspects. (8)

Total L: 45

REFERENCES:

1. Rajkumar Buyya, Christian Vecchiola and Thamarai Selvi S, "Mastering Cloud Computing", Tata McGraw Hill Education Private Limited, New Delhi, 2013.
2. Diane Barrett and Gregory Kipper, "Virtualization and Forensics: A Digital Forensic Investigators Guide to Virtual Environment", Elsevier, USA, 2010.
3. David S Linthicum, "Cloud computing and SOA convergence in your enterprise", Pearson, USA, 2010.
4. Tim Mather, Subra Kumarasamy and ShahedLatif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Complianace", O'Reilly, USA, 2011.

15ZC33 PROGRAMMING PARADIGMS

3 0 0 3

BASICS OF PROGRAMMING: Role of Programming Languages - Programming Paradigms - Syntactic Structure-Expression Notations - Abstract Syntax Trees - Lexical Syntax - Context Free Grammars - Grammars for Expressions. (9)

IMPERATIVE AND OBJECT ORIENTED PROGRAMMING: Structured Programming - Syntax-Directed Control Flow - Design Considerations - Programming with Invariants - Data Representation - Data Types - Error Checking - Procedure Activations - Parameter Passing - Scope and Scope Rules - Activation Records - Object Oriented Constructs - Information Hiding - Design With Modules - Defined Types - Declarations - Inheritance - Polymorphism - Dynamic Allocation – Templates. (9)

FORMAL SEMANTICS AND LANGUAGE DESCRIPTION: Semantic Methods: Synthesized Attributes, Attribute Grammars, Natural Semantics, Denotational Semantics - Static Types and Lambda Calculus: Equality, Substitution, Pure Lambda Terms, Programming Constructs as Lambda Terms, Typed Lambda Calculus, Polymorphic Types. (9)

FUNCTIONAL PROGRAMMING: Types, Values And Operations - Expression Evaluation - Lexical Scope - Type Checking - Lists - Function Declaration By Cases - Functions as First-Class Values - ML: Implicit Types - Data Types -Exception Handling In ML - Scheme: Structure of Lists, List Manipulation, Simplification of Expressions. (9)

LOGIC AND CONCURRENT PROGRAMMING: Computing With Relations - Prolog: Data Structures, Programming Techniques, Control, Cuts - Concurrent Programming: Parallelism In Hardware, Streams And Implicit Synchronization, Concurrency As Interleaving, Liveness Properties - Safe Access To Shared Data. (9)

Total L: 45

REFERENCES:

1. Sethi R, "Programming Languages: Concepts and Constructs", Addison-Wesley, USA, 2002.
2. Sebesta R W, "Concepts of Programming Languages", Addison-Wesley, USA, 2012.
3. Harper R, "Practical Foundations for Programming Languages", Cambridge University Press, USA, 2012.
4. Michael L Scott, "Programming Language Pragmatics", Morgan Kaufmann Publishers Inc, USA, 2009.

15ZC34 CRYPTOGRAPHY AND NETWORK SECURITY

3 0 0 3

SECURITY CONCEPTS & SYMMETRIC CIPHERS: The OSI Security Architecture - Security Attacks, Security Services - Security Mechanisms - A Model for Network Security - Classical Encryption Techniques - Block Ciphers and Stream Ciphers - Data Encryption Standard - Block Cipher Principles - modes - The Origins AES. (9)

PUBLIC-KEY CRYPTOGRAPHY: Basic Concepts in Number Theory: Prime Numbers - Fermat's and Euler's Theorems. Principles of Public-Key Cryptosystems - The RSA Algorithm - Diffie - Hellman Key Exchange - Elliptic Curve Cryptography. (9)

CRYPTOGRAPHIC HASH FUNCTIONS: Applications of Cryptographic Hash Functions - Secure Hash Algorithm (SHA) Message Authentication Codes - Message Authentication Requirements - Message Authentication Functions- Digital Signatures - Digital Signature Standard (DSS). (8)

MUTUAL TRUST: Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption, Asymmetric Encryption - Distribution of Public Keys - X.509 Certificates - Public Key Infrastructure, User Authentication Protocols: Remote User Authentication Principles - Kerberos, Single Sign on. (9)

NETWORK& INTERNET SECURITY PROTOCOLS: Basic Concepts, Secure Sockets Layer (SSL) - Transport-Level Security, Transport Layer Security (TLS) - HTTPS - Secure Shell (SSH) .Email Security: Pretty Good Privacy (PGP)- Firewalls- Characteristics and Types - IP Security - IEEE - NIST - PKCS standards . (10)

Total L: 45

REFERENCES:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", Prentice Hall of India Pearson Education, New Delhi, 2013.
2. Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill Ltd, New Delhi, 2013.
3. Behrouz A and Forouzan, "Cryptography and Network Security", Tata McGraw Hill Ltd, New Delhi, 2008.
4. Bernard Menezes, "Cryptography and Network Security", Cengage Learning India, New Delhi, 2010.

15ZC35 MOBILE COMPUTING

3 0 0 3

WIRELESS COMMUNICATION: Challenges Of Wireless Transmission - Multi-Carrier Modulation - Spread Spectrum - Satellite Communication - Broadcast Systems - Multiplexing - FDMA, TDMA And CDMA - Cellular Organization of Mobile Telephone Networks - Operation of Cellular Networks - Frequency Reuse - Tessellation - Handoff - Capacity Improvement. (9)

WIRELESS NETWORKS: IEEE 802.11 Wireless LAN - Architecture - Modes of Operation - CSMA/CA And Its Variants - Wireless LAN Security - Bluetooth Networks - Generation of Cellular Networks - Overview of GSM - GPRS Network Architecture and Operations - UMTS And IMT 2000 - Packet Switching Domain - Core Network - Radio Access Network - LTE - Control Plane - User Plane. (9)

L3 & L4 WIRELESS PROTOCOLS: Mobile IP - Mobility Features In Ipv6 - Proactive and Reactive Ad Hoc Routing Protocols - DSDV, DSR And AODV - Limitations of Traditional TCP in Wireless Networks - TCP Improvements for Wireless Networks - I-TCP, Snoop TCP, Mobile TCP - Security Issues in Network Layer and Transport Layer. (9)

MOBILE COMPUTING PLATFORM: PDA - Device Characteristics and Software Components - Smart Phone - Convergence Of Mobile Devices - J2ME - Modes, Data Store, GUI Support - HTTP Connection Interface Push Registry - Application Development Using Android - Palm OS Architecture and Program Development - Overview of Other Mobile Operating Systems. (9)

MOBILE INTERNET: WAP - WAP Gateways - WML - VoiceXml - Mobile Messaging - Multimedia Messaging Service - Synchronized Multimedia Integration Language - Application Servers - Internet Portals - Device Management - Synchronization Models - Communication to Servlets and Web Services - Location Aware Mobile Computing - IP Multimedia Subsystem. (9)

Total L: 45

REFERENCES:

1. Asoke Talukder, Hasan Ahmed and Rupa Yavagal, "Mobile Computing: Technology, Applications and Services Creation", Tata McGrawHill, New Delhi, 2010.
2. William Stallings, "Wireless Communication and Networks", Pearson, New Delhi, 2009.
3. Jochen Schiller, "Mobile Communications", Pearson, New Delhi, 2009.
4. Uwe Hansmann, Lothar Merk, Martin S Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, USA, 2003.
5. Ivan Stojmenovic, "Handbook of Wireless Networks and Mobile Computing", Wiley, New Delhi, 2002.

15ZC36 WIRELESS SENSOR NETWORKS

3 0 0 3

INTRODUCTION: Challenges For Wireless Sensor Networks - Comparison of Sensor Network with Ad Hoc Network - Single Node Architecture - Hardware Components - Energy Consumption of Sensor Nodes - Network Architecture - Sensor Network Scenarios - Design Principles. (8)

PHYSICAL LAYER: Wireless Channel And Communication Fundamentals - Physical Layer and Transceiver Design Consideration in Wireless Sensor Networks - IEEE Standards: Bluetooth, IEEE 802.11b - Representative sensor nodes - WINS, μamps. (8)

DATA LINK LAYER: MAC Protocols - Fundamentals of Wireless MAC Protocols, Low Duty Cycle Protocols and Wakeup Concepts - Contention Based Protocols - Schedule Based Protocols - Link Layer Protocols - Error Control - Framing - Traffic - Adaptive Medium Access Protocol (TRAMA) - The IEEE 802.15.4 MAC Protocol. (10)

NETWORK LAYER: Gossiping and Agent-Based UniCast Forwarding - Energy Efficient Unicast, Broadcast and Multicast - Geographic Routing - Mobile Nodes - Data Centric and Content Based Networking - LEACH, PEGASIS - Location Based Routing - GF, GAF, GEAR, GPSR - Real Time Routing Protocols - TEEN, APTEEN, SPEED, RAP - Data Aggregation. (10)

SENSOR PROGRAMMING AND APPLICATIONS: Programming Challenges in Wireless Sensor Networks - Tiny Operating System - Event Driven Programming - Contiki OS - Techniques for Protocol Programming. Applications - Environmental Disaster Monitoring, Habitat Monitoring, Military Battlefield Awareness, Underwater Acoustic And Deep Space Networks, Wireless Body Area Networks (WBAN) for Health-Monitoring - Open Issues and Design Challenges. (9)

Total L: 45

REFERENCES:

1. Holger Karl and Andreas Willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley Publication, USA, 2007.
2. Kazemsohraby, Daniel Minoli and Taieb Znati, "Wireless Sensor Networks, Technology, Protocols and Applications", Wiley Interscience, USA, 2007.
3. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks: An Information Processing Approach", Elsevier Publication, USA, 2004.
4. Sudip Misra, Isaac Woungang and Subhas Chandra Misra, "Guide to Wireless Sensor Networks", Springer Publication, 2006.
5. Sitharama Iyengar S, Nandan Parameshwaran, Balkrishnan N and Chuka D Okye, "Fundamentals of Sensor Network Programming, Applications and Technology", John Wiley & Sons, USA, 2011.

15ZC37 SOFTWARE TESTING AND QUALITY ASSURANCE

3 0 0 3

TESTING FUNDAMENTALS AND TECHNIQUES: Objectives and Principles - V Process Model - Relationship between Testing and Development Life Cycle - Verification Vs Validation - Characteristics Of Good Test Case - Test Case Design - Testing techniques: White Box Testing - Basis Path Testing - Control Structure Testing - Black Box Testing - Graph Based Testing - Equivalence Partitioning - Boundary Value Analysis. (10)

TESTING STRATEGIES: Unit Testing - Integration Testing - System Testing - Acceptance Testing - Special Test Strategies - Art of Debugging - IEEE Standard for Software Unit Testing. (8)

TEST AUTOMATION AND MANAGEMENT: People and Organizational Issues in Testing - Test Planning - Management - Execution - Reporting - Software Test Automation - Tools for Testing - Selection of Test Tool - Challenges in Automation. (8)

QUALITY CONCEPTS: Views of Quality- Quality Control vs Quality Assurance- Cost of Quality- Quality Movement- Quality Assurance Group- Roles and Responsibilities- SQA Activities- Formal Technical Reviews- Statistical Approach to Quality Assurance- SQA plan. (9)

SOFTWARE QUALITY METRICS AND STANDARDS: Software Quality Measurement- Product Quality Metrics- Software Maintenance Metrics- Collecting Software Engineering Data- Software Reliability Models - Models and standards: Role of CMM/CMMI- ISO Standards- Trends in Quality. (10)

Total L: 45

REFERENCES:

1. Roger Pressman S, "Software Engineering: A Practitioners", Tata McGraw Hill, New Delhi, 2009.
2. Watts Humphrey, "Managing the Software Process", Pearson Education, New Delhi, 2000.
3. Watts Humphrey, "Introduction to the team Software Process", Pearson Education, New Delhi, 2002.
4. Pankaj Jalote, "Software Project Management in Practice", Pearson Education, New Delhi, 2005.
5. Gopaldaswamy Ramesh and Ramesh Bhattachiprolu," Software Maintenance: Effective Practices for Geographically Distributed Environments", Tata McGraw Hill, New Delhi, 2009.
6. Bob Hughes and Mike Cotterell, "Software Project Management", Tata McGraw Hill, New Delhi, 2002.

15ZC38 INTERNET OF THINGS

3 0 0 3

INTRODUCTION: Overview- Flavor of the IOT-The "Internet" of "Things"-Technology- Enchanted objects- Making of Internet of Things- Design Principles for Connected Devices. **IOT ARCHITECTURE:** Background and Initial Visions- Definitions and Functional Requirements- Opportunities and Motivation- Future Developments - Possible Architecture for the future IOT. (10)

INTERNET PRINCIPLES: Internet Communication- IP addresses- MAC addresses- TCP and UDP Ports- Application Layer Protocols- IEEE 802 committee family of protocols- Physical layer- Media-Access Control Layer. (10)

PROTOTYPING: Prototypes and Production- Open Source versus Closed Source- Prototyping embedded devices- Electronics- Embedded Computing Basics- Arduino- Raspberry Pi- Electric Imp. (9)

PROTOTYPE TO REALITY: Business Models- Business Model Canvas- Models- Funding an Internet of Things Startup- Lean Startup- Ethics. (8)

APPLICATIONS: Smart Grid- Introduction- Marginal cost of Electricity:Base and Peak production- Managing Demand- Demand Response for Transmission System Operators. (8)

Total L: 45

REFERENCES:

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley & Sons Ltd., UK, 2014.
2. Dieter Uckelmann, Mark Harrison and Florian Michahelles, "Architecting the Internet of Things", Springer, NewYork, 2011.
3. Olivier Hersent, David Boswarthick and OmarElloumi, "The Internet of Things: Key Applications and Protocols", John Wiley & Sons Ltd., UK, 2012.
4. David Boswarthick, Omar Elloumi and OlivierHersent, "M2M Communications: A Systems Approach", John Wiley & Sons Ltd, UK, 2012.

15ZC39/15ZS35 PROFESSIONAL ETHICS

3 0 0 3

ENGINEERING ETHICS: Senses of 'Engineering Ethics' - Variety of moral issues - Types of inquiry - Moral dilemmas -Moral Autonomy - Kohlberg's theory - Gilligan's theory - Consensus and Controversy - Professions and Professionalism -Professional Ideals and Virtues - Uses of Ethical Theories. (9)

ENGINEERING AS SOCIAL EXPERIMENTATION: Engineering as Experimentation - Engineers as responsible Experimenters - Research Ethics -Codes of Ethics - Industrial Standards - A Balanced Outlook on Law - The Challenger Case Study. (9)

ENGINEER'S RESPONSIBILITY FOR SAFETY: Safety and Risk - Assessment of Safety and Risk - Risk Benefit Analysis - Reducing Risk - The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal. (9)

RESPONSIBILITIES AND RIGHTS: Collegiality and Loyalty - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime -Professional Rights - Employee Rights - Intellectual Property Rights (IPR) - Discrimination. (9)

GLOBAL ISSUES: Multinational Corporations - Business Ethics - Environmental Ethics- Computer Ethics - Role in Technological Development - Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Honesty - Moral Leadership - Sample Code of Conduct. (9)

Total L: 45

REFERENCES:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics-Concepts and Case, Cengage Learning", USA, 2009.
3. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 2011.
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, USA, 2012.
5. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, USA, 2001.
6. Prof. (Col) Bajaj P S and Dr. Raj Agrawal, "Business Ethics- An Indian Perspective", Biztantra, New Delhi, 2004.
7. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, USA, 2001.

15ZC40 CLOUD SECURITY

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CLOUD SECURITY: The Evolution of Cloud Computing - Delivery Model - Deployment Models- Barriers to Cloud Computing Adoption in the Enterprise -Confidentiality, Privacy, Integrity, Authentication, Non-Repudiation, Availability,Access Control, Defence in Depth, Least Privilege, and their Importance In Paas, IaaS and SaaS.Cryptographic Systems- Symmetriccryptography, Stream Ciphers, Block Ciphers, Modes of Operation, Public-Keycryptography, Hashing, Digital Signatures, Public-Key Infrastructures, Keymanagement, X.509 Certificates, Openssl. (9)

MULTI-TENANCY ISSUES: Isolation of Users/VMS from Each Other - Virtualization System Security Issues- File System Security, Storage Considerations, Backup and Recovery; Virtualization System Vulnerabilities- Management Console Ulnerabilities, Management Server Vulnerabilities, Administrative VM Vulnerabilities, Guest VM Vulnerabilities, Hypervisor Vulnerabilities, Hypervisor Escape Vulnerabilities, Configuration Issues, Malware - Virtualization System-Specific Attacks- Technologies for Virtualization-Based Security (9)

INFRASTRUCTURE AND DATA SECURITY: Infrastructure Security: The Network Level - The Host Level - The Application Level -Data Security and Storage Aspects of Data Security - Data Security Mitigation - Provider Data and its Security. (6)

IDENTITY, ACCESS MANAGEMENT AND PRIVACY: Trust Boundaries and IAM - Challenges -Definitions - IAM Architecture and Practice - Relevant IAM Standards and Protocols for Cloud Services - IAM Practices in the Cloud - Cloud Authorization Management -Privacy : Data Life Cycle - Key Privacy Concerns in the Cloud - Protecting Privacy - Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing - Legal and Compliance Issues. (9)

CASE STUDY: Cloud Service Providers : Amazon Web Services (IaaS) -Google (SaaS, PaaS) - Microsoft Azure Services Platform (PaaS) - Proofpoint (SaaS, IaaS) - RightScale (IaaS) - Salesforce.com (SaaS, PaaS) - Sun Open Cloud Platform - Workday (SaaS) - Security-As-a-[Cloud] Service - Origins - Today's Offerings – Performance vs. Security (12)

Total L: 45

REFERENCES:

1. Tim Mather, SubraKumaraswamy, ShahedLatif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" O'Reilly Media, 2009.
2. Ronald L. Krutz, Russell Dean Vines, "Cloud Security", 2010.
3. John Rittinghouse, James Ransome, "Cloud Computing"CRC Press,2009.
4. J.R. ("Vic") Winkler, "Securing the Cloud"Syngress", 2011.
5. Cloud Security Alliance, "Security Guidance for Critical Areas of Focus in Cloud Computing"2009.
6. Vmware "VMware Security Hardening Guide" White Paper, June 2011.
7. Cloud Security Alliance 2010, "Top Threats to Cloud Computing" Microsoft 2013.
8. Timothy Grance; Wayne Jansen "Guidelines on Security and Privacy in Public Cloud Computing",NIST, 2011.
9. Evelyn Brown "Guide to Security for Full Virtualization Technologies", NIST, 2011
10. Peter Mell, Timothy Grance, "The NIST Definition of Cloud Computing", NIST 2011.
11. William Hau, Rudolph Araujo et al "How Virtualization Affects PCI DSS", www.foundstone.com.
12. Chenxi Wang "Compliance with Clouds: Caveat Emptor", www.forrester.com/2010.

ONE CREDIT COURSES

For the detailed syllabi of the electives and one credit courses offered by other departments refer to the syllabi of M.E- Automotive Engineering offered by Automobile Engineering Department.