



MANIPAL UNIVERSITY  
JAIPUR

**SCHOOL OF COMPUTING & INFORMATION TECHNOLOGY**

**DEPARTMENT OF INFORMATION TECHNOLOGY**

**BACHELOR OF TECHNOLOGY (INFORMATION TECHNOLOGY)**

**COURSE STRUCTURE & SYLLABI FOR SECOND, THIRD & FOURTH YEARS**

**(From Batch: 2019-23)**

**School of Computing and Information Technology**

**Department of Information Technology**

**Course Structure for B. Tech (Information Technology) Program to be followed from AY 2019-2020**

Year	THIRD SEMESTER						FOURTH SEMESTER					
	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C
II	EO2001	Economics	2	1	0	3	BB0025	Value, Ethics and Governance	2	0	0	2
	MA2101	Engineering Mathematics – III	2	1	0	3	MA2201	Engineering Mathematics – IV	2	1	0	3
	IT2101	Computer-System Architecture (PC-1)	3	1	0	4	IT2201	Web Technologies (PC-5)	3	1	0	4
	IT2102	Data Structures and Algorithms (PC-2)	3	1	0	4	IT2202	Operating Systems (PC-6)	3	1	0	4
	IT2103	Object-Oriented Programming (PC-3)	3	1	0	4	IT2203	Relational Database Management Systems (PC-7)	3	1	0	4
	IT2104	Data Communications (PC-4)	3	1	0	4	IT22XX	Open Elective – I	3	0	0	3
	IT2130	Object-Oriented Programming Lab	0	0	2	1	IT2230	Operating Systems Lab	0	0	2	1
	IT2131	Data Structures and Algorithms Lab	0	0	2	1	IT2231	Relational Database Management Systems Lab	0	0	2	1
							IT2232	Web Technologies Lab	0	0	2	1
			16	6	4	24			16	4	6	23
	Total Contact Hours (L + T + P)		26			Total Contact Hours (L + T + P) + OE		26				
III	FIFTH SEMESTER						SIXTH SEMESTER					
	IT31XX	Program-Elective-1	3	0	0	3	BB0026	Organization and Management	2	1	0	3
	IT3101	Foundations of Data Science (PC-8)	3	1	0	4	IT32XX	Program-Elective-2	3	0	0	3
	IT3102	Software Engineering (PC-9)	3	1	0	4	IT3270	Minor-Project	0	0	4	2
	IT3103	Design and Analysis of Algorithms (PC-10)	3	1	0	4	IT32XX	Open Elective – III	3	0	0	3
	IT3104	Computer Networks (PC-11)	3	1	0	4	IT3201	Artificial Intelligence and Machine Learning (PC-12)	3	1	0	4
	IT31XX	Open Elective – II	3	0	0	3	IT3202	Automata Theory and Compiler Design (PC-13)	3	1	0	4
	IT3130	Design and Analysis of Algorithms Lab	0	0	2	1	IT3203	Cryptography and Information Security (PC-14)	3	1	0	4
	IT3131	Computer Networks Lab	0	0	2	1	IT3230	Compiler Design Lab	0	0	2	1
	IT3132	Software Engineering Lab	0	0	2	1	IT3231	Artificial Intelligence and Machine Learning Lab	0	0	2	1
			18	4	6	25			17	4	8	25
	Total Contact Hours (L + T + P) + OE		28			Total Contact Hours (L + T + P) + OE		29				
IV	SEVENTH SEMESTER						EIGHTH SEMESTER					
	IT41XX	Program-Elective-3	3	0	0	3	IT4270	Major Project				12
	IT41XX	Program-Elective-4	3	0	0	3						
	IT41XX	Program-Elective-5	3	0	0	3						
	IT41XX	Program-Elective-6	3	0	0	3						
	IT41XX	Program-Elective-7	3	0	0	3						
	IT4170	Industrial Training	0	0	0	1						
			15	0	0	16						12
	Total Contact Hours (L + T + P)		15			Total Contact Hours (L + T + P)						

Minor Specializations	Program Electives (For PE-5, PE-6 and PE-7 Slots)	Open Electives
<p><b>1. Data Science</b></p> <ul style="list-style-type: none"> <li>• IT3140 Soft Computing (PE-1)</li> <li>• IT3240 Data Mining and Data Warehousing (PE-2)</li> <li>• IT4140 Big Data Analytics (PE-3)</li> <li>• IT4141 Deep Learning (PE-4)</li> </ul> <p><b>2. Computer Vision and Image Processing</b></p> <ul style="list-style-type: none"> <li>• IT3141 Digital Image Processing (PE-1)</li> <li>• IT3241 Computer Vision (PE-2)</li> <li>• IT4142 Parallel Computing (PE-3)</li> <li>• IT4143 Advanced Computer Vision (PE-4)</li> </ul>	<ul style="list-style-type: none"> <li>• IT4144 Advanced Data Structures</li> <li>• IT4145 Distributed Computing</li> <li>• IT4146 Software Testing Techniques</li> <li>• IT4147 Software Reliability</li> <li>• IT4148 Object-Oriented Design and Patterns</li> <li>• IT4149 Wireless Ad-hoc and Sensor Networks</li> <li>• IT4150 Cloud Computing</li> <li>• IT4151 Software Defined Networks</li> <li>• IT4152 Mobile Computing</li> <li>• IT4153 Natural Language Processing</li> <li>• IT4154 Information Retrieval</li> <li>• IT4155 Network Security and Management</li> </ul>	<ul style="list-style-type: none"> <li>• IT2280 Python Programming</li> <li>• IT3180 Basics of Information Security</li> <li>• IT3280 Basics of Linux Programming</li> <li>• IT3281 Introduction to Data Science</li> </ul>

## **BB0025: VALUE, ETHICS & GOVERNANCE [2 0 0 2]**

### **Objective:**

To improve understanding of values ethics & corporate governance so ensure that we produce responsible citizens for the larger society.

### **Contents:**

Relevance of Value Education in day-to-day life. Mantra for success - Value, Moral and Ethics. Determinants of human nature (Three Gunas) and its impact on human life. Relevance of Personality, Attitude, Behaviour, Ego, Character, introspection, Motivation, Leadership and 4 Qs with relevant Case Studies\*.

Governance: Understanding of Public and Private sector Governance systems; Courts & CAG. Public Sector Governance: Need, relevance, stakeholders.

Private Sector Governance: Proprietary, Partnership, Company (Pvt Ltd & Ltd), Company' Act 2013, Board of Directors; its Roles and Responsibilities. Regulatory bodies; its role in ethical governance.

Projects on PPP mode-relevance & prospects.

CSR: Relationship with Society, Philanthropy and Business strategy, CSR Policy, Triple Bottom Line

### **Reference Books:**

1. Professional Module of ICSI.
2. Ghosh B.N., Business Ethics & Corporate Governance, McGraw Hill.
3. Mandal S.K., Ethics in Business & Corporate Governance, McGraw Hill .
4. Ray C.K., Corporate Governance, Value & Ethics, Vaya Education of India
5. Chatterjee Abha, Professional Ethics, Oxford Publications.

### **Suggestive Case Studies:**

- 1) Uphar Theatre Tragedy- Engineering Ethics
- 2) Bhopal Gas Tragedy- Operational Engineering Ethics
- 3) Satyam Case- Financial Reporting Ethics
- 4) Enron Case- Business Ethics
- 5) Navin Modi Case- Financial Fraudulence

## **IT2101: COMPUTER SYSTEM ARCHITECTURE [3 1 0 4]**

Basics of Digital Electronics: Codes, Logic Gates, Flip-Flops, Registers, Counters, Multiplexer, Demultiplexer, Encoder, Decoder; RTL and Micro Operations: Register Transfer, Bus and Memory Transfer, Logic Micro Operations, Shift Micro Operations; Basic Computer Organization: Complete Computer Description & Design of Basic Computer, Instruction Codes, Computer Instructions, Timing & Control, Instruction Cycles, Memory Reference Instructions, Input/output & Interrupts; Control Unit: Hardwired vs. Micro Programmed Control Unit, Central Processing Unit, General Register Organization, Stack Organization, Instruction Format, Data Transfer & Manipulation, Program Control, RISC, CISC; Computer Arithmetic: Addition & Subtraction, Multiplication Algorithms, Division Algorithms; Input-Output Organization: Peripheral devices, I/O interface, Data Transfer Schemes, Program Control, Interrupt, DMA Transfer, I/O Processor; Memory Unit: Memory Hierarchy, Processor vs. Memory Speed, High-speed Memory, Cache Memory, Associative Memory, Interleave, Virtual Memory, Memory Management; Introduction to Parallel Processing: Pipelining, Characteristics of Multiprocessors, Interconnection Structures, Inter-processor Arbitration, Inter-processor Communication & Synchronization; Case Studies: Case Studies of some Contemporary Advanced Architecture for Processors of Families like Intel, AMD, IBM.

### **References:**

1. Mano Morris M, *Computer System Architecture*, (3e), Prentice Hall India, 2017.
2. C. Hamacher, Z. Vranesic, *Computer Organization*, (6e), Tata McGraw Hill, 2016.
3. Hayes, J. P., *Computer Architecture and Organization*, (3e Revised), Tata McGraw Hill, 2017.
4. Hennessy, J.L., Patterson, D.A, and Goldberg, D., *Computer Architecture a Quantitative Approach*, (6e), Pearson Education Asia, 2017.

## IT2102: DATA STRUCTURES AND ALGORITHMS [3 1 0 4]

Introduction: Algorithm Specification; Performance Analysis: Time and Space Complexity, Asymptotic Notation, Pointer Declaration and Definition, Memory Allocation Functions, Array of Pointers, Type Definition, Enumerated Types, Accessing Structures, Complex Structures, Arrays of Structures, Structures and Functions; Linked Lists: Representations, Singly, Doubly, Header Node, Circular, Applications of Linked Lists: Josephus Problem, Sparse Matrix Storage Using Linked List and Its Operations, Polynomial and Long Integer Arithmetic; Stacks: Representing Stacks in C, Evaluation of Expressions, Multiple Stacks; Applications of Stacks: Infix, Postfix and Prefix and their Conversions, Recursive Definition and Processes, Recursion in C, Writing Recursive Programs Efficiency of Recursion; Recursion Examples: Tower of Hanoi, GCD, Fibonacci Definition; Queues: Linear and Circular Queue, Priority Queue, Linked List Representations; Trees: Basic Terminologies, Binary Tree Representation, Binary Search Tree, AVL Trees, B and B+ Trees; Tree Operations: Inserting, Deleting and Searching; Graph: Graph Operations, Spanning Trees, Minimum Cost Spanning Tree, Shortest Path and Transitive Closure; Searching: Binary and Linear Search Algorithms; Sorting: Insertion, Quick, Merge, Heap, Radix Sort; Hashing: Hashing and Collision Resolution.

### References:

1. Seymour Lipschutz, *Data Structures with C (Schaum's Outline Series)*, (1e), Tata McGraw Hill Education Private Limited, ISBN: 9780070701984, , 2011.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, *Introduction to algorithms*, (3e), Prentice Hall India, ISBN-13: 978-0262033848, ISBN-10: 9780262033848, 2009.
3. Mark Allen Weiss, *Data structures and Algorithm Analysis in C*, (2e), Pearson Education India, ISBN:0-8053-5443-3, 2014.
4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, *Data Structures and Algorithms*, (1e), Pearson Education India, ISBN-13: 978-0201000238, ISBN-10: 0201000237, 2012.
5. A. Tanenbaum, J. Augenstein, *Data Structures using C*, (2e), Pearson Education India, ISBN-13: 978-0130369970, ISBN-10: 0130369977 Pearson Education, 2006.

## **IT2103: OBJECT-ORIENTED PROGRAMMING [3 1 0 4]**

Introduction: Object-oriented Paradigm and Pillars such as Abstraction, Encapsulation, Inheritance and Polymorphism; Java Basics: Compilation and Execution of a Java Program, Access Modifiers; Class and Objects: Class Definition, Creating Objects, Role of Constructors, Method Overloading, Argument Passing, Objects as Parameters, Access Control; I/O Basics: Reading Console Input, Writing Console Output; Array and Strings: Arrays in Java, 1-D, 2-D and Dynamic Arrays, String Basics, String Comparison and Manipulation; Inheritance: Inheritance and its Types, Abstract Class, Inner and Outer Class, Super, Final, Static Keywords; Package and Interface: In-Built Packages and User Define Packages, Role of Interface, Polymorphism via Inheritance; Collection Framework & Generics: List, Set, Map, Generic Classes; Exception Handling: Errors and Exceptions, Types of Exceptions, Handling Exceptions, Multithreading: Thread Class, Runnable, Thread Life Cycle, Synchronization, Thread Priority; Event Handling and GUI Programming: Events, Action Listener, Important Swing Package Classes.

### **References:**

1. Schildt H, *Java: The Complete Reference*, (10e), Tata McGraw-Hill Education Group, 2017.
2. Balagurusamy E, *Programming with Java*, (5e), Tata McGraw Hill, 2017.
3. Daniel Liang Y, *Introduction to Java Programming*, (10e), Pearson Education, 2018.
4. Horstmann CS, *Big Java: Early Objects*, (5e), Wiley's Interactive Edition, 2015.

## **IT2104: DATA COMMUNICATIONS [3 1 0 4]**

Data Transmission: Concepts and Terminology, Analog and Digital Data Transmission, Transmission Impairments, Channel Capacity; Transmission Media: Guided Transmission Media, Wireless Transmission, Wireless Propagation, Line-of-Sight Transmission; Signal Encoding Techniques: Analog and Digital Signals; Digital-to-Digital Conversion: Line Coding Schemes, Block Coding, Scrambling; Analog-to-Digital Conversion: Pulse Code Modulation, Delta Modulation; Digital Data Communication Techniques: Asynchronous and Synchronous Transmission, Types of Errors, Error Detection, Error Correction, Line Configurations; Media Access Control: Introduction, ALOHA, CSMA, CSMA/CD, CSMA/CA; Data Link Control Protocols: Flow Control, Error Control, High-Level Data Link Control (HDLC); Multiplexing: Frequency-Division Multiplexing (FDM), Time-Division Multiplexing (TDM), Code-Division Multiple Access (CDMA); Spread Spectrum: The Concept of Spread Spectrum, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS); Cellular Wireless Communication Techniques: Introduction, 1G, 2G, 3G, 4G, and 5G.

### **References:**

1. W. Stallings, *Data and Computer Communications*, (10e), Pearson Education India, 2014.
2. B. Forouzan, *Data Communications & Networking*, (5e), McGraw Hill, 2013.
3. L. Peterson and T. Davie, *Computer Networks: A Systems Approach*, (5e), Morgan Kaufmann Publishers, 2012.
4. K. R. Fall, W. R. Stevens, *TCP/IP Illustrated*, (2e), Addison-Wesley Publication, 2011.



## **IT2130: OBJECT-ORIENTED PROGRAMMING LAB [0 0 2 1]**

Java Introduction: Compiling and Executing a Simple Java Program and Simple Input/Output; Class and Objects: Class Definition, Creating Objects; Array and Strings: Programs Based Upon 1-D, 2-D and Dynamic Arrays, String Comparison and Manipulation; Inheritance: Inheritance and Its Types, Abstract Class, Inner and Outer Class, Super, Final, Static Keywords; Collection Framework & Generics: Using Collection Classes such as Array Lists and Linked Lists Writing Generic Classes; Exception Handling: Errors and Exceptions, Types of Exceptions; Multithreading: Thread Class, Runnable, Synchronization, Thread Priority; Event Handling and GUI Programming: Action Listener, Swing Package.

### **References:**

1. Schildt H, *Java: The Complete Reference*, (10e), Tata McGraw-Hill Education Group, 2017.
2. Balagurusamy E, *Programming with Java*, (5e), Tata McGraw Hill Education Group, 2017.
3. Daniel Liang Y, *Introduction to Java Programming*, (10e), Pearson Education India, 2018.
4. Horstmann CS, *Big Java: Early Objects*, (5e), Wiley's Interactive Edition, 2015.

## IT 2131: DATA STRUCTURES AND ALGORITHMS LAB [0 0 2 1]

Array: Implementation and Operations on One Dimensional and Two Dimensional Array; Linked-List: Implementation and Operations on Singly, Doubly and Circular Linked Lists; Stacks: Implementation and its Applications; Queue: Implementation and its Applications; Trees: Binary Tree Implementation and its Applications; Binary Search Tree: Implementation and its Operations, AVL Tree; Graph: Implementation and Applications; Sorting: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort and Heap Sort; Searching: Linear and Binary Search.

### References:

1. Seymour Lipschutz, *Data Structures with C (Schaum's Outline Series)*, (1e), Tata McGraw Hill Education Group, ISBN: 9780070701984, 2011.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, *Introduction to algorithms*, (3e), Prentice Hall India, ISBN-13: 978-0262033848, ISBN-10: 9780262033848, PHI, 2009.
3. Mark Allen Weiss, *Data structures and Algorithm Analysis in C*, (2e), Pearson Education India, ISBN:0-8053-5443-3, 2014.
4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, *Data Structures and Algorithms*, (1e), Pearson Education India, ISBN-13: 978-0201000238, ISBN-10: 0201000237, 2012.
5. A. Tanenbaum, J. Augenstein, *Data Structures using C*, (2e), Pearson Education India, ISBN-13: 978-0130369970, ISBN-10: 0130369977, 2006.

## **IT2201: WEB TECHNOLOGIES [3 1 0 4]**

Introduction: Web Development and Client Side Programming, Protocols Governing Web, Internet Services and Tools, Client-Server Computing; HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, HTML5; CSS: Creating Style Sheets, Levels of Style Sheets, CSS Properties, Style Specification Formats, Selector Forms, The Box Model, Conflict Resolution; Javascript: Basic of Javascript, Variables, Arrays and Operators, Functions, Event Handlers, Built-in JS Objects, Form Validations, Conditional and Loops, Debugging and Testing; Introduction to AJAX: AJAX and Node.Js Server, The XMLHttpRequest Object, Handling The Response, JQuery, Passing Data, AJAX Application; PHP Programming: Introduction to PHP, Creating PHP Script, Running PHP Script, Variables and Constants, Data Types, Operators, Conditional Statements, Control Statements, Arrays, Functions, Working With Forms and Databases Connection, Introduction to Web-Server and XAMPP.

### **References:**

1. “*Web Technologies (Black Book)*”, Kogent Learning Solutions Inc., Dreamtech Press, 2009.
2. Jackson, *Web Technologies: A Computer Science Perspective*, (1e), Pearson Education India, 2007.
3. Srinivasan, *Web Technology: Theory and Practice*, (1e), Pearson Education India, 2012.
4. Godbole A., Khate A., *Web Technologies*, (3e), McGraw Hill Education, 2017.
5. Gopalan N. P., Akilandeswari J., *Web Technology: A Developer's Perspective*, (2e Revised), Prentice Hall India Learning, 2014.
6. Roy U. K., “*Web Technologies*”, Oxford Press, 2010.

## IT2202: OPERATING SYSTEMS [3 1 0 4]

Introduction: Operating System Structure, Operating System Operations, Process Management, Memory Management Storage Management, Protection and Security, Special Purpose; System Structure: Operating System Services, User Operating System Interfaces System Calls, Types of System Calls, System Programs Operating System Structure, Virtual Machines, System Boot; Process: Process Concept, Process Scheduling Operations on Processes Inter-Process Communication, Unix Pipes; Multithreaded Programming: Overview, Multithreaded Models Thread Libraries Programs Using Pthreads; Process Scheduling: Basic Concepts, Scheduling Criteria; Process Synchronization: Background, Critical Section Problem Peterson's Solution Synchronization Hardware, Semaphores Classical Problems of Synchronization Classical Problems of Synchronization. Programs Using Pthreads; Deadlocks: System Model, Deadlock Characterization Methods for Handling Deadlocks, Deadlock Prevention Deadlock Avoidance Deadlock Detection, Recovery from Deadlock; Memory Management: Background (Address Binding, Logical vs Physical Address Space, Dynamic Loading, Dynamic Linking And Shared Libraries, Overlays) Swapping, Contiguous Memory Allocation, PAGING, Structure of Page Table Segmentation, Demand Paging, Page Replacement Policies Allocation of Frames , Thrashing; File System Interface and Implementation : File Concept, Access Methods, Directory and Disk Structure, File System Mounting, File System Structure Space Allocation Methods for Files ( Contiguous, Linked , Indexed), Free Space Management (Bit Vector, Linked List, Grouping, Counting); Disk Management: Disk Scheduling Algorithms, Disk Management, Swap Space Management; Protection and Security: Goals of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, The Security Problem, User Authentication, Program Threats, System Threats Intrusion Detection.

### References:

1. Avi Silberschatz, Peter Baer Galvin, Greg Gagne, *Operating System Concepts*, (9e), Wiley India, ISBN: 9788126554270, 8126554274, 2013.
2. William Stallings, *Operating Systems: Internals and Design Principles*, (9e), Pearson Education India, ISBN: 9789352866717, 2018.
3. A.S. Tanenbaum, *Modern Operating Systems*, Fourth Edition, Pearson Education India, ISBN: 9789332575776, 2016.

## **IT2203: RELATIONAL DATABASE MANAGEMENT SYSTEMS [3 1 0 4]**

Introduction: Database Systems, RDBMS Definition, Data Models, 3-Schema Architecture, Challenges in Building RDBMS, Different Components of a RDBMS; Relational Data Model: Concept of Relations and Its Characteristics, Schema-Instance, Integrity Constraints, E/R Model, Extended E/R Model, Converting the Database Specification In E/R and Extended E/R Notation to The Relational Schema; Relational Query Language: Relational Algebra, Tuple Relation Calculus, Domain Relational Calculus, Introduction to SQL, Data Definition in SQL, Table and Different Types of Constraints Definitions, Data Manipulation in SQL, Nested Queries, Notion of Aggregation; Relational Database Design: Functional Dependencies and Normal Forms, Armstrong's Axioms for FD's, Closure of a Set of FD's, Minimal Covers, Decomposition of Relations to Desired Normal Forms, Algorithms for 3NF and BCNF Normalization, Multi-Valued Dependencies and 4NF; Transaction Processing: Concepts of Transaction Processing, ACID Properties, Concurrency Control, Locking Based Protocols, Recovery and Logging Methods; Data Storage and Indexing: File Organizations, Primary, Secondary Index Structures, Hash-Based Indexing, Dynamic Hashing Techniques, Multi-Level Indexes, B-Tree and B+ Tree.

### **References:**

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, *Database System Concepts*, (6e), McGraw Hill, 2013.
2. Ramez Elmasri, Shamkant B. Navathe, *Fundamentals of Database System*, (6e), Pearson Education India, 2013.
3. Raghu Ramakrishnan, Johannes Gehrke, *Database Management Systems*, (3e), McGraw Hill, 2014.
4. Ivan Bayross, *SQL, PL/SQL The Programming Language of Oracle*, (4e), BPB Publications, 2010.
5. C. J. Date, *An Introduction to Database Systems*, (8e), Pearson Education India, 2003.

## **IT2230: OPERATING SYSTEMS LAB [0 0 2 1]**

Introduction: Basic UNIX Commands; Shell Programming: UNIX Shell Commands, Basics of Shell Programming, UNIX System Calls; Inter Process Communication: UNIX Inter Process Communication, Programs on Pipes, CPU Scheduling Algorithms; Pthreads: Creation and Initializing Multithreaded Programs, Deadlock: Deadlock Detection Algorithms, Deadlock Avoidance Algorithms; Memory Management: Page Replacement Algorithms, Memory Allocation Algorithms, Disk Scheduling Algorithms; Virtualization: Concept using VMware.

### **References:**

1. Avi Silberschatz, Peter Baer Galvin, Greg Gagne, *Operating System Concepts*, (9e), Wiley, ISBN: 9788126554270, 8126554274, 2013.
2. William Stallings, "Operating Systems: Internals and Design Principles", (9e), Pearson, ISBN: 9789332518803, 2015.
3. A.S. Tanenbaum, *Modern Operating Systems*, (4e), Pearson Education India, ISBN: 9789332575776, 2016.
4. Sumitabha Das, *Unix Concepts and Applications*, (4e), McGraw Hill Education, ISBN: 9780070635463, 2017.

## **IT2231: RELATIONAL DATABASE MANAGEMENT SYSTEMS LAB [0 0 2 1]**

Introduction: SQL and Its Different Command Categories- DDL, DML, DQL and DCL; Integrity Constraints: Data Integrity Constraints and Built-In Functions; Case Study: Design and Implementing The Data Requirements of a Simple Database Application, Experiments on Views, Indexing, Triggers, Stored Procedures, Transaction.

### **References:**

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, *Database System Concepts*, (6e), McGraw Hill, 2013.
2. Ramez Elmasri, Shamkant B. Navathe, *Fundamentals of Database System*, (6e), Pearson Education India, 2013.
3. Ivan Bayross, *Teach yourself SQL & PL/SQL using Oracle 8i & 9i with SQLJ*, (1e), BPB Publications, 2010.

## **IT2232: WEB TECHNOLOGIES LAB [0 0 2 1]**

Web Programming: HTML- Basic Elements, Hyperlinks, Forms, Frames; Cascading Style Sheets: Inclusion of CSS, CSS Properties; Javascript: Basic Programming, Functions, DOM, Exception Handling, Events, JQuery; Dynamic Programming Using PHP: File Handling, Database Connectivity.

### **References:**

1. "Web Technologies (Black Book)", Kogent Learning Solutions Inc., Dreamtech Press, 2009.
2. Jackson, *Web Technologies: A Computer Science Perspective*, (1e), Pearson Education India, 2007.
3. Srinivasan, *Web Technology: Theory and Practice*, (1e), Pearson Education India, 2012.
4. Godbole A., Khate A., *Web Technologies*, (3e), McGraw Hill Education, 2017.
5. Gopalan N. P., Akilandeswari J., *Web Technology: A Developer's Perspective*, (2e Revised), Prentice Hall India Learning, 2014.
6. Roy U. K., "Web Technologies", Oxford Press, 2010.



### **IT3101: FOUNDATIONS OF DATA SCIENCE [3 1 0 4]**

Descriptive Statistics: Introduction, Descriptive Statistics, Probability Distribution; Inferential Statistics: Inferential Statistics through Hypothesis Testing, Permutation and Randomization Test; Regression and ANOVA: Regression Analysis, Analysis of Variance; Machine Learning: Differentiating Algorithmic and Model Based Framework, OLS, RIDGE & LASSO Regression, KNN & Classification; Supervised Learning with Regression and Classification Technique: Bias-Variance Dichotomy, Logistic Regression, LDA, QDA, Regression and Classification Trees, SVM, Ensemble Methods, Random Forest; Prescriptive Analysis: Creating Data through Designed Experiments, Active Learning, Reinforcement Learning.

#### **References:**

1. H. Trevor et al., *The Elements of Statistical Learning*, (2e), Springer, ISBN 978-0-387-84858-7, 2009.
2. C. Douglas and C. George, *Applied Statistics and Probability for Engineers*, (3e), John Wiley and Sons, ISBN-13: 978-1118539712, 2010.
3. T.M. Mitchell, *Machine learning*, (1e), McGraw-Hill, New York, ISBN-13: 978-0070428072, 2017.
4. Kevin P. Murphy, *Machine Learning - A Probabilistic Perspective*, MIT Press, ISBN-13: 978-0262018029, 2012.

### **IT3102: SOFTWARE ENGINEERING [3 1 0 4]**

Introduction to Software Engineering: Software Components, Software Characteristics, Software Crisis, Software Engineering Processes; Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model; Requirement Engineering Process: Analysis, Documentation, Data Flow Diagrams, SRS Document, IEEE Standards for SRS; Estimation: Estimation of Various Parameters Such as Cost, Efforts, Use Case Point, Class Point Method Estimating, Constructive Cost Models (COCOMO) and its Types, Function Point, Reusability, Object Points, Early Design Model, Post Architecture Model, The Putnam Resource Allocation Model, Software Design, Architectural Design, Low Level Design, Modularization, Design Structure Charts, Pseudo Codes, Coupling and Cohesion Measures, Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design; Coding Standards: Code Review and Walkthrough, Code Inspection; Testing : Testing Objectives, Testing and Debugging, Test Metrics and Measurements, Various Types of Testing Methods; Software Maintenance: Categories of Maintenance, Maintenance Process, Maintenance Models, Estimation of Maintenance Cost, Regression Testing, Software Re-Engineering, Reverse Engineering, Configuration Management and Certification; Software Quality: The Management Spectrum- (The People, The Product, The Process, The Project), SEI Capability Maturity Model, Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9126 Model, Certification Case Study.

#### **References:**

1. R. S. Pressman, *Software Engineering: A Practitioners Approach*, (7e Reprint), McGraw Hill, 2016.
2. R. Mall, *Fundamentals of Software Engineering*, (4e), Prentice Hall India, 2016.
3. K. K. Aggarwal and Y. Singh, *Software Engineering*, (3e Reprint), New Age International Publishers, 2016.
4. P. Jalote, *Software Engineering*, (3e Reprint), Narosa Publishing House, 2012.
5. Subramaniam, *Software Engineering*, Pearson Education India, 2015.

### **IT3103: DESIGN AND ANALYSIS OF ALGORITHMS [3 1 0 4]**

Basics of Algorithms and Mathematics: What is an algorithm?, Mathematics for Algorithmic Sets, Functions and Relations, Vectors and Matrices, Linear Inequalities and Linear Equations; Algorithm Analysis: A priori and a Posteriori Analysis, Time Space Trade off, Asymptotic Notations, Properties of Asymptotic Notations, Recurrence Equations, Solving recurrence equations using Substitution method and Master's method; Divide and Conquer Algorithms: Binary Search, Finding Maximum and Minimum, Merge Sort, Quick Sort, Matrix Multiplication; Greedy Algorithms: Knapsack Problem, Job Sequencing with deadline, Optimal Merge Pattern, Single Source Shortest Path, Minimum Cost Spanning Tree; Dynamic Programming: Multistage Graphs, Matrix Chain Multiplication, All-Pair Shortest Paths, Optimal Binary Search Trees, 0/1 Knapsack, Travelling Salesperson Problem, Graph Traversals, Connected Components, Spanning Trees, Bi-Connected Components; String Matching: Introduction, The Naive String Matching Algorithm, The Rabin-Karp Algorithm, String Matching with Finite Automata, The Knuth-Morris-Pratt Algorithm; Introduction to NP-Completeness: The Class P and NP, Polynomial Reduction, NP-Completeness Problem, NP-Hard Problems, Travelling Salesman Problem, Hamiltonian Problem, Approximation Algorithms.

#### **References:**

1. Horowitz E, Sahni S and Rajasekaran S, *Fundamentals of Computer Algorithms*, (2e), University Press, ISBN0-7167-83, 2007.
2. Cormen T H, Leiserson T H, Rivest R L, and Stein C, *Introduction to Algorithms*, (3e), MIT Press, ISBN-10: 9780262033848, ISBN-13: 978-0262033848, 2009.
3. Aho A V, Hopcroft J E and Ullman J D, *The Design and Analysis of Computer Algorithms*, (1e), Pearson Education India, ISBN-13: 978-0201000290, ISBN-10: 9780201000290, 2007.

### **IT3104: COMPUTER NETWORKS [3 1 0 4]**

Network Layer: Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Quality of Service, MPLS. Classful Addressing, Subnetting, Classless Addressing, Variable Length Blocks, Block Allocation, NAT, Ipv4, Ipv6, Fragmentation, ARP, DHCP, ICMP, Dynamic Routing Protocols: RIP, OSPF & BGP, Multicasting Protocol: IGMP, Introduction to IPV6; Transport Layer: Transport Services, State Diagram, Elements of Transport Protocols: Addressing, Connection Establishment, Connection Release, Congestion Control: Bandwidth Allocation, Regulating the Sending Rate, UDP: UDP Header, TCP: TCP Service Model, TCP Segment Header, TCP Connection Establishment, TCP Connection Release, TCP Window Management, Timer Management; Application Layer: DNS: Name Space, Domain Resource Records, Electronic Mail: SMTP, POP, IMAP, MIME, HTTP, HTTPS, SNMP.

#### **References:**

1. Behrouz A. Forouzan, *TCP/IP Protocol Suite*, (4e), Tata McGraw Hill, ISBN-10: 0070166781, ISBN-13: 9780070166783, 2010.
2. Tanenbaum A. S., *Computer Networks*, (5e), Pearson Education India, ISBN-10: 9332518742, ISBN-13: 978-9332518742, 2013.
3. Comer D. E., *Internetworking with TCP/IP Principles, Protocols and Architecture*, (6e), Pearson Education India, ISBN-10: 1292040815, ISBN-13: 978-1292040813, 2013.

### **IT3130: DESIGN AND ANALYSIS OF ALGORITHMS LAB [0 0 2 1]**

Analysis of Sorting and Searching Algorithms: Bubble Sort, Selection Sort, Insertion Sort, Merge Sort and Quicksort, Linear and Binary Search; Max-Heap: Implementation and Analysis; Knapsack Problem: Implementation and Analysis using Dynamic Programming; Matrix Chain Multiplication: Implementation and Analysis Using Dynamic Programming; Coin Change Problem: Implementation and Analysis using Dynamic Programming; Knapsack Problem: Implementation using Greedy Algorithm; Graph and Searching (DFS and BFS): Implementation and Analysis of Prim's and Kruskal's Algorithms; LCS Problem: Implementation and Analysis using Greedy and Dynamic Programming.

#### **References:**

1. E. Horowitz, S. Sahni and S. Rajasekaran, *Computer Algorithms*, (2e), University Press, ISBN0-7167-83, 2007.
2. Cormen T H, Leiserson T H, Rivest R L, and Stein C, *Introduction to Algorithms*, (3e), MIT Press, ISBN-10: 9780262033848, ISBN-13: 978-0262033848, 2009.
3. Aho A V, Hopcroft J E and Ullman J D, *The Design and Analysis of Computer Algorithms*, (1e), Pearson Education India, ISBN-13: 978-0201000290, ISBN-10: 9780201000290, 2007.

### **IT3131: COMPUTER NETWORKS LAB [0 0 2 1]**

Packet Tracer: Introduction to Packet Tracer; Networking Devices: Networking Device Components, Switch and Router Basic Commands; Topology: Designing of Star Topology using Hub and Switch, IP Configuration of End Devices; DHCP: Configuring DHCP Server; Routing: Static Routing, RIP, OSPF; VLAN: Configuring VLAN and Troubleshooting; NAT: Configuring NAT and Troubleshooting. Network Programming: Transmission Control Protocol (TCP) and User Datagram Protocol (UDP), Network Utilities: PING, NETSTAT, IPCONFIG, IFCONFIG, ARP, TRACE-ROUTE.

#### **References:**

1. Forouzan Behrouz A., *TCP/IP Protocol Suite*, (4e), Tata McGraw Hill, ISBN-10: 0070166781, ISBN-13: 9780070166783, 2010.
2. Tanenbaum A. S., *Computer Networks*, (5e), Pearson Education India, ISBN-10: 9332518742, ISBN-13: 978-9332518742, 2013.

## **IT3132: SOFTWARE ENGINEERING LAB [0 0 2 1]**

Requirement Preparation: Prepare Software Requirement Specification of the Project, System modelling: Function Oriented Diagram, Data Flow Diagram, Entity Relationship Diagram, Software Design using Unified Modelling Language (UML): Use Case Diagram, Class Diagram, Sequence Diagram, Activity Diagram, Collaboration Diagram, Communication Diagram, State Chart Diagram, Interaction Diagram, Component Diagram and Deployment Diagram, Case Study on UML Diagram, Software Testing: Code Level Testing, Functional Testing, Manual Testing, Automated Testing using Tools.

### **References:**

1. R. S. Pressman, *Software Engineering: A Practitioners Approach*, (7e), McGraw Hill, 2016.
2. R. Mall, *Fundamentals of Software Engineering*, (4e), Prentice Hall India, 2016.
3. K. K. Aggarwal and Y. Singh, *Software Engineering*, (3e), New Age International Publishers, 2016.
4. P. Jalote, *Software Engineering*, (3e), Narosa Publishing House, 2012.
5. Subramaniam, *Software Engineering*, (1e), Pearson Education India, 2015.

**BB0026: ORGANIZATION AND MANAGEMENT [2 1 0 3]**

Course offered to Engineering students

Number of Credits Per week - 3

Number of section- ?

<b>Course Code: BB0026</b>	<b>Course Name: Organization and Management</b>
<b>Course Credit: 3</b>	
<b>Objectives</b>	On completion of this course the students will acquire knowledge in the field of organizational management and internal organization of companies required for managing an enterprise. The students will also gain knowledge in the field of personnel management, motivation, management information system and leadership for developing managerial skills. The students will be able to gain knowledge for starting a small scale unit.
<p><b>UNIT 1</b></p> <p><u>1.</u> Meaning and definition of an organization, Necessity of Organization, Principles of Organization, Formal and Informal Organizations. Management: Functions of Management, Levels of Management, Managerial Skills, Importance of Management, Models of Management, Scientific Management, Forms of Ownership, Organizational Structures, Purchasing and Marketing Management, Functions of Purchasing Department, Methods of Purchasing, Marketing, Functions of Marketing, Advertising</p> <p><b>UNIT 2</b></p> <p><u>2.</u> Introduction, Functions of Personal Management, Development of Personal Policy, Manpower Planning, Recruitment and Selection of manpower</p> <p><b>UNIT 3</b></p> <p><u>3.</u> Motivation – Introduction, Human needs, Maslow’s Hierarchy of needs, Types of Motivation, Techniques of Motivation, Motivation Theories, McGregor’s Theory, Herzberg’s Hygiene Maintenance Theory. Leadership - Introduction Qualities of a good Leader, Leadership Styles, Leadership Approach, Leadership Theories.</p> <p><b>UNIT 4</b></p> <p><u>4.</u> Entrepreneurship – Introduction, Entrepreneurship Development, Entrepreneurial Characteristics, Need for Promotion of Entrepreneurship, Steps for establishing small scale unit</p> <p><b>UNIT 5</b></p> <p><u>5.</u> Data and Information; Need, function and Importance of MIS; Evolution of MIS; Organizational Structure and MIS, Computers and MIS, Classification of Information Systems, Information Support for functional areas of management,</p>	
<p><b>REFERENCE BOOKS</b></p> <p><b>Reference:</b></p> <ol style="list-style-type: none"> <li>1. Koontz, Harold, Cyril O'Donnell, and Heinz Wehrich : Essentials of Management, Tata McGraw-Hill, New Delhi</li> <li>2. Robbins, Stephen P, and Mary Coulter : Management, Prentice Hall, New Delhi</li> <li>3. E. S. Buffa and R. K. Sarin “Modern Production / Operations Management”, 8th Edition, Wiley, 1987</li> <li>4. H. J. Arnold and D. C. Feldman “Organizational Behavior”, McGraw – Hill</li> <li><u>6.</u> Aswathappa K: Human Resource and Personnel Management, Tata McGraw Hill</li> <li><u>7.</u> William Wether&amp; Keith Davis, Human Resource and Personnel Management, McGraw Hill.</li> </ol>	



## **IT3201: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING [3 1 0 4]**

Artificial Intelligence: Introduction to Artificial Intelligence, Current Trends in AI, Intelligent Agents, Agent v/s Software Program, Classification of Agents, Working of an Agent, Single and Multi-Agent System, Performance Evaluation of Agents, Architecture of Intelligent Agents; AI Problems: Problem Space: Problem analysis; Problem Solving Techniques: Heuristic search Techniques; Game Playing: Min Max Algorithm, alpha beta pruning; Knowledge Representation: Semantic Networks, Propositional and Predicate Calculus, Semantics for Predicate Calculus, Theorem Prover, Inference Rules, Unification, Resolution, Refutation in Predicate Logic; Machine Learning: Introduction, Types of Learning, Supervised vs Unsupervised Learning, Concept Learning- Concept Learning as Search, Find-S, Version Spaces and Candidate Elimination Algorithm, Decision Tree Learning, Classification and Regression using Supervised Learning ANN-Introduction, Perceptron Learning, Multilayer Networks and the Back-propagation Learning.

### **References:**

1. E. Rich, K. Knight, and S.B. Nair, *Artificial Intelligence*, (3e), McGraw Hill India, 2015.
2. S. Russell, and P. Norvig, *Artificial Intelligence: A Modern Approach*, (3e), Pearson Education India, 2009.
3. Tom M. Mitchell, *Machine Learning*, (1e India Edition), McGraw Hill Education, 2017.
4. Prateek Joshi, *Artificial Intelligence with Python*, (1e), Packt Publishing Limited, 2017.

## **IT3202: AUTOMATA THEORY & COMPILER DESIGN [3 1 0 4]**

Introduction: Automata Theory, Mathematical Preliminaries and Notations, Set Theory, Function and Relations; Finite State Machines: Deterministic and Non-Deterministic Finite Automata, Regular Languages, Mealy and Moore Machines; Regular Sets and Regular Grammars: Chomsky Hierarchy, Regular Expressions, Regular Grammar, Pumping Lemma for Regular Languages; Context Free Languages and Grammars: Ambiguity, Methods for Transforming Grammars; Push Down Automata: Context Free Languages, Non-Deterministic Push Down Automata and Deterministic Push Down Automata, Design of NPDA and DPDA; Introduction to Turing Machine: Basics of Turing Machine, Variations of Turing Machines; Introduction to Compiler Design: Structure of a Compiler, Lexical Analysis, Recognition of Tokens; Introduction to LR Parsing: Simple LR, More Powerful LR Parsers Generators; Semantic Analysis: Syntax Directed Translations; Storage Organization: Basics of Storage Organization.

### **References:**

1. Michael Sipser, *Introduction to the Theory of Computation*, (3e), Cengage Learning, 2014.
2. John C. Martin, *Introduction to Languages and the Theory of Computation*, (4e), Tata McGraw Hill, 2010.
3. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages and Computations, (3e), Pearson Education India, 2006.

### **IT3203: CRYPTOGRAPHY AND INFORMATION SECURITY [3 1 0 4]**

Introduction: Computer and Network Security Concepts, Number Theory and Finite Fields; Symmetric Ciphers: Classical Encryption Techniques, Block Ciphers – DES and AES, Block Cipher Operation, Pseudorandom Number Generators and Stream Ciphers; Asymmetric Ciphers: Principles of Public Key Cryptography, RSA, Elliptic Curve Cryptography; Cryptographic Data Integrity Algorithms: Cryptographic Hash Functions, Message Authentication Codes, Digital Signatures; Mutual Trust: Key Distribution, PKI, User Authentication, Kerberos; Network and Internet Security: Transport Level Security, Wireless Network Security, Email Security, IP Security.

#### **References:**

1. Stallings W, *Cryptography and Network Security: Principles and Practice*, (7e), Pearson Education India, ISBN 978-1-292-15858-7, 2017.
2. Katz J, Menezes A J, Van Oorschot PC, Vanstone S A, *Handbook of Applied Cryptography*, (2e), CRC press, ISBN 0849385237, 2010.
3. Stinson Douglas R., *Cryptography: Theory and Practice*, (3e), Chapman and Hall / CRC Press, 2005.

### **IT3230: COMPILER DESIGN LAB [0 0 2 1]**

Basic Introduction: Preliminary Scanning Applications; Lexical Analysis: Design and Implementation of Lexical Analyzer; Parsing: Design and Implementation of Parser, Implementation of Code Generator; Lex and YACC: Programs using LEX, Programs using YACC.

#### **References:**

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, *Compilers Principles, Techniques and Tools*, (2e), Pearson Education India, 2013.
2. D. M. Dhamdhere, *Systems Programming and Operating Systems*, (2e Revised), Tata McGraw Hill, 2009.
3. Kenneth C. Loudon, *Compiler Construction - Principles and Practice*, (1e), Thomson Press India, 2007.

## **IT3231: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB [0 0 2 1]**

Problem Solving Using Uninformed/Informed Search Techniques: Water Jug Problem using Depth First Search, TSP using Branch and Bound and Nearest Neighbor, Implementation of Hill Climbing Method, Implementation of Best First Search Method; Problem Formulation and Solving: Formulating Real World Problems for AI/ML, Classification and Regression Problems, Intuitive and Simple Algorithms, Representation of the World and Real Data, Visualization, Data Prep; Closer Look at AI/ML Algorithms: Linear Algorithms, Optimization and Training, Non-Linear Solutions and MLP, Gradient Descent and Backpropagation, Decision Trees.

### **References:**

1. E. Rich, K. Knight, and S.B. Nair, *Artificial Intelligence*, (3e), McGraw Hill, 2015.
2. S. Russell, and P. Norvig, *Artificial Intelligence: A Modern Approach*, (3e), Pearson Education India, 2009.
3. Tom M. Mitchell, *Machine Learning*, (1e Indian), McGraw Hill, 2017.
4. Prateek Joshi, *Artificial Intelligence with Python*, (1e), Packt Publishing Limited, 2017.

### **IT3140: SOFT COMPUTING [3 0 0 3]**

Introduction to Soft Computing: Concept of Computing Systems, Soft Computing Versus Hard Computing, Characteristics of Soft Computing, Some Applications of Soft Computing Techniques; Fuzzy Logic: Introduction to Fuzzy Logic- Fuzzy Sets and Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Rules, Propositions, Implications and Inferences, Defuzzification Techniques- Fuzzy Logic Controller Design, Some Applications of Fuzzy Logic; Artificial Neural Networks: Biological Neurons and Its Working, Simulation of Biological Neurons to Problem Solving, Different ANNs Architectures, Training Techniques for ANNs, Applications of ANNs to Solve Some Real Life Problems; Nature Inspired Algorithms: Genetic Algorithms, Concept of Genetics and Evolution and its Application to Probabilistic Search Techniques, Basic GA Framework and Different GA Architectures, GA Operators- Encoding, Crossover, Selection, Mutation, etc., Solving Single-Objective Optimization Problems Using GAs, Particle Swarm Optimization- Implementation, Operators, Case Studies, Ant Bee Colony Optimization- Implementation, Operators, Case Studies.

#### **References:**

1. Martin, F., Neill, Mc. and Thro, E., *Fuzzy Logic: A Practical approach*, (1e), AP Professional, 2000.
2. Ross, T, J., *Fuzzy Logic with Engineering Applications*, (3e), Willey India, 2010.
3. Mitchell, M., *An Introduction to Genetic Algorithms*, (1e), MIT Press, 2000.
4. Goldberg, D. E., *Genetic Algorithms in Search, Optimization and Machine Learning*, (1e), Pearson Education India, 2008.
5. Rajasekaran, S. and Vijayalakshmi Pai, G. A., *Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis, and Applications*, (1e), Prentice Hall India, 2011.
6. Pratihari, D. K., *Soft Computing*, (1e), Narosa Publishing, 2008.
7. Haykin, S., *Neural Networks and Learning Machines*, (3e), PHI Learning, 2011.

### **IT3240: DATA MINING AND WAREHOUSING [3 0 0 3]**

Data warehousing: Introduction to Data Warehouse, Statistical Observation on Data, Data Types, DBMS Schemas for Decision Support , Data Mart, Data Extraction, Transformation and Load (ETL) Operations, Metadata; Online Analytical Processing (OLAP), Online Transaction Processing (OLTP), ROLAP, MOLAP, HOLAP and their Operations, Bitmap Indexing, Join Indexing, Attribute Selection Measure, BUC Cubing Method, Data Cubing, Star Tree Construction, Inverted Index; Data Mining: Introduction Data Mining & Applications, Types of Data, Pre-Processing, KDD Process; Association Rule Mining (ARM): Interestingness of Patterns, Mining Frequent Patterns, K-Frequent Item Set Mining, A-Priori Algorithm, Associations and Correlations Mining, Correlation Analysis, Constraint Based Association Mining; Classification and Prediction : Basic Concepts , Entropy, Decision Tree, Naïve Bayes Algorithm, Neural Networks, Back Propagation, Support Vector Machines, Associative Classification, Lazy Learners, Prediction; Clustering: Basic Concepts, Cluster Analysis, K-Means, Partitioning Methods, Hierarchical Clustering, Expectation Maximization, Density based Clustering, Web Mining, Text Mining, Spatial Mining, Case Study: Case Studies on Various Data Mining Techniques with Varying Data Sets.

#### **References:**

1. J.Han and M. Kambher, *Data Mining Concepts and Techniques*, (3e), Elsevier, 2007.
2. P. N. Tan, M. Steinbach and V. Kumar, *Introduction to Data Mining*, (1e), Person Education India, 2007.
3. A. Berson and S. J. Smith, *Data Warehousing, Data Mining & OLAP*, (10e), Tata McGraw – Hill, 2007.

## **IT4140: BIG DATA ANALYTICS [3 0 0 3]**

Introduction to Big Data: Introduction, Distributed File System, Big Data and its Importance, Drivers, Big Data Analytics, Big Data Applications, Algorithms, Matrix-Vector Multiplication by MapReduce; Big Data Analytics: Analyzing Big Data, Sources of Big Data, Characteristics of Big Data (4 V's), Drivers of BDA, Types of Data, Structured vs. Unstructured Data, Data Marts, Case Study Based Tutorial, Differences Between Traditional DWDM and BDA, Limitations of Traditional RDBMS to Store and Analyses Big Data, Data science, Definition and Concepts; Data Scientists: Key Competencies and Characteristics of Data Scientists, More Discussions on Data Science, Data Wrangling, Data Mugging, Data Jujitsu, Tutorial Based on Data Science Applications, Big Data Analytics Ecosystem; State of the Practice in Analytics: Data Analytics Lifecycle and Discussions, Roles for a Successful Analytics Project, Case Study to Apply the Data Analytics Lifecycle, Analytical Databases and DW Appliances, Hadoop Distributions – Comparing Various BDA Tools; Analyzing and Exploring the Data: Challenges when Managing and Analyzing Big Data, The Role of Data Virtualization in a Big Data Environment; Big Data Platforms and Storage Options: The New Multi-Platform Analytical Ecosystem, Beyond the Data Warehouse - Analytical Databases, Hadoop and NoSQL DBMS.

### **References**

1. EMC Education Services, *Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data*, (1e), John Wiley & Sons, 2015.
2. Minelli, Michael, Michele Chambers, and Ambiga Dhiraj. *Big data, big analytics: emerging business intelligence and analytic trends for today's businesses*, (1e), John Wiley & Sons, 2012.
3. Bahga, Arshdeep and Vijay Madisetti, *Big data science & analytics: A hands-on approach*, (1e), VPT, 2016.



## **IT4141: DEEP LEARNING [3 0 0 3]**

Introduction To Deep Learning: History of Deep Learning, Deep Learning Success Stories, Mcculloch Pitts Neuron, Thresholding Logic, Perceptron's, Perceptron Learning Algorithm; Multi-Layer Network and Optimization Technique: Multilayer Perceptron's (Mlps), Representation Power of Mlps, Sigmoid Neurons, Gradient Descent, Feed Forward Neural Networks, Representation Power of Feed Forward Neural Networks Feed Forward Neural Networks, Back Propagation Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Adagrad, Rmsprop, Adam, Eigenvalues and Eigenvectors, Eigenvalue Decomposition, Basis; Dimension Reduction and Regularization: Principal Component Analysis and its Interpretations, Singular Value Decomposition Auto Encoders and Relation to Pca, Regularization in Auto Encoders, Denoising Auto Encoders, Sparse Auto Encoders, Contractive Auto Encoders Regularization: Bias Variance Tradeoff, L2 Regularization, Early Stopping, Dataset Augmentation, Parameter Sharing and Tying, Injecting Noise at Input, Ensemble Methods, Dropout Greedy Layer Wise Pre-Training, Better Activation Functions, Better Weight Initialization Methods, Batch Normalization Learning Vectorial Representations of Words; Convolutional Neural Networks: Lenet, Alexnet, Zf-Net, Vggnet, Googlenet, Resnet, Visualizing Convolutional Neural Networks, Guided Back Propagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks; Recurrent Neural Networks: Back Propagation Through Time (Bptt), Vanishing and Exploding Gradients, Truncated Bptt, Gru, Lstms Encoder Decoder Models, Attention Mechanism, Attention Over Images.

### **References:**

1. J.Patterson, A.Gibson, *Deep Learning*, (1e), O'Reilly Publication, 2018.
2. Goodfellow I., Bengio Y, *Deep Learning (Adaptive Computation and Machine Learning series)*, (1e), MIT Press, 2017.
3. Shai Shalev-Shwartz , Shai Ben-David, *Understanding Machine Learning: From Theory to Algorithms*, (3e), Cambridge University Press, 2015.

### **IT3141: DIGITAL IMAGE PROCESSING [3 0 0 3]**

Digital Image Fundamentals: Light and Electromagnetic Spectrum, Components of Image Processing System, Image Formation and Digitization Concepts, Neighbours of Pixel Adjacency Connectivity, Regions and Boundaries, Distance Measures, Applications; Image Enhancements: Image Enhancements in Spatial Domain, Basic Gray Level Transformations, Histogram Processing Using Arithmetic/Logic Operations, Smoothing Spatial Filters, Sharpening Spatial Filters; In Frequency Domain: Introduction to The Fourier Transform and Frequency Domain Concepts, Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters; Image Restoration: Various Noise Models, Image Restoration using Spatial Domain Filtering, Image Restoration using Frequency Domain Filtering, Estimating the Degradation Function, Inverse Filtering; Colour Image Processing: Colour Fundamentals, Colour Models, Colour Transformation, Smoothing and Sharpening, Colour Segmentation; Image Compression: Introduction, Image Compression Model, Error-Free Compression, Lossy Compression; Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding; Representation: Boundary Descriptors.

#### **References:**

1. Gonzalez R. C., Woods R. E., *Digital Image Processing*, (4e), Pearson Education India, ISBN. 978-0131687288, 2017.
2. Jain A. K., *Fundamentals of Digital Image Processing*, (1e), Pearson Education India, ISBN: 9789332551916, 933255191X, 2015.
3. J. Burge Mark & Burger Wilhelm, *Principles of Digital Image Processing*, (1e), Springer, 2011.

**IT3241: COMPUTER VISION [3 0 0 3]**

Introduction : Image Processing, Computer Vision, Low-Level Computer Vision, Mid-Level Computer Vision, High-Level Computer Vision, Overview of Diverse Computer Vision; Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality, Image Formation, Image Representations (Continuous And Discrete) , Image Pre-Processing Techniques; Feature Extraction: Point, Line And Edge Detection, Color, Texture, Shape and Structure Features In Spatial and Frequency Domains, Corner Detection, Hough Transform; Image Segmentation: Gray-Level Thresholding, Supervised Vs. Unsupervised Thresholding, Banalization Using Otsu's Method, Locally Adaptive Thresholding, Color-Based Segmentation, Region Oriented Segmentation, Use of Motion in Segmentation, Spatial Techniques, Frequency Domain Techniques, Representation and Description- Boundary and Region Descriptors; Object Recognition: Statistical and Structural Recognition, Recognition Based on Decision Theoretic Methods, Minimum Distance Classifier, Optimum Statistical Classifier; Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-Supervised, Semi-Supervised; Classifiers: Bayes, KNN, ANN Models.

**References:**

1. A. F. David, J. Ponce, *Computer vision – A Modern Approach*, (2e), Pearson Education India, ISBN-13: 978-9332550117, 2015.
2. R. C. Gonzalez, R. E. Woods. *Digital Image Processing*, (4e), Pearson Education India, ISBN 978-0131687288, 2017.
3. R. Klette, *Concise Computer Vision: An Introduction into Theory and Algorithms*", (1e), Springer, ISBN-10: 1447163192, ISBN-13: 978-1447163190, 2014.

## IT4142: PARALLEL COMPUTING [3 0 0 3]

Multi-Core Architecture: Introduction, Need for Multicore-architectures, Laws of Parallel Programming, Amdahl's Law, Gustafson's Law, Moore's Law; Basic Introduction to OpenMP Programming Model: Subroutines, Compiler Directives, Threading and Parallelism, Scheduling Clauses, Concurrency and Locks, Case Studies; Many-Core Architecture: Heterogeneous Parallel Computing, Architecture of Modern GPU, Parallel Programming Languages and Models, History of GPU Computing, Introduction to Data Parallelism, Data Parallelism and CUDA C, CUDA Program Structure, Device Global Memory and Data Transfer, Kernel Functions and Threading; Data-Parallel Execution Model: CUDA Thread Organization, Mapping Threads to Multidimensional Data, Matrix-matrix Multiplication, Synchronization and Transparent Scalability, Assigning Resources to Blocks, Thread Scheduling and Latency Tolerance; CUDA Memories: Importance of Memory Access Efficiency, CUDA Device Memory Types, Strategy for Reducing Global Memory Traffic, Tiled Matrix Multiplication, Memory as Limiting Factor to Parallelism; Performance Considerations: Warps and Thread Execution, Global Memory Bandwidth, Dynamic Partitioning of Execution Resources, Instruction Mix and Thread Granularity; Parallel Patterns: Convolution -1D/2D, Constant Memory and Caching, Prefix Sum, Sparse Matrix Vector Multiplication, Programming Models and Important Trends in Heterogeneous Parallel Computing, Case Studies; MPI Programming Model Introduction: Distributed Memory Programming with MPI, Compilation and Execution using MPI\_Init and MPI\_Finalize, Communicators using MPI\_Comm\_size and MPI\_Comm\_Rank, Communication using MPI\_send And MPI\_receive.

### References:

1. Kirk, David B., and W. Hwu Wen-Mei, *Programming massively parallel processors: a hands-on approach*, (3e), Morgan Kaufmann, 2016.
2. Rohit Chandra, David Kohr, Dror Maydan, Jeff McDonald, *Parallel Programming in OpenMP*, (1e), Morgan Kaufmann, 2018.
3. Grama, Ananth, *Introduction to parallel computing*, (2e), Pearson Education India, 2003.
4. Peter S. Pacheo, *Parallel programming with MPI*, (1e), Morgan Kaufmann, 1997.
5. Shane Cook, *CUDA Programming: A Developer's Guide to Parallel Computing with GPUs*, (1e), Morgan Kaufmann, 2012.

### **IT4143: ADVANCE COMPUTER VISION [3 0 0 3]**

Introduction: Fundamentals of Object Recognition, Low-Level Computer Vision-Edges, Contours, Textures, Shapes and Colors, Motion, Optical Flow and Tracking, Local Features, Invariance, Bag-of-Words Models, Fisher Vector, Middle-Level Representations of Objects: Parts, Attributes, Embedding, etc., Machine Learning and Computer Vision: Clustering and Segmentation, Supervised Classification and Object/Scene/Attribute/Activity Recognition, Probabilistic Models and Fisher Vectors, Learning to Rank and Image Retrieval, Dimensionality Reduction, Manifold Learning, and Image, Convolutional Neural Networks and Large-Scale Image Classification, Recurrent Neural Network, Long Short-Term Memory and Image and Video Captioning.

#### **References:**

1. R. Szeliski, *Computer vision: algorithms and applications*, (1e), Springer Science & Business Media. ISBN. 978-1-84882-934-3, 2010.
2. S.J. Prince, *Computer vision: models, learning, and inference*, (1e), Cambridge University Press, ISBN-13: 978-1-1107-01179-3, 2012.
3. R. Klette *Concise Computer Vision: An Introduction into Theory and Algorithms*, (1e), ISBN-10: 1447163192, ISBN-13: 978-1447163190, Springer, 2014.

## **IT4144: ADVANCED DATA STRUCTURES [3 0 0 3]**

Red-Black Trees: Properties of Red-Black Trees, Rotations, Insertion and Deletion in Red-Black Trees, Analysis of Operations, Fibonacci Heaps: Structure of Fibonacci Heaps, Mergeable-heap Operations, Decreasing a Key and Deleting a Node, Bounding the Maximum Degree. Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Quadratic Probing, Double Hashing. Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists. Splay Trees: Splaying, Search and Update Operations on Splay Trees. NP-Completeness: P and NP, Important NP-Complete Problems. Sorting: Bucket Sort, Radix Sort, Topological Sort. Text Processing: String Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

### **References:**

1. Goodrich M T, Tamassia R, *Algorithm Design*, (2e), John Wiley, ISBN: 978-81-265-0986-7, 2013.
2. Cormen T H, Leiserson C E, Rivest R L, and Stein C, *Introduction to Algorithms*, (3e), MIT Press, ISBN:978-81-2-3-4007-7, 2009.
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## IT4145: DISTRIBUTED COMPUTING [3 0 0 3]

Introduction: Multiprocessor Vs Multicomputer Systems, Distributed Communication Models, Remote Procedure Call, Publish/Subscribe Model, Design Issues and Challenges; Logical Time: Scalar/Vector Time and Their; Global Snapshot: Snapshot Algorithms for FIFO/ Non-FIFO Channels. Terminology and Basic Algorithms: Topology Abstraction and Overlays, Complexity Measures and Metrics, Program Structure, Elementary Graph Algorithms; Message Ordering and Group Communication: Message Ordering Paradigms, Asynchronous Execution with Synchronous communication, Group Communication, Causal Order (CO), Total order; Termination Detection: Termination Detection using Distributed Snapshots, Termination Detection by Weight Throwing, A Spanning-Tree-based Termination Detection Algorithm, Message-Optimal Termination Detection; Distributed Mutual Exclusion Algorithms: Lamport's, Ricart-Agrawala, Singhal's Dynamic Information-Structure Algorithm, Lodha and Kshemkalyani's Fair Mutual Exclusion Algorithm, Quorum-based Mutual Exclusion Algorithms, Maekawa's Algorithm, Agarwal-El Abbadi Quorum-based Algorithm, Token-based Algorithms, Suzuki-Kasami's Broadcast Algorithm, Raymond's Tree-based Algorithm; Deadlock Detection in Distributed Systems: Models of Deadlocks. Knapp's Classification, Mitchell and Merritt's Algorithm, Chandy-Misra-Haas Algorithm for the AND and OR models, Kshemkalyani-Singhal Algorithm for the P-out-of-Q model; Distributed Shared Memory: Memory Consistency Models, Shared Memory Mutual Exclusion, Wait-Freedom, Register Hierarchy and Wait-Free Simulations, Wait-Free Atomic Snapshots of Shared Objects; Check-Pointing and Rollback Recovery: Checkpoint-based Recovery, Log-based Rollback Recovery, Koo-Toueg Coordinated Check Pointing Algorithm, Juang-Venkatesan Algorithm for Asynchronous Check Pointing and Recovery, Manivannan-Singhal Quasi-Synchronous Checkpointing Algorithm, Peterson-Kearns Algorithm based on Vector Time; Consensus and Agreement Algorithms: Agreement in a Failure-Free System (synchronous or asynchronous), Agreement in (Message-Passing) Synchronous Systems with Failures, Agreement in Asynchronous Message-Passing Systems with Failures.

### References

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## **IT4146: SOFTWARE TESTING TECHNIQUES [3 0 0 3]**

Perspective on Testing: Software Testing Principles, Basic Definitions, Test Cases, Role of Discrete Math and Graph Basics for Testers; Black-Box Testing Approaches: Boundary Value Testing, Equivalence Class Testing, Decision Table Testing; White-Box Testing Approaches: Path-Based Testing, Coverage Metrics, Data Flow Testing; Program Mutation: Mutation and Mutants, Test Assessment using Mutation, Mutation Operators; Regression Testing: Regression Test Process, Execution Trace Method, Dynamic Slicing; Integration-Testing: Decomposition-Based, Call Graph-Based, Path-Based; Object-Oriented Testing: Issues, Object-Oriented Unit Testing, Object-Oriented Integration Testing and Object-Oriented System Testing.

### **References:**

1. P. Jorgensen, *Software Testing: A Craftsman's Approach*, (4e), Shroff Publishers and Distributors, 2008.
2. A. Mathur, *Foundations of Software Testing*, (2e), Pearson Education India, 2013.
3. Srinivasan Desikan, Gopaldaswamy Ramesh, *Software Testing: Principles and Practices*, (1e), Pearson Education India, 2010.
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## **IT4147: SOFTWARE RELIABILITY [3 0 0 3]**

Software Metrics: Categories of Metrics, Token Count, Object-Oriented Metrics, Shyam Chidamer and Chris Kemerer's Metrics Suite, Basics of Reliability Theory: Software Reliability Attributes and Specification, Concept of Defects, Faults, Failures, Defect Rate and Reliability, Defect Prevention, Bathtub Curve for Hardware Reliability & Software Reliability, Software Reliability Metrics, Availability, Software Reliability Models, Software Reliability Problems, Modelling Process, Reliability Growth Models, The Rayleigh Model, Software Reliability Allocation Models, Criteria for Model Evaluation, Optimal Reliability Allocation, Software Quality: Quality Planning and Control, Quality Improvement Process, Evolution of Software Quality Assurance (SQA), Major SQA Activities, Major SQA Issues, Zero Defect Software. Trending Reliability Techniques, Predicting Reliability Techniques, Error Seeding, Failure Rate, Curve Fitting, Software Quality Models,

### **References:**

1. J. Musa, *Software Reliability Engineering: More Reliable Software*, (2e), McGraw Hill, 2005.
2. S. Yamada, *Software Reliability Modelling: Fundamentals and Applications*, (1e Reprint), Springer, 2014.
3. R. Mall, *Fundamentals of Software Engineering*, (4e), Prentice Hall India, 2016.
4. K. K. Aggarwal and Y. Singh, *Software Engineering*, (3e Reprint), New Age International Publishers, 2016.

## **IT4148: OBJECT-ORIENTED DESIGN AND PATTERNS [3 0 0 3]**

Introduction: Class and Object Basics, Crash Course in Java Basics such as Packages, Exceptions, Generics and Collections; Object-Oriented Design Process: Identifying Classes and their Responsibilities, Identifying Relationships among Various Classes, Use Cases, CRC Cards, Class Diagrams, Sequence and State Charts; Class Design Guidelines: Designing and Implementing the Interface of a Class, The Importance of Encapsulation, Analyzing the Quality of an Interface, Programming by Contract such via Preconditions, Post-conditions and Invariants; Interface Types and Polymorphism: Understanding Java's Interface Concept with Focus on Polymorphism, Icon, Comparable and Comparator Interfaces; Software Design Patterns: What is Pattern, Components of a Pattern, Types of Pattern; Creational Patterns: Abstract Factory, Factory Method, Singleton; Structural Patterns: Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy; Behavioral Patterns: Chain of Responsibility, Command, Interpreter, Iterator, Observer, State, Strategy and Visitor; Java Object Model: Java Type System, Type Enquiry and Reflection, Generic Types; Frameworks: Role of Framework, Understanding Applet, Collections and Graph Editor Frameworks of Java.

### **References:**

1. C. Horstmann, *Object-Oriented Design and Patterns*, (2e), Wiley India, 2012.
2. E. Gamma, R. Helm, R. Johnson, J. Vlissides *Design Patterns: Elements of Reusable Object-Oriented Software*, (1e), Pearson Education India, 2015.
3. E. Freeman, E. Robson, B. Bates, K. Sierra *Head First Design Patterns: A Brain-Friendly Guide*, (1e), Shroff/O'Reilly, 2016.
4. M. Casciaro, *Node.js Design Patterns*, (2e Revised), Packt Publishing Limited, 2016.
5. M. Blaha, *Object-Oriented Modeling and Design with UML*, (2e), Pearson Education India, 2011.

## **IT4149: WIRELESS AD-HOC AND SENSOR NETWORKS [3 0 0 3]**

Fundamentals of Wireless Communication: Electromagnetic Spectrum, Radio Propagation Mechanisms, Characteristics of the Wireless Channel; Mobile Ad Hoc Networks (MANETs): Concepts and Architectures, Applications of Manets; MAC Protocols for Manets: Issues in Designing a MAC Protocol, Classification of MAC Protocols, Contention based Protocols, Contention based Protocols With Reservation Mechanisms, Contention based Protocols with Scheduling Mechanisms, IEEE 802.11-MAC; Routing and Transport Layer Protocols in Manets: Issues in Designing a Routing and Transport Layer Protocol, Proactive, Reactive (On-Demand) and Hybrid Routing, Transport Layer Solutions, TCP over Ad Hoc Wireless Networks; Wireless Sensor Networks (WSN): Concepts and Architectures, Applications of WSN; WSN and MAC Protocols: Single Node Architecture, Hardware and Software Components of a Sensor Node, WSN Network Architecture, Data Relaying and Aggregation Strategies, MAC Layer Protocols, Self-Organizing, Hybrid TDMA/FDMA and CSMA Based IEEE 802.15.4-MAC; WSN Routing, Localization and QOS: Issues in WSN Routing, OLSR- Localization, Indoor and Sensor Network, Absolute and Relative Localization, Triangulation-QOS, Energy Efficient Design, Synchronization, Transport Layer Issues.

### **References:**

1. Murthy Siva Ram C., Manoj B. S., *Ad Hoc Wireless Networks: Architectures and Protocols*, (1e), Pearson Education India, 2006.
2. Cordeiro C. De Moraes, Agrawal D. P, *Ad Hoc & Sensor Networks: Theory and Applications*, (2e Revised), World Scientific Publishing Company, 2011.
3. Zhao Feng, Guibas Leonides, *Wireless Sensor Networks*, (1e), Elsevier India, 2005.
4. Karl Holger, Willig Andreas, *Protocols and Architectures for Wireless Sensor Networks*, (1e), Wiley India, 2011.
5. Sohraby Kazem, Znati Daniel Minoli, Taieb, "Wireless Sensor Networks-Technology, Protocols, and Applications", (1e), Wiley India, 2010.
6. Hac Anna, "Wireless Sensor Network Designs", (1e), Wiley-Blackwell, 2003.
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### **IT4150: CLOUD COMPUTING [3 0 0 3]**

Clouds and Cloud Computing: Basic Concepts, Cloud Classifications, and Types of Services, Deployment Models; Classic Data Center (CDC): DBMS Concepts, CDC Drawbacks and Need of Cloud Resources, CDC Management and Case Studies; Virtualized Data Center (VDC): Compute and Storage, Compute Virtualization Overview, Compute Virtualization Techniques, Virtual Machines, VM Resource Management Techniques, Physical to Virtual Conversion, Hypervisor Management Software, Virtual Infrastructure Requirements; Storage: Storage Virtualization Review, Virtual Machine Storage, Block Level and File Level Virtualization, Virtual Provisioning and Automated Storage Tiering; Networking: VDC Networking Overview, VDC Networking Components, VLAN and VSAN Technologies, Network Traffic Management, Exercise – VDC Networking; Desktop and Application: Desktop Virtualization, Application Virtualization, Business Continuity in VDC, Fault Tolerance Mechanism in VDC, Backup in VDC, Replication and Migration in VDC, Cloud Infrastructure and Service Creation, Cloud Service Management; Security: Security Basics, Cloud Security Concerns and Threats, Cloud Security Mechanisms, Access Control and Identity Management in Cloud, Governance, Risk and Compliance, Security Best Practices for Cloud, Cloud Migration; Issues in Cloud Considerations: Migration Considerations, Security Issues at Different Phases to Adopt the Cloud.

#### **References:**

1. Josyula, Venkata, Malcolm Orr, and Greg Page. *Cloud computing: Automating the virtualized data centre*, (1e), Cisco Press, 2011.
2. Ray Rafaels. *Cloud computing*, (2e), CreateSpace Independent Publishing Platform, 2018.
3. Buyya, Rajkumar, James Broberg, and Andrzej M. Goscinski, *Cloud computing: Principles and Paradigms*, (1e), John Wiley & Sons, 2010.

## **IT4151: SOFTWARE DEFINED NETWORKS [3 0 0 3]**

Introduction to Networking: TCP/IP Protocol Suite, Distance Vector and Link State Routing Algorithms, Network Protocols (ARP, BGP) and Network Topologies; Introduction to SDN: Overview, History and Evolution of SDN, Architecture of SDN, SDN Flavours, Scalability (Data Centres, Service Provider Networks, ISP Automation), Reliability (QOS, and Service Availability), Consistency (Configuration Management, and Access Control Violations), Opportunities and Challenges; Control and Data Plane Separation: Introduction to Openflow- History and Evolution, Control and Data Plane Separation, Virtual Networking, Use-Cases (Network Access Control, Virtual Customer Edge, Datacentre Optimization); Network Virtualisation: Abstraction of Physical Network (Constrained Forwarding Model, Distributed State, Detailed Configuration), Components of a Virtual Network (Virtual Switch, Bridge, Host-Virtual Adapter, NAT Device, DHCP Server, Network Adapter), Network as a Service (Naas); Applications of SDN: Network Management, Resource Utilization, Network Service Chaining, Bandwidth Calendaring and Network Programmability; SDN Design and Development: Mininet- Applications, Network Virtual Machines, SDN Controller (POX, Floodlight, Opendaylight), Applicability of Openflow Protocols in SDN Controllers.

### **References:**

1. Nadeau T. D., Gray K., *SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies*, (1e), Shroff Publishers, 2013.
2. Goransson P., Black C., *Software Defined Networks: A Comprehensive Approach*, (2e), Morgan Kaufmann, 2016.
3. F. Hu, *Network Innovation through Open Flow and SDN: Principles and Design*, (1e), CRC Press, 2014.
4. Tiwari V., *SDN and Open Flow for Beginners with hands on labs*, (Kindle Edition), Amazon Asia-Pacific Holdings Digital Services, 2013.
5. Subramanian S., "Software Defined Networking with OpenStack", (Kindle Edition), Packt Publishing Ltd., 2016.

## **IT4152: MOBILE COMPUTING [3 0 0 3]**

Introduction: Mobile Computing vs Wireless Networking, Mobile Computing Applications, Characteristics of Mobile Computing, Structure of Mobile Computing Applications; MAC Protocols: Wireless MAC Issues, Fixed Assignment Schemes, Random Assignment Schemes, Reservation based Schemes; Mobile Internet Protocol and Transport Layer: Overview and Features of Mobile-IP, Key Mechanism in Mobile-IP, Route Optimization; Mobile Telecommunication System: Global System for Mobile Communication (GSM), General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS); Mobile Platforms and Applications: Device Operating Systems, Special Constraints and Requirements, Commercial Mobile Operating Systems; Software Development Kit: Ios, Android, Blackberry, Windows Phone; M-Commerce: Structure, Pros and Cons, Mobile Payment System, Security Issues.

### **References:**

1. Schiller Jochen, *Mobile Communications*, (2e), Pearson Education India, 2008.
2. Pattnaik P. K., Mall Rajib, *Fundamentals of Mobile Computing*, (2e), Prentice-Hall of India, 2015.
3. Agarwal D. P., Qing, An Zeng, *Introduction to Wireless and Mobile systems*, (3e), Cengage Learning India, 2010.
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5. William. C. Y. Lee, *Mobile Cellular Telecommunications-Analog and Digital Systems*, (2e), McGraw Hill Education, 2017.

### **IT4153: NATURAL LANGUAGE PROCESSING [3 0 0 3]**

Introduction: Ambiguity and Uncertainty in Language, Processing Paradigms, Phases in Natural Language Processing, Applications, Text Representation in Computers, Encoding Schemes; Linguistics Resources: Introduction to Corpus, Elements in Balanced Corpus, Wordnet, Verbnet; Part of Speech Tagging: Stochastic POS Tagging, Hmm, Transformation based Tagging, Handling of Unknown Words, Named Entities, Multi Word Expressions; Natural Language Grammars: Lexeme, Phonemes, Phrases and Idioms, Word Order, Agreement, Tense, Aspect, Mood and Agreement, Context Free Grammar, Spoken Language Syntax; Parsing-Unification, Probabilistic Parsing, Tree-Bank; Semantics: Meaning Representation, Semantic Analysis, Lexical Semantics, Wordnet; Word Sense Disambiguation: Selection Restriction, Machine Learning Approaches, Dictionary based Approaches; Discourse: Reference Resolution, Constraints on Co-Reference, Algorithm for Pronoun Resolution, Text Coherence, Discourse Structure; Applications of NLP: Spell-Checking, Text Summarization and Information Retrieval, Sentiment Analysis.

#### **References:**

1. D. Jurafsky, J. H. Martin, *Speech and Language Processing*, (2e), Pearson Education India, ISBN-13: 978-0131873216, 2009.
2. Bikel, Daniel, and Imed Zitouni, *Multilingual Natural Language Processing Applications: From Theory to Practice*, (1e), Pearson Education India, 2012.
3. T. Siddiqui, U. S. Tiwary, *Natural language processing and Information retrieval*, (1e), Oxford University Press, ISBN-13: 978-0195692327, 2008.

## **IT4154: INFORMATION RETRIEVAL [3 0 0 3]**

Introduction to Information Retrieval: Mathematical Basics, Vector spaces and Similarity, Probabilities and Statistics, Text Analysis; Pre-processing: Document processing, Stemming, String Matching, Basic NLP tasks – POS Tagging Shallow Parsing; Overview of Text Retrieval Systems: System Architecture, Boolean Models, Inverted Indexes, Document Ranking, IR Evaluation; 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; Query Expansion and Feedback: Query Reformulation, Relevance feedback, Pseudo-Relevance Feedback, Language Model Based, Feedback; Web Search Engines: Models of the Web, Web Crawling; Static Ranking: Page Rank HITS, Query Log Analysis, Adversarial IR, Information Filtering: Adaptive Filtering, Collaborative Filtering, User Interfaces, Text Classification, Naïve Bayes, K-nearest neighbours, Feature selection, Semi-supervised Learning; Text Clustering: Vector-space Clustering; K-means, EM algorithm, Text shingling; Graph-Based Methods: WordNet, Document and Word Graphs, Network Analysis, Random Walks, Harmonic Functions.

### **References:**

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, *Introduction to Information Retrieval*, (2e), Cambridge University Press, 2015.
2. B. Croft, D. Metzler, T. Strohman, *Search Engines: Information Retrieval in Practice*, (3e), MIT Press, 2016.
3. Chengxiang Zhai, *Statistical Language Models for Information Retrieval (Synthesis Lecture Series on Human Language Technologies)*, (2e), Morgan & Claypool Publishers, 2017.



## **IT4155: NETWORK SECURITY AND MANAGEMENT [3 0 0 3]**

Basics of Network Security: Attacks, Services and Mechanisms; Network Security Applications: Kerberos, IPSec, SSL, TLS and VPN; Internet Security: Digital Certificate, PKI, Secure Electronic Payment System and Protocols; Issues in Network Security and Tools: Man in the Middle Attack, Replay, ARP Poisoning, DNS Poisoning, Web based Attacks; Firewalls and IDS: Need of Firewalls, Firewall Characteristics and Access Policy, Type of Firewall, Firewall Basing, Firewall Location and Configuration, Types of Intrusion Detection System, Working of IDS and Policies; Malware: Virus, Worm, Trojan Horse, Working of Malwares, Identifications and Remedies; Network Management: Requirements, IP Network Management, IP-Based Service Implementation, Network Management Architecture, SLA and Network Monitoring, MPLS Network Management, Policy-based Network Management Fundamentals.

### **References:**

1. Pachghare V. K., *Cryptography and Information Security*, (2e Revised), Prentice Hall India, ISBN-10: 9788120350823, ISBN-13: 978-8120350823, 2015.
2. William Stallings, *Cryptography and Network Security*, (6e), Pearson Education India, ISBN-13: 9780133354690, 2014.
3. A. Farrell, S. Abeck, *Network Management Know It All*, (1e), Morgan Kaufmann Publishers, ISBN 9780123745989, 2011.

## **IT2280: PYTHON PROGRAMMING [3 0 0 3]**

Python Concepts: Introduction to Python, Variables, Keywords, Identifiers, Literals, Operators, Comments; Control Statement: if, if else, else if, nested if, for loop, while loop, do while, break, continue, pass; Python OOPs: OOPs Concepts, Object, Class, Constructors, Inheritance; Data structures: List, Tuple, Set, Dictionary; Functions: Functions overview, lambda function, Recursive functions, map, filter and reduce; File and Exception handling: Create a file, read and write operation with file, Introduction to Exceptions & Errors, Handling exceptions using try-except-else-finally; Numpy: Introduction to Numpy, indexing and Boolean indexing, Datatypes and Operations: statistical, Sorting, and Set Operations, Broadcasting, Speed Test –Numpy array vs. list; Pandas: Pandas and its features, Creating Series and Data Frame with data inputs, learning how to handle missing values, Handling vectorized operations, Viewing, selecting, and accessing elements in a data structure; Matplotlib: Data visualization and its importance, matplotlib and its data visualization features, types of plots; Scipy: Introduction, characteristics and sub-packages of SciPy.

### **References:**

1. A. Martelli, "Python in a Nutshell", (3e), Shroff/O'Reilly, 2017.
2. J. Georzen, T. Bower, B. Rhodes, "Foundations of Python Network Programming: The comprehensive guide to building network applications with Python", (2e), APress, 2010.
3. William McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython", (2e), Shroff/O'Reilly, 2017.

### **IT3180: BASICS OF INFORMATION SECURITY [3 0 0 3]**

Introduction: Elements of Information Security, Security Techniques, Category of Information Security, Security Services, Basic Network Security Terminology, Security Attacks. Encryption Techniques: Symmetric and Asymmetric Encryption Methods, Basics of Cryptanalysis, Steganography, Number Theory, Diffie-Hellman Key Exchange, Authentication Methods and Message Digest, Introduction to Digital Signatures. Network Security: Email Security, IP Security, Web Security. Special Topics to Information Security: Intrusion Detection, Malicious Software, Firewall, Computer Forensics.

#### **References:**

1. V. K. Pachghare, *Cryptography and Information Security*, (2e), Prentice Hall India, ISBN-10: 9788120350823, ISBN-13: 978-8120350823, 2015.
2. William Stallings, *Cryptography and Network Security*, (6e), Pearson Education India, ISBN-13: 9780133354690, 2014.
3. Stinson Douglas R., *Cryptography: Theory and Practice*, (3e), Chapman and Hall / CRC Press, 2005.

## **IT3280: BASICS OF LINUX PROGRAMMING [3 0 0 3]**

Introduction: Unix System Overview, Program and Processes, Error Handling, User Identification, Signals, System Calls and Library Functions; File I/O: File Descriptors, Function for File Modification, I/O Efficiency, File Sharing, Atomic Operations; Directories: Stat, Fstat and Lstat Functions, File Types, Set-User-ID and Set-Group-ID, File Access Permissions, Function for Modifying File Permission and Ownership, Symbolic Links; System Data Files and Information: Password File, Shadow Passwords and Other Data Files; Process Environment: Process Termination, Memory Layout of a C Program, Memory Allocation, Setjmp and Longjmp Functions; Process Control: Fork Function, Vfork Function, Exit Functions, Wait and Waitpid Functions, Race Conditions, Changing User IDs and Group IDs; Process Relationship: Logins, Process Groups, Sessions, Controlling Terminal, Job Control; Signals: Signal Concepts, Functions to Raise and Handle Signals, Program Termination, Abort and System Functions; Threads: Thread Concepts, Creation, Termination and Synchronization, Threads Control, Threads and Signals, Threads and Fork, Threads and I/O.

### **References**

1. W R Steven, S A Rago, *Advanced Programming in the Unix environment*, (2e), Addison Wesley, 2011.
2. Y P Kanetkar, *Unix Shell Programming*, (1e), BPB Publication, 2009.

### **IT3281: INTRODUCTION TO DATA SCIENCE [3 0 0 3]**

Descriptive Statistics: Introduction, Descriptive Statistics, Probability Distribution; Inferential Statistics: Inferential Statistics through Hypothesis Testing, Permutation and Randomization Test; Regression and ANOVA: Regression Analysis, Analysis of Variance; Machine Learning: Differentiating Algorithmic and Model Based Framework, OLS, RIDGE & LASSO Regression, KNN & Classification; Supervised Learning with Regression and Classification Technique: Bias-Variance Dichotomy, Logistic Regression, LDA, QDA, Regression and Classification Trees, SVM, Ensemble Methods, Random Forest.

#### **References:**

1. H. Trevor et al., *The Elements of Statistical Learning*, (2e), Springer, ISBN 978-0-387-84858-7, 2009.
2. C. Douglas and C. George, *Applied Statistics and Probability for Engineers*, (3e), John Wiley and Sons, ISBN-13: 978-1118539712, 2010.
3. T.M. Mitchell, *Machine Learning*, (1e), Mc Graw-Hill, New York, ISBN-13: 978-0070428072, 2017.
4. Kevin P. Murphy, *Machine Learning - A Probabilistic Perspective*, MIT Press, ISBN-13: 978-0262018029, 2012.