

SEMESTER I**20MX11 MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE****3 1 0 4**

STATISTICS: Graphical presentation of data – scatter plots – frequency distribution – histograms – box plots – measures of central tendency – measures of dispersion – grouped data. **PROBABILITY:** Review of sets – experiments and sample spaces – events – probability definition – finite sample spaces and enumeration – conditional probability – partitions, total probability – Baye's theorem. **RANDOM VARIABLES:** Distribution function – discrete, continuous random variables – equivalent events – functions of discrete and continuous random variables – expectation – moment generating functions. (12+4)

SET THEORY: Set notation and description - basic set operations - Venn diagrams - laws of set theory - partition - min sets-Principle of inclusion and exclusion. **RELATIONS:** Relations - properties of relations - closure operations on relations. **MATHEMATICAL INDUCTION** Strong Induction and well-ordering – Recursive definitions and structural induction – recursive algorithms – program correctness. (12+4)

FORMAL LANGUAGES: Four classes of grammars (Phrase Structure, Context sensitive, Context Free, Regular) - definitions - Context free Grammar : Right most, Left most derivations – Syntax trees – Unambiguous & ambiguous grammars – Construction of grammars for languages – Derivation of languages from grammars – Regular expressions. (11+3)

FINITE AUTOMATA: Definition of deterministic finite state automaton (DFA), Non deterministic finite state automaton (NFA) - equivalence of DFA and NFA - Equivalence of regular grammars and finite automata. **PUSH DOWN AUTOMATA** Informal description - definition - Deterministic PDA - Equivalence of acceptance by final state and empty stack - Equivalence of PDA and Context Free languages. **TURING MACHINE (TM):** Construction of simple Turing Machines - Universal TM - Halting Problem. Applications of Turing Machine. (10+4)

Total L: 45 + T: 15 = 60**REFERENCES:**

1. William W Hines, Douglas C Montgomery, David M Goldsman and Connie M Borrer, "Probability and Statistics in Engineering", John Wiley, 2008.
2. Ronald E Walpole, Raymond H. Myers, Sharon L Myers and Keying Ye, "Probability & Statistics for Engineers & Scientists", Pearson Education, 2016.
3. Kenneth H Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill, 7th edition. 2018.
4. Bernard Kolman, Robert C Busby and Sharon Ross, "Discrete Mathematical Structures", Pearson Education, 6th edition, 2017.
5. John E Hopcroft, Rajeev Motwani, and Jeffrey D. Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education, 3rd edition, 2016.
6. John Martin, "Introduction to Languages and the Theory of Computation", Tata McGraw Hill, , 4th edition, 2010.

20MX12 STRUCTURED PROGRAMMING CONCEPTS**3 2 0 5**

INTRODUCTION: Characteristics of programming Languages- factors influencing the evolution of programming language, developments in programming methodologies, desirable features and design issues- Programming language paradigms. Programming language processors: Structure and operations of translators, software simulated computer, syntax, semantics, structure, virtual computers, binding and binding time. Program development and execution environments Embedded system requirements and programming. Introduction to C Language and Background - C Programs - Structure -main function and command-line arguments. Identifiers, Data Types, Variables, Constants, Operators, Expressions, Types of expressions, Expression Evaluation and Data type conversions. Input / Output functions. (12+8)

Sequence controls in structured programming: Statements - Sequential statements and Compound statement- Selection Statements – if, else if ladder and switch statements- Repetition statements -while, for, do-while statements and other statements related to looping – break, continue, goto statements, Statements versus Expressions. Functions: Designing Structured Programs, Functions, user defined functions and Standard library functions, inter function communication, Scope, Storage classes-auto, register, static, extern, scope rules, type qualifiers. Recursion- Limitations of recursions- recursive function. Pre-processor commands and Macros. (12+8)

Structured data types and Files in programming: Arrays: Concepts, using arrays in C, , array applications ,two - dimensional arrays, multidimensional arrays, Strings – Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions, string / data conversion. Pointers: Introduction, pointer declarations Pointers for inter function communication, pointers to pointers, compatibility, Pointer Applications-Arrays and Pointers, Pointer Arithmetic Operations and arrays, Passing an array to a function, memory allocation functions, array of pointers, programming applications, pointers to functions. , Structures – Declaration, initialization, accessing structures, operations on structures, Complex structures, structures and functions, passing structures through pointers, self referential structures, unions, bit fields. Enumerated types. Input and Output – Concept of a file, streams, text files and binary files, File handling functions –Applications for files. (12+10)

Markup and Script Languages: Introduction to script programming and processing. Motivation and applications of scripting. Script and Mark-up versus System programming languages. Fundamentals interpreters - dynamic typing-, dynamic scoping - merits and demerits of scripting languages - Types of scripting languages Applications - Multi- Paradigm Programming languages – Domain specific Languages. Software stacks and Script languages. (9+ 4)

Total L : 45 + T: 30 =75

REFERENCES:

1. Terrence W Pratt, Marvin V Selkowitz and T V.Gopal, "Programming Languages Design and Implementation", Pearson Education, 2016.
2. Robert W Sebesta, "Concepts of Programming Languages", Addison Wesley, 2016.
3. Kernighan B.W. and Ritchie D.M., "C Programming Language (ANSI C)", Prentice Hall , 2013.
4. Al Kelley and Ira Pohl, " A Book on C " Pearson Education, 2015.
5. B.A. Forouzan and R.F. Gilberg, "A Structured Programming Approach Using C," Third Edition, Cengage Learning. 2017
6. Peter Prinz and Tony Crawford, C in a Nutshell, O'Reilly, 2016.

20MX13 DATA STRUCTURES

3 0 0 3

INTRODUCTION: Data structures - Abstract Data Types - Primitive data structures - Algorithms: Structure, properties. **Arrays** : – definition Operations - representation of multi dimensioned arrays- addressing function - representation of special type of matrices – lower triangular - upper triangular – representation of sparse matrix. **Strings:** Operations – Implementation.. **Searching** : Linear and Binary Search – Pattern search. (10)

LINEAR DATA STRUCTURES: **Stacks** : Operations -Implementation: Array representation - Applications: Recursion handling - Parentheses matching – conversion of infix to postfix - Evaluation of expressions. **Queues:** Operations - sequential implementation - Circular Queues-Priority Queues – De-queues - Applications. (11)

LISTS:Linked list Vs Array, Memory allocation and de-allocation for linked list - Insertion and deletion of nodes - Singly linked lists, Doubly linked lists, Circular lists, Multiply linked lists – linked stack- linked queue - Applications: addition of polynomials- representation of larger number. (12)

NON-LINEAR DATA STRUCTURES: **Tree** : Terminologies - Implementation-Binary Tree-Properties - Sequential and linked representation - Binary tree traversals–Basic operations – **Graph:** Terminologies - types–representations – Graph Traversal: Breadth First Search and Depth First Search – Applications. **TABLES:** Operations- Hash Table: Hash functions, Implementation, collision resolution and overflow handling techniques, Linear Open Addressing, Chaining. (12)

Total L: 45

REFERENCES:

1. Sahn Sartaj, "Data Structures, Algorithms and Applications in C++", Silicon Press, 2009
2. Aaron M Tanenbaum, Moshe J Augenstein and YediyahLangsam, "Data structures using C and C++ ", PHI Learning, 2009.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education, 2012.
4. VijayalakshmiPai GA, "Data Structures and Algorithms: Concepts Techniques and Applications", McGraw-Hill, 2017.
5. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein "Introduction to Algorithms", The MIT Press, 2014.
6. A. Chitra P T Rajan "Data Structures", Tata McGraw Hill Education, 2016

20MX14 DATABASE MANAGEMENT SYSTEM

3 0 0 3

INTRODUCTION: Databases – Conventional file Processing – Data Modeling for a database – Three level architecture – Data Independence – Component of a Database Management System –characteristics-Advantages and disadvantages of a DBMS- roles- Data base administrator-functions and responsibilities – In-memory database. **DATA MODELS:** Hierarchical- Network data model- ER model: Entity Relationship diagram – Data association - Entities-attributes, relationships- structural constraints– Extended ER diagram Generalization – Aggregation -Composition– Mapping ER diagram to relations, hierarchical and network data models– applications. (11)

RELATIONAL MODEL: Relational data model basics - Codd's rules – properties of Relations- Domains and Key concept – Integrity rules- Relational algebra – Relational algebra queries – Relational calculus: Tuple Relational calculus, Domain relational calculus – Queries in Relational calculus. (11)

RELATIONAL DATABASE MANIPULATION: SQL- data types- types of SQL –static -dynamic - Embedded SQL- table- constraints- table handing commands- records handing commands- Basic data retrieval – Condition specification –aggregate function- order by/group by clause- sub queries-in-any-all- correlated sub queries-exists-not exists-multi table queries - SQL Join –set operations- synonyms- sequences- views- index- SQL API- triggers. (11)

DATA BASE DESIGN THEORY: Functional dependencies - Normal forms – Normalization: 1NF to 5NF- Domain Key Normal Form –losses join and dependency preserving decomposition – Denormalization- Data base tuning. **DATABASE TRANSACTION & SECURITY:** Transaction processing- properties- security and integrity threats- security violations- identification and authentication - discretionary access control based on grant and revoking privilege-mandatory control and role based access control. (12)

Total L: 45**REFERENCES:**

1. Silberschatz A, KorthHandSudarshan S, "Database System Concepts", McGraw-Hill, 2013.
2. Bipin C Desai, "An introduction to Database Systems", Galgotia Publications, 2012.
3. Elmasri R and Navathe S B, "Fundamentals of Database Systems", Pearson Education, 2010.
4. Raghu Ramakrishnan and Johannes Gehrke, "Database Management System", McGraw Hill, 2006.

20MX15 UNIX ARCHITECTURE AND PROGRAMMING**3 2 0 5**

INTRODUCTION TO UNIX: Unix structure, File System – Essential Commands – Directory and File Commands - General Purpose Utilities - Bourne Shell – Shell Wild Cards – Simple Filters – Regular Expressions – Grep Family - Advanced filters – sed, awk- Process - Communication and Scheduling. (10+7)

FILE SYSTEM STRUCTURE: Kernel architecture - Kernel data structure - Buffer Cache - Structure of Buffer pool - Scenarios for buffer retrieval - Reading and Writing disk blocks - Advantages and Disadvantages of buffer cache - Inode - Structure of regular file - Conversion of a pathname to an inode - Inode assignment to a new file - Allocation of disk blocks. (12+8)

PROCESS SYSTEM: Process states and transitions - Context of a process - Saving the context of a process - ManipulatingProcess address space - Process creation and termination – Signals – Awaiting Process Termination - System Boot and initprocess - Process Scheduling – Functions of a Clock Interrupt Handler. (11+7)

PROGRAMMING WITH SHELL: Shell Scripts – Command Line Arguments, Positional Parameters – Decision Making and LoopingConstructs – Redirection – File System Architecture. **MEMORY MANAGEMENT:** Swapping - Allocation of swap space – SwappingProcesses Out – Swapping Processes in – Demand Paging - Data structures of demand paging - Page stealer Process - Page faults. (12+8)

Total L: 45 + T:30=75**REFERENCES:**

1. Sumitabha Das, "Unix System V.4 - Concepts and Applications", Tata McGraw Hill, 2014.
2. Maurice J Bach, "Design of the UNIX Operating System", Pearson, 2015.
3. Richard F Gilberg, Behrouz A Forouzan, "Unix and Shell Programming - A Text Book", Cengage Learning India Private Limited, 2016.
4. UreshVahalia, "UNIX Internals: The New Frontiers", Pearson Education, 2011.
5. Keith Haviland, Dina Gray, "Unix System Programming", Addison Wesley, 2007

20MX16 DATA STRUCTURES LABORATORY**0 0 4 2**

Experiments in the following topics:

1. Applications of arrays
2. Applications of strings.
3. Implementation of searching algorithms.
4. Stacks: operations and applications.
5. Queues: operations and applications.
6. Linked Lists: singly linked, doubly linked list and circular lists.
7. Linked stack and linked queue
8. Binary trees operations.
9. Implementation of graph.
10. Graph Traversals.
11. Hash Table: collision resolution techniques

Total P: 60**20MX17 RDBMS LABORATORY****0 0 2 1**

Experiments in the following topics:

- 1.Data definition Language – Create , Alter, Truncate.
2. Database designing with domain, key and integrity constraints
3. Data manipulation queries.
4. View , aggregate functions, sub queries on a database
- 5.Simple PL/SQL programs
6. PL/SQL programs using functions,stored procedures

7. Usage of cursors
8. Implementing triggers

Total P: 30

20MX18 WEB APPLICATION DEVELOPMENT

0 0 4 2

Study and Develop experiments in the following topics:

1. HTML elements & attributes – link
2. HTML tables, forms & Canvas
3. HTML Multimedia, APIs
4. CSS selectors
5. CSS Media queries, Layout, Transformation, transition
6. Java Script - DOM , BOM methods, Form Validation, Functions
7. GitHub Experiments using PHP & Oracle / MySQL

Experiments in the following topics:

1. Data definition Language – Create , Alter, Truncate.
2. Database designing with domain, key and integrity constraints
3. Data manipulation queries.
4. View , aggregate functions, sub queries on a database
5. Simple PL/SQL programs
6. PL/SQL programs using functions, stored procedures
7. Usage of cursors
8. Implementing triggers

Develop and deploy applications not limited to the following areas:

- i) Ticket reservation
- ii) Online quiz
- iii) Content Management System

Total P: 60

20MX19 PROFESSIONAL COMMUNICATION

0 0 2 1

Introduction to communication concepts- verbal, non verbal, Intra and Interpersonal communication	(3)
Essentials of Group communication	(1)
Meetings, agenda , notice and minutes of meetings	(1)
Business correspondence –Different types of letters	(2)
Oral presentation-Introduction to public speeches	(1)
Interview techniques	(1)
Academic writing	(1)
Speech practice	(6)
Group discussions	(4)
Listening activities	(5)
Mock interviews	(5)

Software : **Elab Technologies**

Total P:30

REFERENCES:

1. Jack C. Richards , Jonathan Hull , Susan Proctor, "Interchange Student's Book 2", Cambridge university Press, New Delhi, 2015.
2. Priyadarshi Patnaik, "Group Discussion and Interview Skills", Indian Institute of Technology, Kharagpur, 2011.

SEMESTER II**20MX21 OBJECT ORIENTED PROGRAMMING USING JAVA****3 0 0 3**

OBJECT ORIENTATION: Object Orientation Programming - Basic Concepts - Abstraction – Classes and Objects – Encapsulation - Inheritance – Polymorphism - **JAVA FUNDAMENTALS:** Features of Java – Java Development Environment – Bytecode - Data types- Variables -Operators – Expressions – Functions – Static Members - Arrays - Strings. (11)

INHERITANCE:Inheritance – Types - Access rules, super – final – Abstract classes – **POLYMORPHISM:** Static binding – Dynamic binding – Method overloading - Runtime Polymorphism. Package: Create - Import – Interface: Create – Implement – Inner classes. **EXCEPTION HANDLING:** Exception - Types – try and catch - Multiple catch - Nested try – throw - throws – finally - User defined exception. (12)

INPUT / OUTPUT:Stream classes: Byte – Character - File class - File operations - Console class – Serialization – Garbage Collection. **MULTITHREADING:** Thread -based multitasking - Process-based multitasking - Java thread model - Creating threads - Thread priorities - Synchronization - Inter thread communication. (10)

EVENT DRIVEN PROGRAMMING: Basics - Applets Vs Applications – AWT: Containers, Components, Layout Managers – Event handling – Event Delegation model. **COLLECTIONS FRAMEWORK:** Collection: Interface – Classes - Generics - Design and development of database applications. (12)

Total L: 45**REFERENCES:**

1. Herbert Schildt, "JAVA - The Complete Reference", 7th Edition, Tata McGraw Hill, 2017.
2. Cay S Horstmann and Gary Cornell, "Core Java Volume I & 2", 10th Edition, Pearson Education, 2017.
3. Deitel and Deitel, "JAVA - How to Program", 11th Edition, Prentice Hall International Inc, 2017.
4. Y. Daniel Liang, Pearson, "Introduction to JAVA Programming, 7th Edition, Tata McGraw Hill, 2017.

20MX22 DESIGN AND ANALYSIS OF ALGORITHMS**3 1 0 4**

INTRODUCTION: Algorithm –Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations lower and upper bound: best case, worst case, average case analysis- Performance analysis of iterative constructs. Recurrences: Formulation and solving recurrence equations. Polynomial and non-polynomial notations-Sorting: Insertion Sort, Selection Sort, Shell Sort, Bubble Sort, Quick Sort, Heap Sort, Merge Sort, Radix Sort – Algorithms –Analysis (11+4)

SEARCH TREES: Binary search trees- Operations: Insert, delete, search –implementation- Analysis. **AVL trees:** Definition – Height – Operations: search– insert, delete - AVL rotations – Examples. **MULTI-WAY SEARCH TREES:** M-way search trees– B-Tree – B+ trees - Tries – Operations: Insert, delete, retrieve- Example. (10+4)

DIVIDE AND CONQUER: Method – Finding the maximum and minimum- Binary Search – Merge sort, Quick sort – Performance Analysis. **DYNAMIC PROGRAMMING:** Method – All pairs shortest path problem – 0/1 Knapsack Problem - Traveling salesman problem-Multi stage decision graph. (12+3)

GREEDY METHOD: Method – Knapsack Problem- Minimum cost spanning tree- Prim's algorithm- Single source shortest path- Optimal storage on tapes – Optimal merge patterns: Huffman Coding. **BACK TRACKING:** Method – Eight queen's problem, Sum of subsets, Knapsack Problem, Graph colouring. **BRANCH AND BOUND:** Method – 0/1 Knapsack. (12+4)

Total :L 45+T :15=60**REFERENCES:**

1. Ellis Horowitz, Sartaj Sahni and SanguthevarRajasekaran, "Fundamentals of Computer Algorithms" Universities Press, 2010.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, 2006.
3. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein "Introduction to Algorithms", The MIT Press, 2009.
4. Stevens S Skiena, "The Algorithm Design Manual", Springer-verlag, London Ltd, 2008.

20MX23 ENTERPRISE COMPUTING**3 1 0 4**

ENTERPRISE FOUNDATIONS :Enterprise software characteristics – options - Enterprise Architectural overview – object oriented software development for enterprise - Component Based software development for enterprise. Multi-tier system - Java

Enterprise System. Use of patterns, frameworks, software stacks for Enterprise application development. Enterprise software for Hospital, University and manufacturing firm. (12+3)

ENTERPRISE DATA ENABLING: Enterprise Data - Basis of JDBC, Drivers, Connection, Statement, Result Set, Advanced JDBC features, Distributed transactions. ORM, JPA, Hibernate framework, NOSQL in Enterprise applications –CRUD operations and Query Languages. **ENTERPRISE APPLICATION ENABLING-** Enterprise Java Beans, Stateless Session Beans, Stateful Session Beans, Message Driven Beans, Entity beans, Accessing and integrating EJBs. (13+ 4)

ENTERPRISE WEB ENABLING: Enterprise-Web Programming, Java Servlets - Java Server pages, State and session management – MVC architecture SPRING frameworks for web tier. **SINGLE PAGE WEB APPLICATIONS** Angular JS – Java script, Typescript, basics Controllers, pages, components, widgets – Data tables, Switching between pages, AJAX programming. (10+5)

DISTRIBUTED ENTERPRISE COMMUNICATIONS ENABLING: Distributed Enterprise Communications Basis – distributed object middleware – synchronous and Communications, Java web services using both SOAP and RESTFUL for Enterprise Applications Message queues, JSON API and Binding - Micro services for Enterprise applications. (10+3)

Total L: 45 + T:15 = 60

REFERENCES:

1. SebastianDaschner, "Architecting modern Java EE applications", Pack.pub.com, 2017
2. KapilaBogahapitiya and Sandeep Nair, "Mastering Java EE 8 Application development", Packt Publishing, 2018.
3. Prashantpadmanaban, "Java EE 8 and Angular", Packt Publishing, 2018.
4. Kogent Solutions Inc. "Java Server Programming", Dreamtech Press, 2016.
5. Francesco Marchioni, Practical Enterprise Application Development, Independently published , 2019
6. Peter Späth , Beginning Jakarta EE Enterprise Edition for Java: From Novice to Professional, 2020.

20MX24 ARTIFICIAL INTELLIGENCE

3 1 0 4

INTRODUCTION: Definitions of Artificial Intelligence (AI)-Foundations of AI - History of AI- Intelligent Agents-Structure of Agents. **AI SEARCH ALGORITHMS:** State Space Model-Trial and Error- Breadth First Search- Depth First Search- Brute Force Search-A* Algorithms – illustrative problems and real world applications. (11+4)

NON CLASSICAL AI SEARCH ALGORITHMS: Genetic Algorithms - Simulated Annealing. **GAME PLAYING:** AND/OR Search Trees-Game Trees - Minmax Algorithm - Alpha-Beta Pruning. **CONSTRAINT SATISFACTION:** Definition – Inference - Backtrack Search and Local Search for Constraint Satisfaction Problems – illustrative problems and real world applications. (12+4)

KNOWLEDGE, REASONING, AND PLANNING: Logical Agents- Propositional Logic- First-order predicate Logic – real world modeling and Inference - Backward Chaining - Forward Chaining – Resolution - illustrative problems and applications. (11+3)

PROBABILISTIC REASONING: Semantics of Bayesian Networks – inference. **LEARNING:** Supervised learning - Unsupervised learning- reinforcement learning – illustrative problems and applications. (11+4)

Total L: 45 + T:15 = 60

REFERENCES:

1. Stuart Russel and Peter Norvig, "Artificial Intelligence – A modern approach", Prentice Hall, Third Edition, 2010.
2. Elaine Rich, Kevin Knight and Shivashankar B Nair, "Artificial Intelligence", McGraw Hill, 2008.
3. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013.
4. Patrick Henry Winston, "Artificial Intelligence", Addison Wesley, Third Edition, 1992.
5. Luger George F and Stubblefield William A, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Pearson Education, Sixth Edition, 2008.
6. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.

20MX25 SOFTWARE ENGINEERING METHODOLOGIES

3 1 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-cost estimation techniques- **REQUIREMENTS GATHERING:** Requirements gathering tasks – Requirements Engineering Process - Qualities of good requirements-Types of Requirements-Requirements elicitation- Requirements documentation- Analysis Documentation. (10+3)

FUNCTIONAL ORIENTED APPROACH: Functional Decomposition-Context diagram - Data flow diagrams - Data Dictionary-Functional Independence-Modular Design-Coupling-Cohesion- Design tools – Structured Chart, HIPO Diagram, Decision Tree, Decision Table, Pseudo code – User Interface Design - Software Design Documentation. (12+4)

OBJECT ORIENTED APPROACH: Objects and Classes-Object Identification-Relationship among objects-classification-Use cases-UML Diagrams to support Object Oriented Analysis and Design. **PROGRAMMING STANDARDS AND CODING:** Structured programming coding standards-Maintainability of code. (11+4)

SOFTWARE TESTING FUNDAMENTALS: Black-Box and White-Box testing – Basis Path testing – Requirements phase testing - Design phase testing - Program phase testing - Desk debugging and program peer view test tools - Evaluating test results - Installation phase testing - Acceptance testing – Testing GUI – Testing Web Applications. **DEBUGGING:** The art of Debugging – Debugging Process – Debugging Strategies. (12+4)

Total L: 45 +T:15 = 60

REFERENCES:

1. Roger Pressman S and Bruce Maxim “Software Engineering: A Practitioner's Approach”, Tata McGraw-Hill, 2020.
2. Ian Sommerville, “Software Engineering”, Pearson Education, 2018.
3. Pankaj Jalote's “Software Engineering: A Precise Approach”, Wiley,2010
4. James Rumbaugh, Ivar Jacobson and Grady Booch, “The Unified Modeling Language Reference Manual”, Pearson Education, 2009.

20MX27 JAVA PROGRAMMING LABORATORY

0 0 4 2

- Implement the following concepts, using the problem sheets given during the lab sessions:
 - Object-oriented features.
 - Arrays and strings.
 - Inheritance
 - Interfaces and packages.
 - User-defined exceptions.
 - Stream classes.
 - Multithreading.
 - Operations on objects using Collections framework.
 - Event driven programming with database connectivity.
- Design, develop and deploy packages to apply features of Java in solving real world problems.

Total P: 60

20MX28 ENTERPRISE APPLICATION DEVELOPMENT

0 0 4 2

1. Handson in the following topics/ concepts:
 - i) Primitive data types
 - ii) Containers.
 - iii) Functions
 - iv) Object oriented programming using python
 - v) Files in python
 - vi) User Interface using open source frameworks like Django/Flask
 - vii) Concepts and features of J2EE Technology
 - viii) Features and feasibility study of MEAN Stack technology
 - ix) Features and feasibility study of Typescript
2. Design, deploy and document application specific to the areas not limited to the following:
 - i) User Interface using open source frameworks like Django/Flask
 - ii) Applications using web scrapping
 - iii) Applications using image processing
 - iv) Developing sensors based applications
 - v) Applications for Data Analytics

Total P: 60

SEMESTER III**20MX31 CLOUD COMPUTING****3 2 0 5**

INTRODUCTION TO CLOUD COMPUTING: Basics of Distributed Systems – Distributed Architectural Models – Parallelization - Cloud Computing Architecture – Deployment models - Infrastructure-as-a-Service (IaaS) – Platform-as-a-Service (PaaS) – Software-as-a-Service (SaaS) - Comparison of Cloud Computing with Grid, Cluster and Utility Computing - Pros and Cons of Cloud Computing. (12+7)

VIRTUALIZATION: Virtual Machines - Types of Virtualization - Architecture of VMM - Implementation Levels of Virtualization - Tools for Virtualization –Virtualization for Cloud - Virtualization for Datacenter Automation. (11+8)

CLOUD ARCHITECTURE AND PLATFORMS: HDFS Architecture - Google Big Table - Amazon AWS - Amazon EC2, Amazon Simple Storage Service (S3) – Windows Azure - Aneka frame work - IBM blue Cloud - Eucalyptus – Open Stack. **CLOUD PROGRAMMING MODELS:** Implementation of Map reduce - Twister and Iterative Map Reduce. (11+8)

CLOUD SECURITY: Introduction to Cloud Security - Challenges and Risks – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security - Identity Management and Access Control – Autonomic security. (11+7)

Total L: 45 + T:30= 75**REFERENCES:**

1. Liu M L, "Distributed Computing Principles and Applications", Pearson Education, New Delhi, 2012.
2. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, Cloud Computing : Concepts, Technology & Architecture, Prentice Hall, 2013.
3. Ajay D Kshemkalyani, "Distributed Computing: Principles, Algorithms, and Systems", Cambridge University Press, 2013.
4. Rajkumar Buyya, James Broberg and Andrzej M Goscinski "Cloud Computing: Principles and Paradigms" Wiley Press, 2011.
5. Venkata Josyula, Malcolm Orr and Greg Page, "Cloud Computing Automating the Virtualized Data Center", Cisco press, 2012.
6. Ronald L. Krutz, Russell Dean Vines, "Cloud Security – A comprehensive Guide to Secure Cloud Computing", Wiley – India, 2010.

20MX36 MOBILE APPLICATION DEVELOPMENT**0 0 4 2**

- 0 Design of simple apps using Text and Page Layout
- 1 Create apps using various Controls and Styles
- 2 Develop apps with Page Navigation.
- 3 Creating apps with menu, list, grid layouts and multimedia controls
- 4 Designing apps with notification management
- 5 Creating apps with data storage and content provider support
- 6 Designing apps that supports Mobility and Location Based Services
- 7 Packaging and Deploying apps in Market place

Total P: 60

SEMESTER IV
20MX41 PROJECT WORK

0 0 24 12

The Project work involves the following:

1. Preparing a brief project proposal including
 - a. Problem Identification
 - b. Literature Survey
 - c. System requirements and specification
 - d. Model Development and Design Methodologies
 - e. Time Line activities
2. A report highlighting the design finalization based on [functional requirements & standards (if any)].
3. A presentation including the following:
 - a. Implementation phase(Hardware/software/both)
 - b. Testing & Validation of the system
4. Consolidate report preparation.

Total P: 360

PROFESSIONAL ELECTIVES**20MXAA DESIGN PATTERNS****3 0 0 3**

INTRODUCTION TO PATTERNS: Reusable object oriented software – Motivation - Best design practices of object oriented software - Benefits of patterns – Definition – Types - Pattern description - How design patterns solve design problems - Pattern Language IDIOMS. (10)

DESIGN PATTERNS: Creational pattern: Abstract factory – Builder - Factory method – Prototype – Singleton, Structural patterns: Adapter – Bridge – Composite – Decorator – Façade – Flyweight - Proxy, Behavioral patterns: Command – Interpreter - Iterator, Mediator - Memento – Observer - State – Strategy - Template method – Visitor - Chain of Responsibility, Case Study (12)

ARCHITECTURAL PATTERNS: From Mud to Structure: Layers - Pipes and Filters - Blackboard, Interactive Systems: Model View Controller (MVC), Case studies. (10)

CODE REFACTORING: What is refactoring - Principles in refactoring - Bad smells in code - Composing methods - Moving features between objects - Organizing data - Simplifying conditional expressions - Making method calls simpler - Dealing with generalization. (13)

Total L : 45**REFERENCES:**

1. Erich Gamma, Richard Helm, Ralph Johnsons and John Vlissides, "Design Patterns: Elements of Reusable Object Oriented Software", Pearson Education, New Delhi, 2015.
2. Frank Buschman, Regine Meunier, Hans Rohnert, Peter Sommerlad and Michael Stal, "Pattern-Oriented Software Architecture: A System of Patterns" Volume 1, Wiley, New Delhi, 2008.
3. Martin Fowler, Kent Beck, William Opdyke, Don Roberts, "Refactoring: Improving the Design of Existing Code", Addison Wesley, Massachusetts, 2011.
4. Alan Shalloway, James R.Trott, Design Patterns Explained: A New Perspective on Object Oriented Design, 2nd Edition ,2007

20MXAB SOFTWARE PROJECT MANAGEMENT**3 0 0 3**

INTRODUCTION: Software Projects various other types of projects - Problems with software projects - an overview of project planning - Project evaluation - Project Analysis and technical planning - Project estimates - Preparation of Estimates - COCOMO model - Function Point Analysis - Putnam Model - Non-development overheads. (12)

ACTIVITY PLANNING: Project schedules - Sequencing and scheduling projects - Network planning models - Shortening project duration - Identifying critical activities. (11)

RISK MANAGEMENT: Identifying and managing risks - Risk analysis - Risk planning and control. **RESOURCE ALLOCATION:** Identifying of resource requirements-scheduling of resources- publishing the resource schedule. **MONITORING AND CONTROL:** Visualization project progress – Earned value analysis – Change control. **MANAGING PEOPLE AND ORGANIZING TEAMS:** Understanding behavior – selecting right people for the job – Motivational models – working in groups – Leadership. (12)

SOFTWARE QUALITY: Quality and the quality system - standards and procedures - Technical activities – Component - Continuous Improvement - Software Tasks - Management responsibility - Quality System - Contract Review - Document Control - Product identification and trace ability. **CASE STUDY:** Using Project management tools. (10)

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1. Mike Cotterell and Bob Hughes, "Software Project Management", 5th Edition, Tata McGraw-Hill, 2011.
2. Robert K Wysocki, Robert Beck Jr and David B Crane, "Effective Project Management , Traditional, Agile, Extreme", 7th Edition, John Wiley& Sons Inc, 2011.
3. Roger PressmanS, "Software Engineering - A Practitioner's Approach", 7th Edition, Tata McGraw-Hill Book Company, 2010.
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20MXAC SECURITY IN COMPUTING**3 0 0 3**

SYMMETRIC KEY ENCRYPTION: Security Goals – Security Services- Security Attacks-Cryptographic tools - Classical Cryptosystem (Substitution and Transposition ciphers)- Stream ciphers – Block ciphers –Modes of Operation- Data Encryption Standard (DES) – Linear and Differential Cryptanalysis - Advanced Encryption Standard(AES) - RC4 (12)

ASYMMETRIC KEY ENCRYPTION ALGORITHMS: Public-key encryption Model (Secrecy & Authentication) - RSA – ElGamal Cryptosystem- Elliptic Curve Cryptosystem (ECC) -Security of RSA – The Integer Factorization Problem - Pollard's rho factoring algorithm – The Discrete Logarithm Problem: Baby-step giant- step algorithm (11)

KEY GENERATION AND DIGITAL SIGNATURES: Random Key Generation - Manual Key distribution – Key distribution centers – Diffie–Hellmann Key Exchange -Randomness - ANSI X9.17 generator - Linear Feedback Shift Registrars (LFSR)- Message Digest Algorithm (MD5)- General Structure of Hash function – Secure Hash Algorithm (SHA – 1) – Digital Signature Algorithm (DSA) (11)

NETWORK AND SYSTEM SECURITY: Application Layer Security :E- Mail Security- Pretty Good Privacy (PGP) –Transport Layer security : Transport and Tunnel Modes – Secure Sockets Layer (SSL) Architecture and Protocol - IP Security- IP Sec-modes. Intruders and Intrusion – Viruses and Worms – Firewalls – Design Principles – Packet Filtering – Application gateways. (11)

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1. Behrouz A Fououzan, "Cryptography & Network Security", Tata McGraw Hill, 2007.
2. William Stallings, "Cryptography and Network Security – Principles and Practice", Pearson Educational, 2013.
3. Josef Pieprzyk, Thomas Hardjono and Jennifer Sebery, "Fundamentals of Computer Security", Springer, 2002.
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20MXAD ADVANCED DATABASE TECHNOLOGY**3 0 0 3**

QUERY AND TRANSACTION PROCESSING : Data Storage and Querying : Storage and File Structure - Indexing and Hashing – Physical Database Design and Tuning - Query Processing Algorithms – Query Optimization Techniques – Transaction Management: Transaction Processing Concepts – Concurrency Control – Recovery Techniques – Database Security. (12)

DISTRIBUTED DATABASES: Parallel Databases – Inter and Intra Query Parallelism – Distributed Database Features – Distributed Database Architecture – Fragmentation – Distributed Query Processing – Distributed Transactions Processing – Concurrency Control – Recovery – Commit Protocols. (11)

ADVANCED DATA MODELS: OBJECT DATABASES : Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects. Active Database: Concepts and Triggers – Temporal Databases – Spatial Databases – XML and Web Databases. (11)

EMERGING SYSTEMS:

Enhanced Data Models - Client/Server Model - Mobile Databases- -NoSQL models:.JSON- Document databases (11)

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1. Thomas Connolly and CarlolynBegg, "Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education 2003.
2. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems",Seventh Edition, Pearson Education, 2016.
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4. Steven Keller , "JSON Book: Easy Learning of JavaScript Standard Object Notation", CreateSpace Independent Publishing Platform, 2016.
5. Dan Sullivan, "NoSQL for Mere Mortals", Pearson Education Inc, 2015

20MXAE COMPUTER GRAPHICS**3 0 0 3**

INTRODUCTION:Overview of Graphics Systems - Raster Scan Displays - Random Scan Displays –Graphics Input and Output Devices – Graphics software and standards – **OUTPUT PRIMITIVES:** Points and lines, Line drawing algorithms,

Mid-point circle and ellipse algorithms. **FILLED AREA PRIMITIVES:** Scan line polygon fill algorithm, Boundary-fill and flood-fill algorithms. (11)

TWO DIMENSIONAL GRAPHICS: Basic transformations - Matrix representation and homogeneous coordinates - Composite transformations - **2D VIEWING:**The viewing pipeline, Viewing coordinate reference frame, Window to view-port coordinate transformation, Viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland – Hodgeman polygon clipping algorithm. (11)

CURVES AND SURFACES:Parametric representation of curves - Bezier curves - B-Spline curves - Parametric representation of surfaces - Bezier surfaces - Curved surfaces - Ruled surfaces - Quadric surfaces. **THREE DIMENSIONAL GRAPHICS:** 3D transformations - Viewing 3D graphical data - Orthographic, oblique, perspective projections - Hidden lines and hidden surface removal. (12)

ANIMATION GRAPHICS:Design of animation sequences - Animation functions - Raster animation - Key frame systems - Motion specification - Morphing - Tweening.**COMPUTER GRAPHICS REALISM:** Tiling the plane - Recursively defined curves - Koch curves - C curves - Dragons - Space filling curves - Fractals - Grammar based models - Turtle graphics - Ray tracing. (11)

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1. Donald Hearn and Pauline Baker M, "Computer Graphics with open GL", Pearson Education, 2013.
2. Foley James D., VandamAndries and Hughes John F., "Computer Graphics : Principles and Practice", Pearson Education, 2013.
3. Gonalez R.C and Woods R.E, "Digital Image Processing", Pearson Education, 2009.
4. Roy. A. Plastock and Gordon Kalley, "Theory and Problems of Computer Graphics", Schaum'sOutline Series, McGraw Hill, 2000.

20MXAF EVOLUTIONARY COMPUTING

3 0 0 3

INTRODUCTION: Historical development – Features– Classification and COMPONENT – Advantages – Applications.

EVOLUTIONARY ALGORITHM: COMPONENT of Evolutionary Algorithms (EA) - Working principle of EA, Applications: N-Queens problem - Knapsack problem - Introduction to different branches of evolutionary computation: Genetic algorithm - Evolutionary programming - Evolutionary strategies - Genetic programming. (11)

EVOLUTIONARY COMBINATORIAL OPTIMIZATION: Local search: Simulated annealing - Tabu search, Hybrid algorithm: Lamarckian evolution - Memetic algorithms, Application: Knapsack problem - Minimum spanning tree problem - Travelling Salesman Problem(TSP). (11)

ANT COLONY OPTIMIZATION: Ant foraging behavior - Theoretical considerations – Convergence proofs – ACO Algorithm – ACO and model based search – Variations of ACO: Elitist Ant System (EAS), MinMax Ant System (MMAS) and Rank Based Ant Colony System (RANKAS). (11)

PARTICLE SWARM OPTIMIZATION: Principles of bird flocking and fish schooling – Evolution of PSO – Operating principles – PSO Algorithm – Neighborhood Topologies – Convergence criteria – Variations of PSO: Binary, weighted, repulsive, combined effect PSO and clonal PSO. **ARTIFICIAL BEE COLONY (ABC) OPTIMIZATION:** Behavior of real bees, ABC algorithm- variations of ABC: ABCgbest and ABCgbestdist. (12)

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2. Marco Dorigo and Thomas Stutzle, "Ant Colony optimization", Prentice Hall of India, New Delhi 2005.
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4. Frank Neumann and Carsten Witt, "Bio-inspired Computation in Combinatorial Optimization", Springer, New York, 2010.
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20MXBA COMPUTER NETWORKS

3 0 0 3

Internetworking: Interconnecting devices: repeaters, hubs, switches, routers, Gateways – IP Addressing – Ipv4 Addressing – Classless IP addressing –Subnetting – Supernetting - Address Translation –Host Configuration –Error Reporting -Routing in Internet -Intra-domain routing: DVR, LSR –Inter-domain Routing: Path vector routing –Features of RIP, OSPF, BGP -IPv6 – Multicasting –SDN (12)

End-to-End Protocols: Transport Services –Connection oriented, Reliable service, Flow and Error control –UDP -TCP: Connection establishment, Connection Termination, Data Transfer -Issues in resource allocation –Queueing disciplines –TCP Congestion Control –Congestion Avoidance mechanism. (11)

Internet Applications: HTTP –FTP -SMTP -Infrastructure Services –Name Services, Network Management services –RTTP – VOIP -Overlay Networks –Routing overlays, Peer-to-peer networks, Content Distribution Networks. Case study: NS1, NS2. (11)

Network Infrastructure:Organizational policies, IT infrastructure services, user and hardware provisioning - Server operating systems – Virtualization - Network services - DNS for web services - Troubleshoot network services - Configure email services, security services, file services, print services, and platform services. (11)

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1. Behrouz A. Forouzan, "Data Communications and Networking" -McGraw Hill Education, 4thedition , 2017
2. Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", Pearson Education India, 5thedition , 2013
3. Behrouz A. Forouzan, "TCP/IP Protocol Suite ", McGraw Hill Education, 4thEdition, 2017
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5. William Stallings, "Data and Computer Communications", Prentice Hall, 2014.

20MXBB DATA MINING AND ANALYTICS

3 0 0 3

DATA MINING: Motivation - Steps in Data Mining – Architecture - Data Mining and Databases – Data Warehouses – Data Mining functionalities – Classification – Data Mining primitives – Major issues. **DESCRIPTIVE ANALYTICS:** Descriptive data summarization–Types of measurement scales–Measures of central tendency- Measures of Variance – Data Visualization-Data cleaning – Data integration and transformation – Data reduction – Data discretization and concept hierarchy generation. (12)

CLUSTER ANALYSIS: Types of data – Categorization of clustering methods – Partitioning Methods: k means and k Medoids – Hierarchical Methods: Agglomerative and Divisive hierarchical clustering- Outlier analysis. **CLASSIFICATION:** Issues regarding classification – Classification by Decision Tree induction – Bayesian Classification – Rule based classification –Classifier accuracy measures – evaluating the accuracy of a classifier. (14)

PREDICTIVE ANALYTICS: Issues regarding prediction – comparison of classification and prediction – linear regression – applications to real world problems – predictor error measures – Evaluating the accuracy of predictors. **PRESCRIPTIVE ANALYTICS:** Trend analysis –regression analysis – moving average methods – time series forecasting – similarity search. (10)

MINING FREQUENT PATTERNS, ASSOCIATIONS AND CORRELATIONS: Market basket analysis - Frequent itemsets, Association rules – frequent pattern mining – mining various kinds of Association rules – The Apriori Algorithm – Generating association rules from frequent itemsets. (9)

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2. U Dinesh Kumar, " Business Analytics : The Science of Data-Driven Decision Making", Wiley , 2018
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5. Arun K Pujari, "Data Mining Techniques", University Press, 2013.

20MXBC MACHINE LEARNING

3 0 0 3

INTRODUCTION: Machine learning-Examples of machine learning applications. **SUPERVISED LEARNING:** Learning a class from examples-VapnikChervonenkis dimension – Noise - Learning multiple classes - Regression- Dimensions of a supervised machine learning algorithm. **BAYESIAN DECISION THEORY:** Classification – losses and risks – Discriminant functions – Association rules. (10)

PARAMETRIC METHODS: Maximum likelihood estimation – Bias and Variance – Baye's estimator – Parametric classification-Regression. **DIMENSIONALITY REDUCTION:** Subset selection – Principal component Analysis – Feature embedding – Factor Analysis. **CLUSTERING:** Mixture densities – k-Means clustering – Supervised learning after clustering- Hierarchical clustering. (12)

NON PARAMETRIC METHODS: Non parametric density estimation – non parametric classification- Distance based classification – Outlier detection. **DECISION TREES:** Univariate trees – Pruning – Learning rules from data. **MULTILAYER PERCEPTRON:** Understanding the brain - Perceptron –Training - Learning Boolean functions-Multilayer perceptrons- Universal approximator- Back propagation algorithms - Training. (11)

HIDDEN MARKOV MODELS: Discrete Markov processes – Hidden Markov Models (HMM) –Evaluation problem –Finding the state sequence–Learning model parameters – HMM as a graphical model. **DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS:** Factors, response and strategy of experimentation – randomization, replication and blocking – cross validation and resampling methods- Measuring classifier performance –internal estimation –Hypothesis testing – Comparing two classification algorithms. (12)

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2. Tom Mitchell, “Machine Learning” , McGraw Hill, 1997.
3. Peter Flach , “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, Cambridge Press, South Asia Edition, 2015
4. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2011.

20MXBD INTERNET OF THINGS

3 0 0 3

BASICS OF IOT:Introduction to Internet of Things (IoT) – Machine to Machine (M2M) — Features and Definition of IoT– Recent Trends in the Adoption of IoT – Societal Benefits-IoT Enabling Technologies – IPv6 - Basic Architecture - Components of IoT: Embedded Computation Units, Microcontrollers, System on Chip (SoCs) - Sensors – Actuators – Communication Interfaces. (11)

PROTOCOLS OF IOT:Low Power Personal Area networks (LowPAN): Overview, 6LowPAN, IEEE 802.15.4, BLE, Zigbee, Zwave, and Thread - Wi-Fi - Low Power Wide Area Networks (LPWAN): Concepts and features, SigFox, LoraWAN, LPWAN-3GPP, Comparing different LPWAN technologies:- Rest Architecture - HTTP – CoAP: Architecture, Features, Applications - MQTT: Architecture, Feature, Applications - Comparing different IoT Application Layer protocols. (11)

MODERN NETWORKING:Web of Things versus Internet of Things –Two Pillars of the Web –Architecture Standardization for WoT-**CLOUD COMPUTING:** Introduction to the Cloud Computing, Cloud service options, Cloud Deployment models, Load balancing, Hypervisors, Comparison of Cloud providers - Software Defined Networking(SDN): Overview, Architecture, Rule placement, OpenFlow Protocol, Relevance of SDN to IoT (12)

PROTOTYPINGAND APPLICATIONS IN IoT: Prototyping embedded devices - Open Source versus Closed Source - Embedded Computing Basics - Arduino - Raspberry Pi - Implementation.Smart homes – Energy – Health Care – Smart Transportation – Smart Living – Smart Cities- Smart Grid – Smart Agriculture. (11)

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3. Jim Doherty, “SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization”, Addison-Wesley, 2016
4. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley and Sons Ltd, UK, 2014.
5. William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud” Addison-Wesley, 2015
6. Arduino Projects for Engineers Paperback ,NeerparajRai,BPB Publishers, 2016

20MXBE WIRELESS NETWORKS

3 0 0 3

WIRELESS FUNDAMENTALS AND TECHNOLOGIES : Introduction to cellular networks,-wireless local area networks-Spectrum allocations – Radio propagation models-Narrowband digital modulation and wireless fading environments. – Modern Communications Systems – MAC – SDMA – TDMA – FDMA - CDMA - Cellular and Ad-hoc-Concepts. **WLAN TECHNOLOGIES:** wireless network architectures – 802.11 PHYs - 1 MAC – WPA and WEP- 802.11i: Security – 802.11e: MAC Enhancements for Quality of Service – Related Wireless Standards (Hyperlan, HomeRF, Bluetooth, Zigbee, Wireless USB)- WiFi and Wi MAX Standards. (11)

WIRELESS PANs MANs – Physical and MAC layer details, Wireless PANs – Architecture of Bluetooth Systems, Physical and MAC layer details, Standards-WLAN deployment issues- Interference – Resource Allocation..**AD HOC AND SENSOR NETWORKS:** Ad hoc Network- Characteristics- Table-driven and Source-initiated On Demand routing protocols, Hybrid protocols - Routing in intermittently connected mobile networks. Wireless Sensor networks- Classification, MAC and Routing Protocols. (12)

MOBILE NETWORK AND TRANSPORT LAYERS: Mobile IP – Dynamic Host Configuration Protocol-Mobile Ad Hoc Routing Protocols–Multicast routing-TCP over Wireless Networks – Indirect TCP – Snooping TCP – MobileTCP – Fast Retransmit / Fast Recovery – Transmission/Timeout Freezing-Selective Retransmission – Transaction Oriented TCP- TCP over 2.5 / 3G wireless Networks. (12)

FUTURE TRENDS: Emerging WLAN Related Technologies – 802.11 Trends – Cellular – 802.16 – 802.20 – 802.22 – UWB, Cognitive Radios, RFID – 4G and Communications Convergence. (10)

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20MXBF DEEP LEARNING

3 0 0 3

Introduction: Motivation for deep learning - **Machine learning Basics** - From machine learning to deep learning- Logistic regression- gradient descent-**Introduction to neural networks:** input units-output units-hidden units-cost functions-hypotheses and tasks- training data - maximum likelihood based cost - cross entropy - MSE cost- feed-forward networks- MLP - sigmoid units- . Learning in neural networks: output vs hidden layers; linear vs nonlinear networks. Implementing neural nets (12)

Backpropagation :Back propagation neural nets;Learning via gradient descent- recursive chain rule - bias-variance tradeoff – **Regularizationand output units:** linear- softmax - RELU; (10)

Deep Learning Methods: Linear Factor Models - Auto encoders - De-noising Autoencoders- Stacked Autoencoders- Monte Carlo methods – Hylorid Monte Method - - Deep Generative Models- **Convolutional neural networks:** Motivation –pooling-dropout-Variants of CNN-implementation of CNN (12)

Sequence modeling:Recurrent and Recursive nets- Recurrent Neural Networks- Bidirectional RNNs-Encoder-Decoder Sequence-to-Sequence Architectures - Implementation of RNNs (11)

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5. N D Lewis, "Deep Learning made easy with R: A Gentle Introduction for Data Science", 2016

20MXBG MULTIDIMENSIONAL DATA STRUCTURES

3 0 0 3

MULTIDIMENSIONAL POINT DATA: Range Trees -Priority Search Trees-Quadrees: Point Quadrees-Trie-Based Quadrees-MX Quadtree-PR Quadrees -K-d Trees: Point K-d Trees -Trie-Based K-d Trees-PR K-d Tree-R Trees-Bucket Methods-Hybrid Tree. (12)

BOUNDARY-BASED REPRESENTATIONS: Image-Based: Line Quadtree-Edge Quadtree-Sector Tree-Cone Tree . Object-Based: Strip Tree-Prism Tree-HAL Tree. (11)

HIGH-DIMENSIONAL DATA : Multidimensional Indexing Methods .- X-Tree-Sphere Tree-OS Tree-Distance-Based Indexing Methods: M-Tree, Sa-Tree. (11)

AUDIO AND VIDEO DATA: Frame Segment Tree-R-Segment Tree-Video Segmentation-model of audio data-meta data to represent audio content-capturing audio content-indexing audio data- TV trees. (11)

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1. Hanen Samet, "Foundations of Multidimensional and Metric Data Structures", Morgan Kaufman, USA, 2001
2. Subrahmanian V S, "Principles of Multimedia Database Systems", Morgan Kaufman, USA, 2001.

18MXBH OPEN SOURCE SYSTEMS

3 0 0 3

PRINCIPLES OF OPEN SOURCE: Introduction to Open Source Systems (OSS) - The Philosophy of OSS - The Cathedral and Bazaar Model - Commercial Software and OSS - Free Software and Freeware – Open Source Licensing - Copyright vs Copyleft – Bug Fixing - Software patenting and violations. (11)

OPEN SOURCE LANGUAGES: Basics – Client-side scripting, Server-side scripting, Open Source middleware system, Data types – Operators – Statements – Functions – Arrays – OOP – String Manipulation and regular expression – File handling and data storage – PHP and SQL database – PHP and LDAP – PHP Connectivity – Sending and Receiving E-mails - Debugging and error handling – Security – Templates. Case Study: Python.. (12)

OPEN SOURCE DATABASES: NoSQL Databases – Types - Documents Database – MongoDB - CRUD operations – Two phase commit - Data models – Aggregation – Indexes - Mongo shell – Query operators – Replication. Case Study: Column and Graph based databases. (11)

OPEN SOURCE SOFTWARE TOOLS: IDEs (Eclipse) - Model Driven Architecture tools (OpenXava)– Software Testing IDE (Selenium) – Version control system (Git) – Content Management System (Joomla) - Web server (Apache) – Framework (Rails, Bootstrap). (11)

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2. Kristina Chodorow and Michael Dirolf, "MongoDB: The Definitive Guide", O'Reilly, 2010.
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5. Bruce A Tate and Curt Hibbs, "Ruby on Rails: Up and Running", O'Reilly Media, 2008.
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20MXBI UBIQUITOUS AND PERVASIVE COMPUTING

3 0 0 3

INTRODUCTION:Model ubiquitous & pervasive computing system to everywhere computing-applications of ubiquitous & pervasive computing: Healthcare, Tracking, emergency information systems, home networking appliances and entertainment. Emerging trends in Pervasive /Ubiquitous / Invisible Computing - Device Technology - Internet of Things paradigm - role of RFID tags. **WIRELESS CONNECTIVITY:** Connecting the world – wireless internet access technologies - Mobile internet protocols - short-range and wide-range, Wireless data networks - Pervasive networks. (10)

UBIQUITOUS&PERVASIVE APPLICATION DEVELOPMENT: Design and implement interfaces - middleware technique - Web application development - Wireless Markup Language -Push and pull services- Pervasive Application-Design & Implementation of real-time embedded smart systems of relevance - Developing mobile applications – presentation transcoding – device independent view component. (12)

CONTEXT AWARE SYSTEMS:Fundamentals of Context aware computing - Mobility awareness -Spatial awareness - Temporal awareness - ICT system awareness - Autonomous systems - Reflective and self-aware systems - Self management and autonomic computing - Context modeling languages. **LOCATION CONTEXT:**Mobile/cellular network - location modeling - location management -Architectures and Protocols for Location Services-Mobile location protocol-Location framework-Location API– *Open Geospatial Consortium* location Services. (11)

LOCATION BASED SERVICES: Location Based Services – Location Relatedness and Query Model - Location Dependent Data – Location Aware Queries – Location Dependent Queries – Moving Object Database Queries – Query Classification – Query Translation Steps in LDQ Processing - introduction to Voronoi diagram, Voronoi index structure for modeling location dependent information system. **CASE STUDIES:**Ubiquitous and pervasive computing systems to identify their strengths, limitations and the future directions: smart home, smart healthcare, smart traffic. LBS Applications and Services case study: Development of the Yellow pages search, m-tourism- Find friend application- L-Commerce - Navigation Systems: A Spatial Database Perspective. Current trends in the area of data management in ubiquitous and pervasive environments. (12)

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2. Adelstein F And Gupta S K S, "Fundamentals Of Mobile And Pervasive Computing", Tata Mcgraw Hill, 2012.
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6. Mohammad S. Obaidat, Mieso Denko, Isaac Woungang, "Pervasive Computing And Networking", Wiley, 2016

20MXBJ HUMAN COMPUTER INTERACTION**3 0 0 3**

Introduction: The importance of User Interface – Characteristics of UI – Guidelines, Principles and Theories - Universal Usability - **Design and evaluation in the real world:** Designing for the desktop – Mobile and other devices – The Web . (12)

Design Processes: Understanding and conceptualizing interaction -Conceptual Model / Framework – Modeling Users: Personas and Goals– Setting the Vision: Scenarios and Design Requirements- Evaluation and the User Experience –Design Case Studies (10)

Interaction Process: The process of interaction design– Lifecycle Models - User Centric Approach-Direct Manipulation and Immersive Environments - Expressive Human and Command Languages – Devices - Communication and Collaboration (12)

Prototyping and Evaluation:Prototyping and construction – Wireframes – Low-fidelity prototyping – High-fidelity prototyping – Tool support – Introducing Evaluation - What, why and when to Evaluate – Evaluation framework - **D E C I D E:** A framework to guide evaluation – Pilot studies - Future Interfaces and Grand Challenges. (11)

Total L:45**REFERENCES:**

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven M. Jacobs – “Designing the User Interface – Strategies for Effective Human Computer Interaction”, Pearson , 6th Edition, 2016.
2. Wilbert O. Galitz – “The Essential Guide to User Interface Design “, Wiley, 2nd Edition, 2015.
3. Jeff Johnson – “Designing with the mind in mind”, Morgan Kaufmann,2nd edition, 2014.
4. Interaction Design: Beyond Human-Computer Interaction, Fourth Edition by Preece, Sharp & Rogers, 2015.
5. About Face: The Essentials of Interaction Design, Fourth Edition by Cooper, Reimann, Cronin, &Noessel, 2014.

20MXBK SOFT COMPUTING**3 0 0 3**

INTRODUCTION: Artificial Intelligence systems –Fuzzy systems – Neural networks – Evolutionary Computation. **NEURAL NETWORKS:**Basic concepts – model of an artificial neuron- Neural network architectures –learning methods –Perceptron-Back propagation networks – Associative Memory- Extreme learning machine – Applications to real world problems. (11)

FUZZY SYSTEMS: Fuzzy sets - Membership functions – Basic fuzzy operations- Fuzzy relations - operations on fuzzy relations – Fuzzy logic - Fuzzy rule based systems - Defuzzification - Graphical inference method – Applications to real world problems. (12)

EVOLUTIONARY COMPUTATION: Fundamentals. **GENETIC ALGORITHMS:** encoding methods – fitness function – reproduction methods - Genetic inheritance operators - Cross over operators - Mutation –Working principle. **EVOLUTION STRATEGIES:** ($\mu + \lambda$) Evolution strategy- ($\mu\lambda$) Evolution Strategy. **DIFFERENTIAL EVOLUTION:** fundamentals –operations – strategies – Applications to real world problems. (11)

HYBRID SYTEMS: Integration of neural networks, fuzzy systems and evolutionary algorithms - Fuzzy Backpropagation neural network – architecture – learning algorithm- Evolutionary extreme learning machine- architecture – learning algorithm - Applications to real world problems. (11)

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20MXBL SOCIAL NETWORKING AND WEB MINING**3 0 0 3**

INTRODUCTION: Data mining and web mining – web community and social network analysis – Evolution of social networks – Basic concept in social networks. **SOCIAL NETWORK DATA AND REPRESENTATION:** Structural – composition - affiliation variables-modes-boundary specification and sampling- type of networks- measurement and collection – Notation for social network data - Review of graph theory - Data set- Tools - Pajek, Netdraw, UCInet. (12)

STRUCTURAL PROPERTIES OF SOCIAL NETWORKS: Notions of centrality, cohesiveness of subgroups, roles and positions, block models - Information diffusion – power law. (11)

WEB MINING: Web crawler – types of web crawler - Web search – Characteristic of Web data – types of web mining, **WEB CONTENT MINING:** Web Content Mining: Vector Space Model, Web Search, Personalized Web Search. (11)

WEB LINKAGE MINING: Hyperlinks- co-citation and bibliographic coupling- page rank and HITS algorithm – web community discovery. (11)

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REFERENCES:

1. Guandongxu and Yanchunzhang, "Web mining and social networking: Techniques and applications", Springer Science and Business Media, 2011.
2. Bing Liu, "Web Data Mining Exploring Hyperlinks, Contents, and Usage Data", Springer, 2011.
3. Stanley Wasserman and Katherine Faust, "Social network analysis: methods and applications", Cambridge University Press, 2012.
4. Anthony Bonato, "A Course on Web Graphs", American Mathematical Society, 2008.

20MXBM MULTI-CORE PROGRAMMING

3 0 0 3

MULTI-CORE PROCESSORS : Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks – Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance Issues – Parallel program design. (11)

PARALLEL PROGRAM CHALLENGES: Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes). (12)

SHARED MEMORY PROGRAMMING WITH OpenMP: OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations. (11)

DISTRIBUTED MEMORY PROGRAMMING WITH MPI : MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation. (11)

Total L:45

REFERENCES:

1. Herlihy M and Shavit N, "The Art of Multiprocessor Programming", Morgan Kaufmann, 2008.
2. Kirk D B and Hwu W W, "Programming Massively Parallel processors: A Hands-on approach", Morgan Kaufmann, 2010.
3. Huges C and Huges T, "Professional Multi-core programming: Design and Implementation for C++ developers", Wrox, 2008.

20MXCA ENTREPRENEURSHIP

3 0 0 3

INTRODUCTION TO ENTREPRENEURSHIP: Definition – Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs – Importance of Entrepreneurship. **CREATIVITY AND INNOVATION:** The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. (11)

FORMS OF BUSINESS ORGANIZATION: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. **DEVELOPING AN EFFECTIVE BUSINESS MODEL:** The Importance of a Business Model – Starting a small scale industry - Components of an Effective Business Model. (12)

APPRAISAL OF PROJECTS: Importance of Evaluating various options and future investments – Entrepreneurship incentives and subsidies – Appraisal techniques. **FINANCING THE NEW VENTURE:** Determining Financial Needs – Sources of Financing – Equity and Debt Funding – Case studies in Evaluating Financial Performance. (12)

THE MARKETING FUNCTION: Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. **INTELLECTUAL PROPERTY PROTECTION AND ETHICS:** Patents – copyright – Trademark – Geographical indications – Ethical and social responsibility and challenges. (10)

Total L : 45

REFERENCES:

1. Donald F.Kuratko and Richard M.Hodgetts, "Entrepreneurship", South-Western, 2007.

2. Vasant Desai, The Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, 2010.
3. Gupta S. L., Arun Mittal, "Entrepreneurship Development", International Book House, 2012.
4. Sudha G. S., "Management and Entrepreneurship Development", Indus Valley Publication, 2009.
5. Badi. V., Badi N. V., "Business Ethics", Vrinda Publication, 2012.
6. Prasanna Chandra, "Projects – Planning, Analysis, Financing, Implementation and review", Tata McGraw Hill, 2012.

20MXCB PRINCIPLES OF MANAGEMENT AND BEHAVIOURAL SCIENCES

3 0 0 3

PRINCIPLES OF MANAGEMENT: Definition and significance of management - functions of Management - society and environment, social responsibility of organizations. **BUSINESS ORGANISATION:** Forms of business Organizations and Resource Mobilization - internal and external sources of resources. (11)

GLOBALISATION: Evolving paradigm for the new Economic Era issues for global competitiveness, and proactive forces of globalization - Importance and functions of Marketing, Advertisement and sales promotion activities. **MATERIALS MANAGEMENT:** Importance and scope of materials management - Inventory control and its systems - ROL, EOQ, ABC Analysis, MRP, VED, FSN and value analysis. (12)

PROJECT MANAGEMENT: Definition and Objectives of Project Management - Phases in Project Management cycle - Project appraisal. **HUMAN RESOURCE MANAGEMENT:** Importance objectives and its functions, Motivation - Frustration - Conflict Management - Theories of Motivation - Stress Management. Leadership - Theories - Functions - Models. Human Resources development. (11)

GROUP BEHAVIOUR: Group dynamics, conformity, Sociometry and group cohesiveness leadership - Group Dynamics Informal Organization- sociometry- cohesiveness-Interaction analysis **WELFARE INDUSTRY:** Working Condition, service facilities and safety industries. (11)

Total L : 45

REFERENCES:

1. Clifford F. Gray, Erik W. Larson, Gawtam V. Desai, "Project Management : The Managerial Process", McGraw Hill, 2014
2. Hahold Koontz and O'Donnel, "Essentials of Management", McGraw Hill, 2015.
3. Leap H and Cnino M D, "Personnel Human Resource Management" Macmillan Publishing Co., 1999.
4. ArunMonappa and Mirza Saiyadain S, "Personnel Management", McGraw Hill, 2001.

20MXCC PROBABILITY AND STATISTICS

3 0 0 3

INTRODUCTION: Graphical presentation of data – scatter plots – frequency distribution – histograms – box plots – measures of central tendency – measures of dispersion – grouped data. **PROBABILITY:** Review of sets – experiments and sample spaces – events – probability definition – finite sample spaces and enumeration – conditional probability – partitions, total probability – Baye's theorem. (13)

RANDOM VARIABLES: Distribution function – discrete, continuous random variables – equivalent events – functions of discrete and continuous random variables – expectation – moment generating functions. **JOINT PROBABILITY DISTRIBUTIONS:** Joint distribution for two dimensional random variables - marginal distributions – conditional distributions – conditional expectation – regression of the mean – Independence of random variables - covariance and correlation - distribution function for two dimensional random variables. **DISCRETE AND CONTINUOUS DISTRIBUTIONS:** Bernoulli trials and Bernoulli distribution – Binomial distribution – Poisson distribution – Normal distribution – central limit theorem - Normal approximation to the Binomial distribution – Applications. (11)

LINEAR REGRESSION AND CORRELATION: Simple linear regression – prediction of new observations – Correlation. **TESTS OF HYPOTHESES:** Statistical hypotheses – Type I and Type II errors – one sided and two sided hypotheses- Tests of hypotheses on a single sample – Tests of hypotheses on two samples – Testing for goodness of fit. (10)

TIME SERIES ANALYSIS: Examples of time series – time series plots – nature and uses of forecasts – measuring forecast errors – measurement of trends – moving average method – method of least squares. **STATISTICAL QUALITY CONTROL:** Quality improvement and statistics – control charts – control charts for measurements – control charts for individual measurements – control charts for attributes – real world applications. (11)

Total : 45

REFERENCES:

1. William W Hines, Douglas C Montgomery, David M Goldsman and Connie M Borrer, "Probability and Statistics in Engineering", John Wiley, 2008.
2. Douglas C Montgomery and George C Runger, "Applied Statistics and Probability for Engineers", John Wiley, 2010.

3. Ronald E Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, "Probability & Statistics for Engineers & Scientists", Pearson Education, 2016.
4. Douglas C. Montgomery, Cheryl L. Jennings and Murat Kulahci, "Introduction to Time Series Analysis and Forecasting", John Wiley, 2015.

20MXCD OPTIMIZATION TECHNIQUES

3 0 0 3

INTRODUCTION: Statement of an optimization problem – classification of optimization problem – classical optimization techniques: Single variable optimization, Multi variable optimization, Equality constraints, Inequality constraints, No constraints. (10)

LINEAR PROGRAMMING: Mathematical formulation of LPP – Graphical method for two dimensional problems – central problems of Linear Programming – Definitions – Simplex – Algorithm – Phase I and Phase II of Simplex Method – Big M Method – Revised Simplex Method - Simplex Multipliers – Dual and Primal – Dual Simplex Method. Sensitivity Analysis. Programming with solvers. Karmarkar's method – statement, Conversion of the Linear Programming problem into the required form, Algorithm. Transportation problem and its solution – Assignment problem and its solution by Hungarian method. (13)

NON LINEAR PROGRAMMING – UNCONSTRAINED OPTIMIZATION: One dimensional minimization – Unimodal and Multimodal Function - Unrestricted search – Interval halving method – Fibonacci method. Multi-dimensional minimization – Univariate method – Pattern search method – Hooke and Jeeves method – Gradient of a function – Steepest descent method – Conjugate gradient method. Programming tools for solving NLP. (11)

NONTRADITIONAL OPTIMIZATION ALGORITHM: Genetic Algorithm – Working Principle – Comparison between GA and traditional method – GA operators – GA for constrained Optimization – Real coded GA. **DECISION MAKING:** Decisions under uncertainty, under certainty and under risk – Decision trees – Expected value of perfect information and imperfect information. (11)

Total L: 45

REFERENCES:

1. Kalyanmoy Deb, "Optimization for Engineering Design Algorithms and Examples", PHI Learning, 2014.
2. Singiresu S. Rao, "Engineering Optimization Theory and Practice", New Age International, 2013.
3. Hamdy A. Taha, "Operations Research – An Introduction", Pearson Education, 2014.
4. Hillier and Lieberman, "Introduction to Operations Research", Tata McGraw-Hill, 2011.
5. Kambo N. S., "Mathematical Programming Techniques", Affiliated East – West Press, 2012.

20MXCE NUMERICAL METHODS

3 0 0 3

SOLUTION OF ALGEBRIC SIMULTANEOUS EQUATIONS: Gauss – Jordan elimination, Cholesky method, Crout's method, Gauss – Jacobi method, Gauss – Seidel method. Matrix Inverse by Gauss – Jordan method. **EIGEN VALUES AND EIGEN VECTORS:** Power method of finding dominant eigen value and inverse power method for finding smallest eigen value, Jacobi method for symmetric matrices. (12)

FINITE DIFFERENCES AND INTERPOLATION: Finite difference operators- Interpolation-Newton-Gregory forward and backward Interpolation, Lagrange's Interpolation formula. Solution of linear second order difference equations constant coefficients. (12)

DIFFERENTIATION AND INTEGRATION: Numerical differentiation using Newton-Gregory forward and backward polynomials. Numerical integration-Gaussian quadrature, Trapezoidal rule and Simpson's one third rule. (10)

ORDINARY DIFFERENTIAL EQUATIONS: Taylor series method, Euler and Modified Euler method, (Heun's method), Runge-Kutta method, Milne's method, Adams-Moulton method, Solution of boundary value problems of second order by finite difference method. (11)

Total L : 45

REFERENCES:

1. Stevan C. Charpa and Raymond P. Canale, "Numerical Methods for Engineers with Software and programming Applications", Tata McGraw Hill, 2011.
2. Cuties F. Gerald and Patrick O. Whetly, "Applied Numerical Analysis", Pearson Education, 2011.
3. Yousef Saad, "Numerical methods for large eigen value problems", University Press, 2011.

18MXCF APPLIED GRAPH THEORY**3 0 0 3**

INTRODUCTION: Review on Definition and Basic Terminologies of Graphs – Representations of Graphs – Walks in Graphs and Digraphs- Subgraphs-Vertex Degrees - Path and Cycles - Regular and Bipartite Graphs- Incidence Matrices- Graph Traversals-Applications: Markov Chains- Four Cubes Problem- Social Networks. (10)

EULERIAN AND HAMILTONIAN GRAPHS: Exploring and Travelling – Eulerian Graphs – Hamiltonian Graphs – Applications: Dominoes – Chinese Postman Problem. **PATHS AND CONNECTIVITY:** Connected Graphs and Digraphs-Menger's Theorem for Graphs-Applications: Reliable Telecommunication Networks. (11)

PLANARITY: Planar Graphs – Euler's Formula-Cycle Method for Planarity Testing – Kuratowski's Theorem – Duality. **COLORINGS AND DECOMPOSITIONS:** Vertex Colorings – Edge Colorings – Algorithm for Vertex and Edge Colorings – Vertex Decomposition – Edge Decomposition. (13)

MATCHING AND FACTORS: Matching, Perfect matching, Tutte's 1-factor theorem, weighted Bipartite matching, Hall's theorem. **NETWORK FLOWS AND APPLICATIONS:** Flows and cuts in Networks, Maximum-flow problem, flows and connectivity– applications. (11)

Total L : 45**REFERENCES :**

1. Douglas B West, "Introduction to Graph Theory", Pearson Education, New Delhi, 2015.
2. Joan M Aldous and Robin J Wilson, "Graphs and Applications- An Introductory Approach", Springer-Verlag, New York, 2007.
3. Reinhard Diestel, "Graph Theory", Springer-Verlag, Berlin Heidelberg, 2017.
4. Haynes T W, Hedetniemi and Slater P J, "Fundamentals of Domination in Graphs", CRC Press 2015.
5. Jonathan Gross and Jay Yellen, "Graph Theory and its Applications", CRC Press, 2005.

ONE CREDIT COURSES**20XK01 DOMAIN SPECIFIC LANGUAGES****1 0 0 1**

Introduction: Domain Specific Language (DSL)- differences between a regular language and DSL. Usefulness and the power of DSL: Need for DSL - its power over the generic languages such as Java and C#. Real world examples of DSL: SQL: a language dedicated to access the data from relational databases XSLT: a language for transforming XML documents. (2)

Grammar Language: describing the "text" of a DSL - syntax of the DSL -A simple DSL - the problem statement: Move a graphical cursor across the screen, as per the program instructions. (2)

Defining the language: Extension from the XBase language - support to declare variables, define and call subroutines (like square) – accessing Java's Math.* functions - color constants. (2)

Integrating with the IDE: Creating and editing the grammar in Eclipse IDE. (2)

Runtime for the language in a Java VM. (2)

Hands on sessions in the Laboratory (10)

Total L: 15**REFERENCES:**

1. Xtext Framework <http://www.eclipse.org/xtext>
2. Grammar of XText <http://git.eclipse.org>
3. XBase language <http://www.wiki.org/xbase>
4. XText Documentation <http://www.eclipse.org/xtext>

20XK02 SOFTWARE TESTING – INDUSTRY PERSPECTIVES**1 0 0 1**

Testing Overview / Evolution of testing - Testing approaches; evolution of Software Development models, Various black box testing techniques, test design techniques, Software Testing in Industry, Testing throughout the Life cycle, Types of Software Testing, Test Concepts. (2)

Test Management- Application of Project Management with respect to Testing, Evolution of Test Management, Test Management in various Test cycles/phases. (2)

Test Design / Test Techniques- Various black-box test design techniques, All - pairs, Exploratory Testing - Functional testing and Non-Functional Testing : test concepts , strategies and types. Test driven development - Automation testing- Best Practices and Challenges. (3)

Testing of Enterprise applications- testing techniques/methodologies that are followed in end-to-end of the Enterprise applications, challenges faced. (2)

Testing Big Data (HANA)/Mobile applications - testing of applications run on HANA DB, testing of mobile applications, challenges faced. (1)

PROJECT (5)

Total L: 15**REFERENCES:**

1. Cem Kaner, Jack Falk, Hung Quoc Nguyen, " Testing Computer Software", Wiley publications, 1988.
2. William Perry, "Effective Methods for Software Testing", Wiley, New Delhi, 2009.
3. John Watkins, "Testing IT : An off the shelf Software Testing Process", Cambridge Press, Cambridge, 2010.

20XK03 OPERATING SYSTEM PERFORMANCE ASSESSMENT**1 0 0 1**

Workload Definition- Elements of OS Performance - CPU, I/O - Memory & Disk, Network- Elements of a performance test - Load, Stress, Endurance, Spike, Volume, Scalability, Throughput. (2)

In detail- CPU Performance - Memory Performance - Storage Performance - Network Performance. (2)

Typical Performance Parameters monitored - Performance Tools - Designing a real world Performance test. (2)

Some quick ways to check a system performance.	(2)
Comparison of a specific workload on Windows & Linux - Performance in a virtualized world - Distributed Systems & Performance.	(2)
Case Studies.	(5)

Total L: 15**REFERENCES:**

1. William Stallings, "Operating Systems: Internals and Design Principles", Prentice-Hall, 2011.
2. Silberschatz A, Galvin P and Gagne G, "Operating System Concepts" John Wiley, 2013.

20XK04 MULTI-CORE TECHNOLOGY**1 0 0 1**

Parallel Architecture and Terminology: Processor Technology Trends - Architecture Trends –Traditional Architectures – Transition to Multicore- Multicore Architectures.	(2)
Programming the Multicore- Programming – OS Interaction – Applications – Synchronization – Scheduling.	(6)
Programming Paradigms - Threading as a Parallel Programming Model – Virtual Environments.	(2)
PROJECT	(5)

Total L: 15**REFERENCES:**

1. Kirk D B and Hwu W W, "Programming Massively Parallel processors: A Hands-on approach", Morgan Kaufmann, 2010.
2. Jason Roberts, Shameem Akhter, "Multi-core Programming: Increasing Performance through Software Multithreading", BPB Publications, 2011.

20XK05 SKILLS FOR VIRTUAL TEAMS**1 0 0 1**

VIRTUAL TEAMS : Introduction to Geographically Distributed teams –Need –Difference between Virtual and physical teams - compositions- Advantages of virtual teams	(2)
ISSUES AND RISKS : Communication Issues- Temporal Issues- Cultural Issues – Challenges - Project risks .	(3)
TOOLS AND SOLUTIONS: Process changes, Tools - Planning , Tracking, Communication, Tool Issues	(2)
SKILLS: Building Trust – Goal Orientation - Cross-Team Leadership - Communication – Interaction/Bonding – Teaming - Adherence to Process – Effective Tool Skills - Motivation	(2)
CASE STUDIES: Different cases- Observation – Participation as team - Skill Building	(6)

Total L: 15**REFERENCES:**

1. Michael Abrams et. al , "Big Book of Virtual Teambuilding Games: Quick, Effective Activities to Build Communication, Trust and Collaboration from Anywhere! ", Big Book Series, McGraw-Hill Education; First edition.
2. Hassan Osman, "Influencing Virtual Teams: 17 Tactics That Get Things Done with Your Remote Employees" , 2016, Kindle, ISBN-13: 978-1530005147
3. Deborah L. Duarte, Nancy Tennant Snyder," Mastering Virtual Teams: Strategies, Tools, and Techniques That Succeed", Wiley, Third Edition,
4. Online resource: Virtual teams : A new way to work - <http://dx.doi.org/10.1108/eb054625> .

20XK06 SOFTWARE CONFIGURATION MANAGEMENT AND CONTINUOUS DELIVERY**1 0 0 1**

Software Configuration Management (SCM): Components of Software Configuration Management Plan – Process of identifying, maintaining, controlling and baselining configuration items – case study from one of the live projects – tool set to assist SCM – Lab exercise on creating SCM plan for the project and set up the Development Environment. (2.5)

Version Control Systems (VCS): Importance of controlling versions – life cycle / state of a configuration items – Role of coding standards and coding style – Product semantic versioning – Branching & Merging – case study from one of the live projects – Lab exercise using git – Role of Backups – Conducting configuration audit . (2.5)

Build and Unit Test Automation: Build life cycle – Build automation tools (Maven or Gradle or Webpack) – automate code review, unit test, code quality reports as part of build automation. (2)

Continuously Integrate (CI) and Integration Test Automation: Scope and advantages of Continuous Integration – Introducing complete toolset involved in CI – Case study from a live project – Lab exercise using Jenkins as CI, Selenium / Protractor as Integration Test Automation (2)

Continuous Deployment and Deployment Automation: Importance of Continuous Deployment – Setting up deployment environment in AWS instance – Automate application deployment using Docker and / or Ansible – Continuous monitoring or health check. (2)

PROJECT: Given a simple use case, define and implement the complete Software Configuration Management process along with Continuous Delivery leveraging the tools introduced in the class. (4)

Total L: 15**REFERENCES:**

1. Software Engineering Body of Knowledge, <https://www.computer.org/web/swebok/v3>
2. Test Driven Development, https://en.wikipedia.org/wiki/Test-driven_development
3. Continuous Integration (CI), <https://martinfowler.com/articles/continuousIntegration.html>
4. Continuous Delivery: <https://martinfowler.com/bliki/ContinuousDelivery.html>
5. Version Control System,
6. Build automation: <https://maven.apache.org/>
7. CI Automation: <https://jenkins.io/>
8. Continuous Delivery, <https://www.docker.com/>