SEMESTER IX

18XW91 PRINCIPLES OF MANAGEMENT AND BEHAVIOURAL SCIENCES

3 0 0 3

PRINCIPLES OF MANAGEMENT: Meaning, Definition and Significance of Management, Basic Functions of Management – Planning, Organizing, Staffing, Directing and Controlling. Organizational Environment – Social, Economic, Technological and Political. Corporate Social Responsibility - Case discussion (8)

INDUSTRIAL AND BUSINESS ORGANIZATION: Growth of Industries (Small Scale, Medium Scale and Large Scale Industries). Forms of Business Organizations. Resource Management – Internal and External Sources. (7)

ORGANIZATIONAL BEHAVIOUR: Significance of OB, Impact of culture on organization. Role of leadership and leadership styles. Personality and Motivational Theories. Attitudes, Values and Perceptions at work - Case discussion (7)

GROUP BEHAVIOUR: Group dynamics, Group formation and development, group structure and group cohesiveness. Informal organization – Sociometry – Interaction analysis - Exercises (8)

GLOBALISATION: Issues for global competitiveness, proactive and reactive forces of globalization. Cross cultural management – Management of work force diversity. (5)

HUMAN RESOURCE MANAGEMENT: Objectives and Functions, Selection and Placement, Training and Development – Conflict management – Stress management - Human resource management in global environment - Human resource information system(HRIS) - Case discussion. (10)

Total L:45

TEXT BOOKS:

1. Harold Koontz, Heinz Weihrich and Ramachandra Aryasri, “Principles of Management”, Tata McGraw Hill, 2014.
2. Mamoria CB, “Personnel Management”, Sultan Chand & Sons, 2005.

REFERENCES:

1. John W Newstrom and Keith Davis, “Organizational Behavior”, Tata McGraw Hill, 2010.
2. Stephen P Robbins, ”Organisational behavior”, Prentice Hall, 2010.
3. Khanna O P, “Industrial Engineering & Management”, Dhanpat Rai Publications, 2010.

18XW92 SOFTWARE TESTING

3 0 0 3

INTRODUCTION: Need for testing – Psychology of testing – Testing economies – Types of testing – SDLC and testing – Verification and Validation. (6)

DEVELOPING A TEST APPROACH: Defining a software system testing strategy - Developing software system testing tactics - Testing tools – Test Plan and Test Cases. (4)

TESTING A SOFTWARE USING A LIFE CYCLE METHODOLOGY: 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. (10)

TESTING METHODOLOGY FOR SOFTWARE MAINTENANCE: Testing the correctness of the installing a software change - Testing the validity of a software cost estimate - Testing the progress of the software system - Inspecting test plan and test cases - Software Inspection - Costs and Benefits - Overview - The Inspection Process. (8)

TESTING OBJECT ORIENTED SOFTWARE: Challenges – Differences from testing non-OO software – Class testing strategies – class modality – State based testing. (3)

TESTING METHODLOGIES : Testing Rapid Application Development– Testing Adequacy of System Documentation – Testing Web based systems-Testing off the shelf Software – Testing in Multi-platform environment – Testing Security – Testing Data warehouse – Testing Metrics – Evaluating test effectiveness (10)

TECHNIQUES FOR AUTOMATING TEST EXECUTION: Testing and test automation – Tool support for lifecycle Testing - Common problems of test automation – limitations of automating software testing. (4)

Total L: 45

TEXT BOOKS:

1. William Perry, "Effective Methods for Software Testing", John Wiley,2009.

REFERENCES:

1. John Watkins, “Testing IT: An off the shelf Software Testing Process”, Cambridge Press,2010.
2. John Watkins, “Agile Testing: How to succeed in an extreme Testing environment”, Cambridge Press, 2009.
3. Boris Beizer, “Software Testing Techniques”, Dream Tech Press, 2003.

18XW93 PRINCIPLES OF COMPILER DESIGN

3 0 0 3

SYSTEMS PROGRAMMING: Language Processors – Data Structures for Language Processing – Introduction to Assemblers, Macro processors, Interpreters – Linkers and Loaders. (7)

COMPILERS: Introduction – phases of compiler – Bootstrapping – Compiler writing tools – FLEX – BISON – JavaCC – PLY. (2)

LEXICAL ANALYSIS: Role of a lexical analyzer – finite automata –regular expressions to finite automata – minimizing the number of states of a deterministic finite automata – implementation of a lexical analyzer. (6)

PARSING TECHNIQUES: Context free grammars – derivations and parse trees – ambiguity – capabilities of context free grammars. Top down and bottom up parsing – handles – shift reduce parsing – operator precedence parsing – recursive descent parsing – predictive parsing. (9)

AUTOMATIC PARSING TECHNIQUES: LR parsers – canonical collection of LR (0) items – construction of SLR parsing tables – LR1 sets of items construction – CLR parser – LALR parser. (6)

SYNTAX DIRECTED TRANSLATION AND INTERMEDIATE CODE: Semantic actions – Implementation of syntax directed translations – Syntax directed definitions - Postfix notation, Quadruples, triples, indirect triples, Translation of Expressions - control flow – Representing information in a symbol table (9)

CODE OPTIMIZATION: Basic blocks – DAG representation – error detection and recovery - code generation. (6)

Total L:45

TEXT BOOKS:

1. John J Donovan, “Systems Programming”, Tata McGrawHill,2012.
2. Dhamdhere D M, “Systems Programming”, Tata McGrawHill,2012.

REFERENCES:

1. Alfred V Aho, Monica S Lam, Ravi Sethi, Jeffrey D Ullman, “Compilers: Principles, Techniques and Tools”, Pearson,2013.
2. Dhamdhere D M, “Compiler Construction Principles and Practice”, Macmillan,2008.
3. Allen I Holub “Compiler Design in C (Digitized)”, Prentice Hall, 2015.
4. Leland L. Beck, “System Software: An Introduction to Systems Programming”, Pearson India, 2002.

18XW96 PRINCIPLES OF COMPILER DESIGN LAB

0 0 4 2

1. Development of a Lexical Analyzer.
2. Design and Implementation of a Symbol Table Manager.
3. Implementation of the following Parsing algorithms.
   a. Recursive descent Parser b. Shift reduce Parser.
4. Implementation of a Syntax Directed Translation Engine to
   a. Simulate a Desk Calculator b. Generation of Postfix code.
5. Implementation of Lexical Analyser using FLEX.
6. Implementation of Syntax Analyser using BISON.
7. Implementation of Lexical Analyser and Syntax Analyser using JavaCC.
8. Implementation of Lexical Analyser and Syntax Analyser using PLY.

Total P: 60

18XW97 SOFTWARE TESTING LAB

0 0 4 2

1 Manual Code Review Process and recording the defects in specified format.
2. Testing the software package using open source Testing tools
3 Creating a test plan document for the package and preparation of the test data for validation testing.
4 Using Rational Test Manager to design the test cases. Specification of test pre-conditions, post-conditions and acceptance criteria
5. Using Rational Robot for recording and playback of test script related with the package
6. Setting Debug options in Robot and playing back a script. Debugging compiler errors using Robot.
7. Testing the package for Load Testing with available testing tool
8 Testing the package for Coverage Analysis using Rational Pure Coverage
9 Testing the package for Reliability Testing using Rational Test Factory
10 Testing the Package for Memory management errors using Rational Purify and elimination of those defects

Total P: 60

18XW98 CAPSTONE PROJECT LAB

0 0 4 2

A multi-faceted project that can be chosen by the student based on his/her area of interest / Assigned by the faculty.

Total P:60

SEMESTER X

18XWP2 PROJECT WORK II

0 0 0 12

PROFESSIONAL ELECTIVES

18XWA1 MODELLING AND SIMULATION

3 2 0 4

PRINCIPLE OF COMPUTER MODELLING AND SIMULATION: Monte Carlo simulation. Nature of computer modeling and simulation. Limitations of simulation, areas of application. (3)

SYSTEM AND ENVIRONMENT: Components of a system - discrete and continuous systems. Models of a system - A variety of modelling approaches. (4)

DATA-DRIVEN MODELS: Empirical Models-Introduction - Linear Empirical Model- Predictions-Linear Regression - Nonlinear One-Term Model - Multiterm Models - Advanced Fitting with Computational Tools (4)

RANDOM NUMBER GENERATION: Techniques for generating random numbers - Midsquare method - The midproduct method - Constant multiplier technique - Additive congruential method - Linear congruential method - Tauswarthe method - Tests for random numbers - The Kolmogorov_Smirnov test - The Chi-square test. (5)

RANDOM VARIABLE GENERATION: Inverse transform technique - Exponential distribution - Uniform distribution - Weibull distribution. Empirical continuous distribution - generating approximate normal variates - Erlang distribution. Empirical Discrete distribution - Discrete Uniform distribution - Poisson distribution - Geometric distribution - Acceptance - Rejection technique for Poisson distribution - Gamma distribution. (7)

DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS: Input - Output analysis - variance reduction techniques - Antithetic variables - verification and validation of simulation models. (5)

DISCRETE EVENT SIMULATION: Concepts in discrete-event simulation, manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory problem. (7)
SIMULATION LANGUAGES - GPSS - SIMSCRIPT - SIMULA - SIMPLE_1, Programming for Discrete event systems in GPSS, SIMPLE_1 and C. (5)

CASE STUDIES: Simulation of LAN - Manufacturing system - Hospital system. (5)

TUTORIAL PRACTICE:
1. Implement variance reduction.
2. Implement event scheduling.
3. Simulate inventory problem.
4. Simulate a manufacturing system.

Total L: 45+T: 30=75

TEXT BOOKS:

1. Jerry Banks and John S. Carson, "Discrete Event System Simulation", Prentice Hall, 2013.
2. Angela B.Shiflet and George W. Shiflet, " Introduction to Computational Science: Modeling and Simulation for the Sciences", Princeton University Press, 2014

REFERENCES:

1. Mohsen Guizani, AmmarRayes, Bilal Khan, Ala Al-Fugaha, "Network Modelling and Simulation - A Practical Perspective", John Wiley, 2010.
2. Averil M Law , "Simulation Modelling and Analysis", Tata McGraw Hill, 2014.

18XWA2 MODERN DATABASES

3 2 0 4

PARALLEL AND DISTRIBUTED DATABASES: Architecture of parallel databases – Parallel query evaluation, Parallel query optimization – Introduction to distributed databases, DDBMS Architecture, Distributed Database Design, Distributed Query Processing and Optimization. (8)

DATA MODELING FOR BIG DATA: Big Data and Challenges, Big Data models, NoSQL data models, Basic principles of NoSQL models, SQL databases VsNoSQL databases. (7)

NOSQL DATABASES (PART 1): Key - Value Stores: Oracle Coherence – Amazon DynamoDB, Key -Value Stores (in-memory) : Redis , Key-value Stores (B-tree): Berkeley DB, Column Oriented Store: Google BigTable , Apache Cassandra - Hbase. (10)

NOSQL DATABASES (PART 2): Document Oriented Stores – MongoDB - Apache CouchDB - XML databases, Graph databases: Neo4J - OrientDB, Object Database: Db4o (10)

MAP-REDUCE: Apache Hadoop and HDFS, Microsoft Azure – Big data Applications. (5)

DATABASE INTEGRATION: Data warehousing, Schema directed data integration - Data exchange: Schema mapping and information preservation - automatic schema matching - Information Preserving XML Schema Embedding. (5)

TUTORIAL PRACTICE:
1. Implementing object databases
2. Implementing spatial databases and spatial queries
3. Distribution using Map-Reduce on Big Data (Hadoop).
4. Data Integration from heterogeneous Databases.
5. Implementation of No-SQL databases- DynamoDB, MongoDB, Google"sBigTable, DBo4, Neo4J.

Total L: 45+T: 30=75

TEXT BOOKS:

1. M.TamerOzsu, Patrick Valduriez, "Principles of Distributed Database Systems", 2011.
2. Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled - Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, 2013.
3. Guy Harrison, "Next Generation Databases: NoSQL and BigData", Apress, 2015.
4. ShashankTiwari, "Professional NoSQL", John Wiley & Sons, 2011.
5. Anhai Doan, Alon Halevy, Zachary Ives, "Principles of Data Integration", Morgan Kaufmann, 2012.

REFERENCES:

1. Ramez Elmasri and Shamkrant Navathe, "Fundamentals of Database Systems", Addison Wesley, 2013.
2. Kristina Chodorow, "MongoDB: The Definitive Guide", O'Reilly Media, 2012

18XWA3 SOFTWARE METRICS

3 2 0 4

FUNDAMENTALS OF MEASUREMENT: Measurement in Software Engineering-Scope of Software Metrics - Measurement and Models-Measurement scales and scale types-Classifying software measures - Software Measurement validation - Software Metrics Data collection - Analyzing software measurement data. (10)
MEASURING INTERNAL PRODUCT ATTRIBUTES: Size and Structure - Measuring external product attributes. (5)

SOFTWARE RELIABILITY: Measurement and prediction - Parametric Reliability Growth models - The recalibration of software reliability growth predictions. (10)

RESOURCE MEASUREMENT: Productivity, teams and tools- Making process predictions - Good estimates - Models of effort and cost - Dealing with Problems of current estimation methods. (10)

MEASUREMENT AND MANAGEMENT: Planning - Measurement program - Measurement tools-Measurers - analysts - audience - Measurement in practice. (10)

TUTORIAL PRACTICE:
1. Complete the time recording log and Defect Recording log.
2. PSP Programming assignment.
3. Assess the Quality of the Student's PSP Data and record your observations in the specified format.
4. Estimate the size of the program using PSP Techniques and record it in the specified format.
5. Design Review Exercise.
6. Code Review exercise.
7. Exercise for measuring process and product quality.
8. Development of Project Plan.
9. Measurement of the quality of Team's process and Product.

Total L: 45+T: 30=75

TEXT BOOKS:

1. Norman E Fenton and Shari Lawrence Pfleeger, "Software Metrics", Thomson Brooks/Cole, 2013.

REFERENCES:

1. Stephen H Khan, "Metrics and Models in Software Quality Engineering", Pearson Education, 2012.
2. Dick B Simmons and Newton C Ellis, "Software Measurement", Prentice Hall, 2012.

18XWA4 PARALLEL AND DISTRIBUTED COMPUTING

3 2 0 4

INTRODUCTION : Forms of Computing – Monolithic – Distributed – Parallel-Cooperative - Computational demands of parallel processing, Flynn's classification – Terminology. (5)

PARALLEL COMPUTER ARCHITECTURES: Classification – Inter connection networks – Vector computers – Shared memory parallel computers – Cache coherence – Distributed shared memory parallel computers – Message passing parallel computers – Cluster of workstations. (5)

PARALLEL PROGRAMMING MODELS: Shared memory model, Message passing model - Synchronous and Asynchronous message passing models, Leader-Election algorithm, Breadth-First Search. Shortest Paths, Broadcast and Converge cast, Data Parallel model. (7)

PARALLEL ALGORITHMS : Models of parallel computation including PRAM - CRCW, CREW, ERCW, EREW models, Design and analysis of Parallel algorithms: : Automatic vs. Manual Parallelization – Understand the Problem and the Program – Partitioning – Communications – Synchronization – Data Dependencies – Load Balancing – Granularity – I/O – Limits and Costs of Parallel Programming – Performance Analysis and Tuning – Parallel Examples – Array Processing Matrix multiplication, Sorting, Searching, Merging, Minimum spanning tree, Prime numbers. (10)

DISTRIBUTED COMPUTING: Introduction to Distributed Programming - System *Models*- Architectural models - Client-server model, Peer-to-peer model- Variations of the above models -Distributed computing paradigms – Inter process communication -The API for the Internet protocols - External data representation and marshalling - Group communication - Case study: inter process communication in UNIX - Distributed file systems. (8)

DISTRIBUTED PROGRAMMING ALGORITHMS: Fundamental issues and concepts - Synchronization, Mutual Exclusion, Termination Detection, Clocks, Event ordering, Locking - Distributed Computing Tools & Technologies (CORBA, JavaRMI, Web Services). (5)

EMERGING AREAS OF PARALLEL AND DISTRIBUTED SYSTEMS: Grid computing, Peer-to-peer systems, Overlay networks, Edge computing and Ad-hoc networks. (5)

TUTORIAL PRACTICE:

1. Analyze Parallel algorithms to predict performance.
2. Implement Dekker's algorithm.
3. Implement Dinning philosopher algorithm.
4. Implement Array processing.
5. Implement Matrix Computation, Searching and Sorting algorithms using parallel processing.
6. Implement parallel algorithms using MPI.
7. Analyze the implementation of the above algorithms in a distributed environment.

Total L: 45+T: 30=75

TEXT BOOKS:

1. Quinn Michael J, "Designing Efficient Algorithms for Parallel Computers", Tata McGraw Hill, 2004.
2. Wilkinson B and Allen M, "Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers", Prentice Hall, 2005.

REFERENCES:

1. Hariri and Parashar, "Tools and Environments for Parallel and Distributed Computing", John Wiley, 2004.
2. Jean Dollimore, TimKindberg and George Coulouris, "Distributed Systems: Concepts and Design", Addison Wesley, 2011.
3. Michael J Quinn, "Parallel Computing: Theory and Practice", Tata McGraw-Hill, 2004.
4. Joel M.Crichlow, "Distributed And Parallel Computing", Prentice Hall Of India, 2004.
5. Andrew S Tannenbaum and Maarten Van Steen, "Distributed Systems, Principles and Paradigm" Prentice Hall, 2013.
6. Vijay K Garg,"Elements of Distributed Computing", John Wiley, 2014.

18XWA5 DATA COMPRESSION

3 2 0 4

DATA COMPRESSION LEXICON: Introduction To Data Compression - Dawn Age - Coding - Modeling - Ziv And Lampel- Lossy Compression. (4)

MINIMUM REDUNDANCY CODING (THE DAWN AGE): The Shannon - Fano Algorithm, The Huffman Algorithm - Into The Huffman code: Counting the Symbols, Building the Tree - Compression Code. (4)

ADAPTIVE HUFFMAN CODING: Adaptive coding - Updating the Huffman tree - the code. (4)

ARITHMETIC HUFFMAN CODING: Arithmetic coding - The code. (6)

STATISTICAL MODELING: higher-order modeling - finite context modeling - adaptive modeling – highest- order modeling. (4)

SLIDING WINDOW COMPRESSION: lz77 algorithm - lzss compression - Compression code. (5)

DICTIONARY-BASED COMPRESSION: lz78 compression and decompression algorithms – lzw compression and decompression algorithms – lzmw compression and decompression – lzap compression and decompression. (8)

SPEECH COMPRESSION: digital audio concepts - lossless compression of sound. (5)

VIDEO COMPRESSION: jpeg compression – discrete cosine transforms – coefficient quantization. (5)

TUTORIAL PRACTICE:

1. Implement Shannon Fano algorithm and Huffman algorithm.
2. Design compression and decompression program using adaptive Huffman coding.
3. Implement arithmetic coding algorithm.
4. Design compression program using statistical modeling upto 3 order.
5. Design compression and decompression program using L277 algorithm.

Total L: 45+T: 30=75

TEXT BOOKS:
1. Mark Nelson, Jean Loup Gailly "The Data Compression Book", M&T Books, 2008.

REFERENCES:
1. Yun Q Shi, Huifang Sun, “Image and Video Compression for Multimedia Engineering”, CRC Press, 2008.
2. Khalid Sayood, “Introduction to Data Compression”, Morgan Kaufmann, 2006.

18XWA6 COMPUTER GRAPHICS AND VISUALIZATION

3 2 0 4

GRAPHICS INPUT - OUTPUT DEVICES: Raster scan Displays - Random scan displays - Direct view storage tubes - Flat panel displays - Mouse - Track Ball - Joy Stick - Digitizers - Touch panels - LCD. GRAPHICAL USER INTERFACE AND INTERACTIVE INPUT METHODS: The user dialog - Input of graphical data - Input function - Interactive picture construction techniques - Virtual reality environments. (3)

OPENGL: Architecture, The OpenGL API, Primitives and Attributes, Color, Viewing, Control Functions, Programming Event-Driven Input, Transformations, *OpenGL Extensions.* (3)

TWO DIMENSIONAL GRAPHICS: Basic transformations - Matrix representation and homogeneous coordinates - Composite transformations - Line drawing algorithms: DDA and Bresenham's algorithms - Circle generation algorithms: Mid point circle algorithm - Point clipping - Line clipping: Cohen Sutherland algorithm - Polygon clipping: Sutherland Hodgeman algorithm - Line covering. (7)

RASTER GRAPHICS: Fundamentals: generating a raster image, representing a raster image, scan converting a line drawing, displaying characters, speed of scan conversion, natural images - Solid area scan conversion: Scan conversion of polygons, Y-X algorithm, properties of scan conversion algorithms - Interactive raster graphics: painting model, moving parts of an image, feed back images. (7)

CURVES AND SURFACES: Parametric representation of curves - Bezier curves – B-Spline curves - Parametric representation of surfaces - Bezier surfaces - Curved surfaces - Ruled surfaces - Quadric surfaces – Concatenation of two curve segments – Order of Continuity. (7)

IMAGE PROCESSING FUNDAMENTALS: Sampling and Quantization, Image Enhancement - Histogram Processing, Filtering (8)

THREE DIMENSIONAL GRAPHICS: 3D transformations - Viewing 3D graphical data - Orthographic, oblique, perspective projections - Hidden lines and hidden surface removal. (6)

FRACTAL-GEOMETRY METHODS: Tiling the plane - Recursively defined curves - Koch curves - C curves - Dragons - Space filling curves - Fractals - Grammar based models - Graftals - Turtle graphics - Ray tracing. (4)

Note: Algorithms in have to be implemented by using C++/ OpenGL.

TUTORIAL PRACTICE:
1. Implementation of Simple transformations.
2. Implementation of Line drawing algorithms.
3. Windowing and Line Clipping.
4. Polygon clipping.
5. Implementation of an Analog Clock.
6. Polygon filling algorithms.
7. Merging of a circle and square.
8. Fractal drawing.
9. Image Processing Functions

Total L: 45+T: 30=75

TEXT BOOKS:
1. Donald Hearn and Pauline Baker M, “Computer Graphics with OpenGL", Pearson Education, 2014.
2. William M. Newmann and Robert F Sproull, “Principles of Interactive Computer Graphics”, Tata McGraw Hill, 2011.

REFERENCES:
1. Foley James D, VandamAndries and Hughes John F, "Computer Graphics: Principles and Practice", Addison Wesley, 2013.
2. Rafael C Gonzalez., and Richard Eugene Woods, “Digital Image Processing”, Prentice Hall, 2009.
3. Anil K Jain, “Fundamentals of Digital Image Processing”, Prentice Hall, 2010.
4. Angel, “Interactive Computer Graphics- A top down approach with OpenGL”, Addison Wesley, 2011.
5. Francis S. Hill, Stephen M. Kelley , “Computer Graphics”, Prentice Hall, 2007.

18XWA7 PRINCIPLES OF PROGRAMMING LANGUAGES

3 2 0 4

INTRODUCTION: The Role of Programming Languages: Toward Higher-level Languages, Problems of Scale, Programming Paradigms, Language Implementation Bridging the Gap - Language Description:- Syntactic Structure: Expression Notations, Abstract Syntax Trees, Lexical Syntax, Context -Free Grammars, Grammars for Expressions, Variants of Grammars. (9)

IMPERATIVE PROGRAMMING: Statements: Structured Programming:- The Need for Structured Programming, Syntax-Directed Control Flow, Design Considerations: Syntax, Handling Special Cases in Loops, Programming with invariants, Proof Rules for Partial Correctness, Control flow in C - Types: Data Representation:- The Role of Types, Basic Types, Arrays Sequences of Elements, Records: Named Fields, Unions and variant Records, Sets, Pointers: Efficiency and Dynamic Allocation, Two String Tables, Types and Error Checking - Procedure Activations:- Introduction to Procedures, Parameter-passing Methods, Scope Rules for Names, Nested Scopes in the Source Text, Activation Records, Lexical Scope: Procedures as in C, Lexical Scope: Nested Procedures and Pascal. (12)

OBJECT ORIENTED PROGRAMMING: Groupings of Data and Operations:- Constructs fro Program Structuring, Information Hiding, Program Design with Modules, Modules and Defined Types, Class Declarations in C++, Dynamic Allocation I C++, Templates: Parameterized Types, Implementation of Objects in C++. - Object-Oriented Programming:- What is an Object?, Object-Oriented Thinking - Objects in Smalltalk. (6)

FUNCTIONAL PROGRAMMING: Elements of Functional Programming:- A little Language of expressions, Types : Values and Operations, Function declarations, Approaches to Expression Evaluation, Lexical Scope, Type Checking - Functional Programming in a Typed Languages:- Exploring a List, Function Declaration by Cases, Functions as First-Class Values, ML: Implicit Types, Data Types, Exception Handling in M, Little quit in Standard ML - Functional Programming with Lists:- Scheme, a Dialect of Lisp, The Structure of Lists, List Manipulation, A Motivating Example: Differentiation, Simplification of Expressions, Storage Allocation for Lists. (10)

OTHER PARADIGMS: Logic Programming:- Computing with Relations, Introduction to Prolog, Data Structures in Prolog, Programming techniques, Control in Prolog, Cuts - An Introduction to Concurrent Programming:- Parallelism in Hardware, Streams: Implicit Synchronization, Concurrency as interleaving, Liveness Properties, Safe Access to Shared Data, Concurrency in Ada, Synchronized Access to Shared variables. (8)

TUTORIAL PRACTICE:

1. Language tools like LEX, YACC.
2. Inter – Intra sequence control mechanism.
3. Parameter passing mechanism in C, C++.
4. Comparing Object oriented concepts in C++, Java.
5. List Operations in Prolog.
6. Fact finding & Theorem proving in Prolog.
7. Recursive functions in Functional programming language.
8. Expression evaluation in functional programming language.

Total L: 45+T: 30=75

TEXT BOOKS:

1. Terrence W Pratt, Marvin V Selkowitz and T V Gopal, “Programming Languages Design and Implementation”, Pearson Education, 2006.
2. Robert Harber, “Programming in standard ML”, Carnegie Mellon University, 2005.

REFERENCES:

1. Ravi Sethi, “Programming Languages Concepts and Constructs “, Pearson Education, 2009.
2. Robert W Sebesta, “Concepts of Programming Languages”, Pearson Education, 2009.
3. Al Kelley and Ira Pohl, “A Book on C “, Pearson Education,2009.

18XWA8 AGILE SOFTWARE DEVELOPMENT

3 2 0 4

AGILE COMPUTING - An Introduction– The Problem with parsing experience-Three levels of listening Cooperative game of Invention and Communication-Individuals-Overcoming Failure modes-Working Better in some ways than others - Drawing on Success modes (9)

AGILE PROCESS MODELS – Extreme programming, ASD, DSDM, Scrum, Crystal, FDD, Agile Modeling (9)

TEAM COMMUNICATION -Communicating and Cooperating teams – Convection currents of information-Jumping communication gaps-Teams as communities-Teams as Ecosystems (10)

AGILE METHODOLOGIES -Agile and self-adapting-The crystal methodologies-Crystal orange web-The agile software development manifesto-The agile alliance-Peter Naur, Programming as Theory Building. (12)

Case Studies (5)

TUTORIAL PRACTICE:

1. Exercise for modular development.
2. Exercise for Incremental delivery approach.
3. Development of Metaphor.
4. Exercise for proving the productivity using pair programming approach.
5. Exercise for understanding the concept of “Simple Design”.
6. Exercise to understand “Test first “technique.
7. Writing user stories.
8. Creation of vision card.
9. Writing acceptance tests.
10. Exercise for refactoring the code.

Total L: 45+T: 30=75

TEXT BOOKS:
1. Alistair Cockburn, “Agile Software Development”, Pearson Education, 2014.

REFERENCES:
1. Craig Larman, “Agile and Iterative Development”, Pearson Education, 2012.
2. Mike Cohn, “Agile Estimating and Planning”, Pearson Education,2012.

18XWA9 PERVASIVE COMPUTING

3 2 0 4

INTRODUCTION: Past, present, future; the pervasive computing market, m-Business, challenges and future of pervasive computing -modeling key for pervasive computing - pervasive system environment interaction - architectural design for pervasive system, application examples of pervasive computing: Healthcare, Tracking, emergency information systems, home networking appliances and entertainment. (5)

DEVICE TECHNOLOGY FOR PERVASIVE COMPUTING: Hardware,computing devices and their characteristics - pervasive information access devices-smart identification, smart card, labels, tokens - embedded controls, smart sensors, actuators -Human-machine interfaces, Biometrics - Various operating systems for pervasive devices. (4)

COMMUNICATION TECHNOLOGIES FOR PERVASIVE COMPUTING: Connecting the world – WWAN, SRWC, DECT, Bluetooth, IrDA – mobile internet – internet protocols. Audio networks, data networks - wireless data networks - pervasive networks - service oriented networks - network design issues - Managing smart devices in virtual environments, human user-centered and physical environments - pervasive computing issues and outlook. (7)

APPROACHES FOR DEVELOPING PERVASIVE APPLICATIONS: Categorization - smart services for pervasive application development - developing mobile applications – presentation transcoding – device independent view component – heterogeneity of device platforms - Context Awareness and Mobility to build pervasive applications. (8)
CONTEXT AWARE SYSTEMS: Modelling - mobility awareness - spatial awareness - temporal awareness - ICT system awareness - Intelligent Systems - basic concepts- autonomous systems - reflective and self-aware systems - self management and autonomic computing - complex systems. (8)

LOCATION AWARE SYSTEMS: Basic concepts - location modelling - Introduction to location management – DNS Server, server process, client process – location update – location inquiry-location management cost – network topology – mobility pattern, memory less movement model, Markovian Model, Shortest distance model, Gauss-Markov model, Activity Based Model, Mobility Trace, Fluid-flow Model, Gravity Model. (7)

LOCATION DEPENDENT QUERY MODELS : Location dependent information system- location dependent data – location aware queries – location dependent queries – moving object database queries - query transition steps in LDQ processing. (6)

TUTORIAL PRACTICE:
1. Create Application with onClick, onKeyDown, onFocusChanged Event Handlers
2. Create Application with Toast Notifications
3. Create Application with Android's Advanced User Interface Functions
4. Create Android Audio/Video Application
5. Create Application to Create, Modify and Query an SQLite Database
6. Create Application that Works with an Android Content Provider
7. Create application that performs Data Storage and Retrieval from Android External Storage
8. Create Location-Aware application that uses Proximity Alerts and Google Maps API
9. Implementation of small packages to demonstrate all APIs.

Note: All implementations using android.

Total L: 45+T: 30=75

TEXTBOOKS:
1. Stefan Poslad, “Ubiquitous Computing - Smart Devices, Environment and Interactions”, John Wiley, 2011.
2. Adelstein F and Gupta S K S, “Fundamentals of Mobile and Pervasive Computing”, Tata McGraw Hill, 2008.

REFERENCES:
1. Guruduth Banavar, Norman Cohen, Chandra Narayanaswami, “Pervasive Computing: An Application-Based Approach”, Wiley Interscience, 2012.
2. Mohammed Ilyas and Imad Mahgoub, “Mobile Computing Handbook”, Auerbach Publications, 2005.
3. Burkhardt, Henn, Hepper, and Rintdorff, Schaeck. “Pervasive Computing”, Pearson Education, 2009.
4. Ashoke Talukdar and Roopa Yavagal, “Mobile Computing”, Tata McGraw Hill, 2010.

18XWAA SEMANTIC WEB

3 2 0 4

INTRODUCTION TO SEMANTIC WEB: Today’s Web - From Today’s Web to the Semantic Web - Examples - Semantic Web Technologies - A Layered Approach. (4)

DESCRIBING STRUCTURED WEB DOCUMENTS USING XML: Introduction to Markup languages - The XML Language - Structuring - Namespaces - Addressing and Querying XML Documents - Processing. (8)

DESCRIBING WEB RESOURCES IN RDF: Introduction to RDF - Basic Ideas - RDF: XML-Based Syntax - RDF Schema: Basic Ideas - RDF Schema - An Axiomatic Semantics for RDF and RDF Schema - A Direct Inference System for RDF and RDFS - Querying in RQL. (9)

WEB ONTOLOGY LANGUAGE: OWL Introduction - The OWL Language - Examples - OWL in OWL - Future Extensions. (8)

LOGIC AND INFERENCE: Introduction - Example of Monotonic Rules: Family Relationships - Monotonic Rules: Syntax - Monotonic Rules: Semantics - Nonmonotonic Rules: Motivation and Syntax - Example of Nonmonotonic Rules - Rule Markup in XML for Monotonic Rules - Rule Markup in XML for Nonmonotonic Rules. (8)

APPLICATIONS: Horizontal Information Products - Data Integration - e-Learning - Web Services - Other Scenarios. (4)

ONTOLOGY ENGINEERING: Constructing Ontologies Manually - Reusing Existing Ontologies - Using Semiautomatic Methods - On-To-Knowledge Semantic Web Architecture. (4)

TUTORIAL PRACTICE:

1. Generation of a well formed XML document.
2. Creating XML DTD and XSD for the given XML document.
3. Design a XSLT to display the XML document (given as input) based on the constraints given.
4. Generate an RDF graph.
5. Create an RDFS ontology (in triple or graph notation).
6. Write an RDF/XML encoding for the given situation.
7. Generation of OWL document.
8. A Package to implement the techniques.

Total L: 45+T: 30=75

TEXT BOOKS:

1. Grigoris Antoniou and Frank van Harmelen, “A Semantic Web Primer”, The Massachusetts Institute of Technology Press, Cambridge,2012.

REFERENCES:

1. Dean Allemans, James Handler, “Semantic web for the working ontologist: Effective modeling in RDFS and OWL”, Elsevier, 2011.
2. Pascal Hitzler, Markus Krotzsch, Sebastian Rudolph, “Foundations of Semantic Web Technologies”, CRC Press, 2009.

18XWAB CLOUD COMPUTING

3 2 0 4

INTRODUCTION TO PARALLEL AND DISTRIBUTED COMPUTING: Introduction, Architecture and Distributed computing models and technologies SOA, Web Services (5)

GRID, CLUSTER AND UTILITY COMPUTING: Introduction, Architecture, Pros & Cons, Real time applications. (4)

INTRODUCTION TO CLOUD COMPUTING: Definition, History, Comparison of Cloud Computing with Grid, Cluster and Utility Computing, Deployment models – Private, Public, Hybrid and Community - Pros and Cons of Cloud Computing. SaaS, PaaS, IaaS etc. (8)

VIRTUALIZATION: Types of Virtualization, Tools for Virtualization, Architecture of VMM, Virtualization for Cloud. (4)

ADVANCED WEB TECHNOLOGIES: AJAX and Mashup – Programing examples using applications. (4)

MAP REDUCE PARADIGMS: Introduction, GFS Architecture, HDFS Architecture, Hbase, Google big Table, Amazon’s (key value) pair storage and Microsoft’s Azure infrastructure, Map reduce programming examples. (6)

CLOUD COMPUTING FRAMEWORK: Amazon EC3, S3 storage revises, Aneka frame work, IBM blue Cloud. (7)

APPLICATIONS: Distributed search engine and distributed data mining in the cloud. (7)

TUTORIAL PRACTICE:

1. Parallel programming using pvm on Linux platform
2. Develop web services using Eclipse or similar tools
3. Virtualization (VM Ware, VCloud, Hyper V)
4. Develop a Mashup website based on 2 or more existing websites
5. Build Private cloud compatible with AWS API using Eucalyptus
6. Build Cloud platform using Openstack
7. Package development using tools supported by cloud providers as a free service

Total L: 45+T: 30=75

TEXT BOOKS:

1. Anthony TVelte, Toby JVelte and Robert Elsenpeter, “Cloud Computing : A Practical Approach”, Tata McGraw Hill, 2010

REFERENCES:

1. Liu M L, “Distributed Computing Principles and Applications”, Pearson Education, 2009
2. Ron Schmelzer, ”XML and Web Services Unleashed”, Pearson Education, 2008.
3. Dean J and Ghemawat S, “ MapReduce: Simplified Data Processing on Large Clusters” OSDI, 2004.

4. DeCandia, DenizHastorun, MadanJampani, GunavardhanKakulapati, AvinashLakshman, Alex Pilchin, SwaminathanSivasubramanian, Peter Vosshall and Werner Vogels, " Dynamo Amazon's Highly Available Key-Value Store", SOSP, 2007.
5. Ghemawat S, Gobioff H and Leung S T, "The Google File System",SOSP, 2003.

18XWAC HUMAN COMPUTER INTERACTION

3 2 0 4

INTRODUCTION: Design, Models, Evaluation. Need to understand people, computers and methods. Motivation. Contexts for HCI. (4)

FOUNDATION OF HCI - HUMAN ABILITIES & COMPUTERS: Human abilities - Vision. Hearing. Touch. Memory. Computers - Speed. Interfaces. Widgets. Effects on interaction. (6)

INTERACTION: Understanding the psychology towards Compters. Egonomics. Need finding. Understanding user's needs and expectations. Interaction styles - Command language. Form filling. Menu selection. Direct manipulation. (6)

DESIGN GUIDELINES & EVALUATION: Heuristics as guidelines - Simple and natural dialogue, Speak the user's language, Be consistent, Provide shortcuts. Using heuristics to explain usability problems. Style guides. Evaluation of users interfaces: Heurisitc evaluation, measuring API usability. (8)

USER-CENTERED DESIGN: Introduction to User-centered design and prototyping. Methods - Verbal techniques, Paper prototyping, Mock interfaces, Tutorials and manuals. Collaboration with users. (9)

CASE STUDIES:
Web design: Build a web application to demonstrate various techniques. Focus on user interaction, design and ease of use.

Mobile app design: Build a mobile application to demonstrate the following: Issues with interactions in mobile. Limitations of building apps in the small screens of mobile device; Designing the app for better usability.

Game development: Build a game to understand the challenges in building a rich as well as an easy to use interface. (12)

TUTORIAL PRACTICE :
1. Web design: Build a web application with preference to user interaction, design and ease of use.
2. Mobile app design: Build a mobile application to demonstrate Issues with interactions in mobile; using small screens of mobile device with better usability.
3. Game development: Build a game to understand the challenges in building a rich as well as an easy to use interface.

Total L: 45+T: 30=75

TEXT BOOKS:
1. Alan Dix, Janet Finlay, Gregory Abowd and Russell Beale, "Human-Computer Interaction", Prentice Hall, 2009.
2. Yvonne Rogers, Heken Sharp and Jenny Preece, "Interaction Design: Beyond Human-Computer Interaction", John Wiley, 2011.

REFERENCE :
1. William Buxton, "Performance by design: The role of design in software product development", Proceedings of the Second International Conference on Usage-Centered Design, 2003.

18XWAD SOCIAL NETWORK ANALYSIS

3 2 0 4

INTRODUCTION: Motivation - different sources of network data - types of networks - tools for visualizing network data - review of graph theory basics. (9)

GRAPH THEORETIC PROPERTIES OF SOCIAL NETWORKS: Notions of centrality - Strong and weak ties – Homophily - Structural Balance. (5)

DYNAMIC PROPERTIES OF NETWORKS: Information diffusion - networks effects on information diffusion - maximizing influence spread - power law and heavy tail - preferential attachment models - small world phenomenon - cascading behavior on networks - Epidemics. (11)

BEHAVIORAL PROPERTIES ON NETWORKS: Network economics - Bargaining and power in networks - Sponsored search markets. (10)

MINING GRAPHS: Community and cluster detection: random walks - spectral methods - link analysis for web mining. (10)

TUTORIAL PRACTICE:
1. Getting acquainted with UCINET and Netdraw.
2. Implementing graph-theoretic/social network metrics using UCINET.
3. Working with Visualization, Ego networks, Centrality, Community Detection etc.

Total L: 45+T: 30=75

TEXTBOOKS:

1. David Easley and Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning About a Highly Connected World”, Cambridge University Press, Cambridge, 2010.

REFERENCES:

1. Stanley Wasserman, Katherine Faust, “Social network analysis: methods and applications”, Cambridge University Press, Cambridge,1998.
2. Peter R. Monge, Noshir S. Contractor, “Theories of communication networks”, Oxford University Press, 2003.
3. Duncan J Watts. “Six degrees: the science of a connected age”, Norton, 2004.
4. Narahari, Y., Garg, D., Ramasuri, N., and Prakash, H, “Game Theoretic Problems in Network Economics and Mechanism Design Solutions”, Springer-Verlag, 2008.

18XWAE ADVANCED COMPUTER GRAPHICS

3 2 0 4

GEOMETRICAL TRANSFORMATIONS: 2D Transformations- Homogeneous Coordination and metric representation – Composition of 2D transformations – Window to view port transport, Efficiency- Matrix representation of 3D transformations – Composition of 3D transformation – Transformation as a change in coordinate system. (3)

VIEWING IN 3D: Projections – specifying arbitrary 3D viewing – The Mathematics of planar geometric projections – implementing planar geometric projections, Coordinate systems. (3)

OBJECT HIERARCHY: Geometric modeling- Characteristics of retained – mode graphics packages – Defining and displaying structure – Modeling transformations, Hierarchical structure networks. (3)

INPUT DEVICES – INTERACTION TECHNIQUES AND INTERACTION TASKS: Interaction hardware – Basic interaction tasks – Composite interaction tasks. (3)

DIALOGUE DESIGN : The form and content of user-computer dialogues – User interface styles – Important design considerations – Modes and syntax – Visual design – The design methodology (3)

USER INTERFACE SOFTWARE: Basic interaction – handling models - window management systems – output handling in window systems – Input handling in windows systems – Interaction –technique toolkits – User-interface management systems. (3)

REPRESENTING CURVES AND SURFACES: Polygon meshing – parametric cubic curves, parametricbicubic surfaces, quadric surfaces. (3)

SOLID MODELLING: Representing solids – Regularized Boolean set operations – Primitive instancing – Sweep representations – Boundary representations – Spatial – Partitioning representations – Constructive solid geometry – Comparison of representation – User interfaces for solid modeling. (4)

VISIBLE SURFACE DETERMINATION : Function of two variables – Techniques for efficient visible surface algorithms – Algorithms for visible line determination – The z-buffer algorithm – List – priority Algorithm – Area subdivision algorithms – Algorithms for octrees – Algorithms for curved surfaces – Visible ray tracing. (3)

REALISM: Fundamental difficulties – Rendering techniques for line drawing – Rendering techniques for shaded images – Improved object models – Dynamics – steropsis – Improved displays – Interacting with our other senses – Aliasing and antialiasing. (3)

ACHROMATIC AND COLORED LIGHT: Achromatic light – Chromatic color – Color Models for Raster Graphics – Reproducing Color – Using Color in Computer Graphics. (3)

ILLUMINATIONS AND SHADING : Illumination models – Shading models for polygons – Surface detail – Shadows – Transparency – Inter object reflections – Physically based illumination models – Extended light sources – Spectral sampling – Improved camera model – Global Illumination algorithms – Recursive ray tracing – Radiosity methods – The rendering pipeline. (4)

IMAGE MANIPULATION AND SHADING: Image Basics - Filtering – Image Processing – Geometric transformations of Images – Multipass transformation – Image Composition – Mechanism for Image Storage – Special Effects with images (4)

ANIMATION : Conventional and Computer assisted Animation – Animation languages – Methods of controlling animation - Basic rules of animation – Problems peculiar to animation. (3)

TUTORIAL PRACTICE :

Implement the following using the OpenGL library in VC++

1. Using glRect function, draw : a) A flurry b) A checkerboard
2. Write the window to view port mapping functions, and use it to draw the sine curve in real world coordinates.
3. Using user defined lineTo and moveTo functions, plot the Fibonacci series.
4. Write the Canvas class and its supporting classes. Use the Canvas class to draw a simple meander.
5. Write functions to change the background and foreground colors.
6. Write a function to draw an n-sided polygon (using the basic Canvas class and line To and move To functions)
7. A program to draw the Sierpinski gasket.
8. A program to draw the graph of a given mathematical function f(x).
9. A program to read a data file that contains a collection of Polylines in the appropriate format and draw each polyline.
10. A parameterized function to display a house and call it many times by passing different values to form a village.
11. A program that displays a colored triangle and rectangle and rotates them at different angles along two axis.

Total L: 45+T: 30=75

TEXT BOOK:

1. Foley, Andries van Dam, Feinerand Hughes “Computer Graphics Principles & Practice”, Addison Wesley, 2013.

REFERENCE:

1. Donald Hearn and Pauline Baker M, Warren Karithers, “Computer Graphics with OPENGL”, Pearson Education, 2014.

18XWAF DEEP LEARNING

3 2 0 4

INTRODUCTION – Neural networks - Deep Networks - Deep Feedforward Networks – Learning XOR, Gradient Based Learning – Hidden units , Design – Backpropagation - Regularization of deep learning, (5)

OPTIMIZATION FOR TRAINING DEEP MODELS – Challenges in neural network optimization - Basic algorithms – Parameter initialization strategies – Algorithms with adaptive learning rates – Meta algorithms (10)

CONVOLUTIONAL NETWORKS – Convolution operation - Motivation – Pooling – Variants of convolution function (8)

RECURRENT NETWORKS – Unfolding computational graphs – Recurrent neural networks(RNN) – Bidirectional RNNs - Deep recurrent network – Methodology – Applications (10)

DEEP LEARNING RESEARCH : Linear Factor Models, Autoencoders, Representational Learning, Structured probabilistic models for deep learning, Monte Carlo Methods, Deepgenerativemodels (8)

APPLICATIONS: Natural language processing, Big Data, Brain Computer Interface, Visual Data, IoT (4)

TUTORIAL PRACTICE:

1. Collect data sets from the url : http://deeplearning.net/datasets/
2. Use Tensor Flow library for visualization of data sets in different domains and analysis:
   a) Music
   b) Image processing
   c) Text analysis (Next word prediction, etc)
   d) Speech processing

Total L: 45+T: 30=75

TEXT BOOKS:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville , “Deep Learning”, The MIT Press, 2016.
2. Yoshua Bengio, “Learning Deep Architectures for AI”, Foundations & Trends in Machine Learning, 2009.

REFERENCES:

1. Adam Gibson, Josh Patterson "Deep Learning: A Practitioner's Approach ", OReilly, 2016.
2. Nicholas Locascio and Nikhil Buduma "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", OReilly, 2017

18XWAG BIG DATA ANALYTICS

3 2 0 4

OVERVIEW– Big Data era – characteristics - Definition of data features – Big data value – Development – Challenges – Intelligent data analysis - .Nature of data - Evolution of database - Limitations of existing solutions. (4)

RELATED TECHNOLOGIES–Cloud computing – Relationship between cloud computing and big data - Internet of Things (IOT): IOT preliminaries – relationship between IOT and Big data; Data Centre – Hadoop – Preliminaries and Big Data – NoSQL - Hadoop eco system - Data loading techniques – Flume - Sqoop– Hive - Pig Latin - Mahout – HDFS- Map Reduce. (12)

BIG DATA GENERATION AND ACQUISITION:– Enterprise data – IOT data – Internet data – Biomedical data – Data generation from fields - Data Collection – Transportation - Preprocessing. (8)

DATA STREAMS: Stream Concepts – Stream data model and architecture – stream computing – sampling data in a stream – filtering streams – counting distinct elements in a stream – estimating moments – Real time analytics platform (RTAP) applications. (11)

MASSIVE DATA ANALYTICS: Map-reduce for machine learning, Nearest Neighbor classifier, Multi-task learning, Topic model. (3)

APPLICATIONS – Application evolution – Fields: Structured, Text, Web, Multimedia, Network, Mobile traffic; Social Network – Healthcare and medical – Collective intelligence – smart grid. (7)

TUTORIAL PRACTICE:

1. Implementation of large scale machine learning algorithms using Hadoop and Mapreduce.
2. Problems using data streams.
3. Developing applications using heterogeneous data sets (Text, Web, Graph, Image, IOT) .

Total L: 45+T: 30=75

TEXT BOOKS:

1. Min Chen, Shiven Mao, Yin Zhang, Victor CM Leung, “Big Data: Related Technologies, Challenges and Future Prospects”, Google(ebook), Springer, 2014.
2. EMC^2 Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley, 2015

3. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley, 2013
4. Vlasios Tsiatsis, Ioannis Fikouras, Stefan Avesand, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, Academic Press Inc, 2014

REFERENCES:

1. Ravi Kannan, John Hopcroft, “Foundations of Data Science”, 2013.
2. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer-Verlag, 2011.
3. Richard Hartley, Andrew Zisserman, “Multiple View Geometry in Computer Vision”, Cambridge University Press, 2004.
4. Olivier Hersent, David Boswarthick, “The Internet of Things: Key Applications and Protocols”, Wiley, 2012.
5. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2011.

18XWAH DATA MINING

3 2 0 4

INTRODUCTION: Motivation for Data Mining – Importance – Definition – Kinds of data for Data Mining – Data Mining functionalities – Patterns – Classification of Data Mining Systems – Major issues in Data Mining. (4)

DATA PREPROCESSING: Types of data, Data cleaning, Aggregation, Sampling – Data Reduction – Feature subset selection - X^2 and Information Gain. (6)

DATA WAREHOUSE and OLAP TECHNOLOGY: Overview- Need for Data Warehouse- multidimensional data model-Data Warehouse architecture -Data warehousing Schemas - Data Warehousing to Data mining (7)

MINING FREQUENT PATTERNS, ASSOCIATIONS AND CORRELATIONS: Basic concepts – Efficient and Scalable Frequent Itemset Mining methods – Apriori, FP Tree . (6)

ENSEMBLE OF CLASSIFIERS: Classification –Evaluating the accuracy of a classifier- Ensemble Learning–Bagging, Boosting, Cascading – Ensemble pruning. (7)

CLUSTERING: Categorization of major clustering methods – density based methods –DBSCAN, OPTICS, DENCLUE- Outlier analysis. (5)

MINING DATA STREAMS: Challenges-Mining time- Series databases and sequence data –Stationary data stream learning-Hoeffding trees- Evolving data stream mining. (5)

APPLICATIONS AND TRENDS IN DATA MINING: Spatial Data Mining –Graph Mining- Web Mining –Text Mining. (5)

TUTORIAL PRACTICE:

1. Familiarize with tools like WEKA and statistical package like R
2. Getting to know your Data –Feature Selection
3. Ensemble Learning
4. Association Rules

Total L: 45+T: 30=75

TEXT BOOKS:

1. Jiwei Han, Micheline Kamber , “ Data Mining – Concepts and Techniques”, Morgan Kaufmann, 2011.
2. Tan, Steinbach, Kumar, “Introduction to Data Mining”, Pearson Education, 2014.

REFERENCES:

1. Anand Rajaraman, and Jeffrey Ullman, “Mining Massive Data sets”, Cambridge University Press, 2014.
2. Trevor Hastie, Robert Tibshirani, Jerome Freidman,” The Elements of Statistical Learning: Data Mining, Inference and Prediction”, Springer, 2011.
3. Ian Witten, Frank Eibe, Mark A Hall and Geffery Holmes, "Data Mining: Practical Machine Learning Tools”, Elsevier, 2011.

18XWAI NATURAL LANGUAGE PROCESSING

3 2 0 4

INTRODUCTION: Natural language processing techniques**-** The different analysis levels used for NLP: morpho-lexical - syntactic – semantic - pragmatic - markup (TEI, UNICODE) – Applications – open problems. (3)

WORDS : Regular expressions – Automata – Morphology – Finite state Transducers – Finite state morphological parsing – Combining FST lexicon and rules – Porter Stemmer Algorithm – Probabilistic models for Spelling – Bayes method, Minimum edit distance - N-Grams – Counting words in Corpora – Simple n-grams – Smoothing – Evaluating language models : Entropy, Perplexity- Part of Speech Tagging (POS) – Rule based tagging – Stochastic based tagging – Transformation based tagging - Context Free Grammars - Top down parser – Earley Algorithm – Bottom-up parsing – CYK parser – Probabilistic parsing. (15)

SEMANTICS : Meaning structure of a language – First order predicate calculus – Alternative approaches to meaning – Syntax driven sematic analysis – Attachments for a fragment of English – Word Sense Disambiguation – Machine learning approaches – Dictionary based approaches – Pragmatics : Discourse – Text coherence (10)

NATURAL LANGUAGE GENERATION: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Language similarities and differences – The transfer metaphor – Direct translation – Statistical translation - Translation involving Indian Languages. (12)

CASE STUDIES : Sentiment Analysis **-** Information extraction - Automatic summarization - Information retrieval and Question answering - Named entity recognition and relation extraction - IE using sequence labeling (5)

TUTORIAL PRACTICE:

1. Implementing word similarity.
2. Implementing simple problems related to word disambiguation.
3. Simple demonstration of part of speech tagging.
4. Lexical analyzer.
5. Semantic analyzer.
6. Translation from one language into another language
7. Word sense disambiguation

Total L: 45+T: 30 = 75

TEXT BOOKS:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2009.
2. Christopher Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing", MIT Press, 2003.

REFERENCES:

1. James Allen, "Natural Language Understanding", Addison Wesley, 2008.
2. Steven Bird, Ewan Klein, and Edward Loper, "Natural Language Processing with Python - Analyzing Text with the Natural Language Toolkit", O'Reilly Media, 2009.

18XWAJ DATA SCIENCE

3 2 0 4

INTRODUCTION TO DATA SCIENCE: Data wrangling, cleaning, and sampling to get a suitable data set - Mathematics for understanding the data – Descriptive statistics : Visualizing Data - Central Tendency –Variability –Standardizing -Normal Distribution -Sampling Distributions. (8)

DATA MANIPULATION AT SCALE: Parallel databases, parallel query processing, in-database analytics, MapReduce, Hadoop, Key-value stores and NoSQL; tradeoffs of SQL and NoSQL. (8)

DATA ANALYTICS USING STATISTICAL TECHNIQUES: Review of univariate regression, multiple regression - Linear regression and related methods - splines and regularization - Kernel methods - Generalized additive models - Kernel smoothing - Gaussian mixtures and EM algorithm - Geometry, subspaces, orthogonality, projections, normal equations, rank deficiency, estimable functions and Gauss-Markov theorem - Computation via QR decomposition, Gramm-Schmidt orthogonalization and the SVD - Multivariate normal distribution. (15)

COMMUNICATING RESULTS : Visualization - descriptive statistics and visualisations, privacy, ethics – multivariate visualization.(5)

SPECIAL TOPICS : Graph Analytics: structure, traversals, analytics, PageRank, community detection, recursive queries, Semantic web. (5)

CASE STUDY : Community Detection – Collaborative Network – Opinion mining – Co-citation network (4)

TUTORIAL PRACTICE:

1. Introduction to R and problems using R.
2. Collect datasets from Kaggle and Data Analysis.
3. Implementation of various predictive models.
4. Generate the results using Confidence levels.
5. Implementation of SVD.

Total L: 45+T:30 = 75

TEXT BOOKS:

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2011.
2. Ravi Kannan and John Hopcroft, "Foundations of Data Science", 2013.

REFERENCES:

1. Johannes Ledolter, 'Data Mining and Business Analytics with R', John Wiley, 2013
2. Gareth James and Daniel Witten, Trevor Hastie, Robert Tibshirani, "An Introduction to Statistical Learning with Applications in R", Springer, 2013.
3. Michael T. Longnecker, R. Lyman Ott," An Introduction to Statistical Methods and Data Analysis", Cengage Learning 2008.
4. T. Hastie, R. Tibshirani, and J. Friedman, "The elements of statistical learning: data mining, inference, and prediction", Springer, 2009.
5. Matthew A. Russell,"Mining the Social Web: Analyzing Data from Facebook, Twitter, LinkedIn, and Other Social Media Sites", O'Reilly Media, 2013.

18XWAK INTERNET OF THINGS

3 2 0 4

INTRODUCTION TO 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. (2)

IoT ARCHITECTURE: Functional Requirements - IoT Enabling Technologies – IPv6 - Basic Architecture - Components of IoT: Embedded Computation Units, Microcontrollers, System on Chip (SoCs) - Sensors – Actuators – Communication Interfaces. (7)

RF COMMUNICATION TECHNOLOGIES IN IoT: Wireless Sensor Networks (WSN): Overview, Fault Tolerance - RFID – NFC - 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. (7)

APPLICATION LAYER PROTOCOLS IN IoT: Rest Architecture - HTTP – CoAP: Architecture, Features, Applications - MQTT: Architecture, Feature, Applications - Comparing different IoT Application Layer Protocols. (7)

MODERN NETWORKING: 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. (8)

SECURITY IN IoT: IEEE 802.11 Wireless Networks Attacks: Basic Types, WEP Key Recovery Attacks, Keystream Recovery Attacks against WEP – RFID Security – Security Issues in ZigBEE: Eavesdropping Attacks, Encryption Attacks – Bluetooth Security: Threats to Bluetooth Devices and Networks – Blockchain in IoT security. (10)

PROTOTYPING: Prototyping embedded devices - Open Source versus Closed Source - Embedded Computing Basics - Arduino - Raspberry Pi - Implementation. (2)

APPLICATIONS IN IoT: Smart homes – Energy – Health Care – Smart Transportation – Smart Living – Smart Cities- Smart Grid – Smart Agriculture. (2)

TUTORIAL PRACTICE:

1. Simulating Wireless Sensor Networks
2. Connected Vehicle applications
3. Traffic Signal Monitoring & Control System
4. Smart home automation
5. IOT Based Person/Wheelchair Fall Detection
6. Gas Pipe Leakage Detector using Robot
7. Smart Energy Meter Monitoring
8. IOT Based Fire Department Alerting System

Total L: 45+P: 30=75

TEXTBOOKS:

1. Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things”, Springer, New York, 2011
2. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley and Sons Ltd, UK, 2014.
3. Thomas Erl, Dr. Zaigham Mahmood, Professor Ricardo Puttini,"Cloud Computing: Concepts, Technology & Architecture", PHI, 2013
4. Brian Russell, Drew Van Duren, "Practical Internet of Things Security", Packt Publishing, 2016

REFERENCES:

1. Olivier Hersent, David Boswarthick and Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, John Wiley and Sons Ltd., UK 2012.
2. Kai Hwang, Geoffery C.Fox, Jack J.Dongarra, “Distributed and Cloud Computing”, Elsevier, 2012.
3. William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud” Addison-Wesley, 2015
4. Jim Doherty, “SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization”, Addison-Wesley, 2016
5. Johnny Cache, Joshua Wright and Vincent Liu, “Hacking Exposed Wireless: Wireless Security Secrets and Solutions”, Tata McGraw Hill,, 2010.

18XWAL ADVANCED SYSTEMS PROGRAMMING

3 2 0 4

LINUX SYSTEM: Design Principles – Kernel Modules – Process Management Scheduling – Memory Management – Input-Output Management – File System – Interprocess Communication. iOS and Android: Architecture and SDK Framework – Media Layer – Services Layer – Core OS Layer. (6)

OVERVIEW OF SYSTEM CALLS - anatomy of a system call and x86 mechanisms for system call implementation - MMU/memory translation, segmentation, and hardware traps interact - create kernel-user context separation – virtualization. (6)

THE KERNEL EXECUTION AND PROGRAMMING CONTEXT: Live debugging and tracing – Hardware and software support for debugging – Dtrace: programming, implementation/design, internals – Kprobes and SysTrace: Linux catching up. (7)

LINKING AND LOADING – Executable and Linkable Format (ELF) – Internals of linking and dynamic linking – Internals of effective spinlock implementations on x86. (4)

PROCESS AND THREAD KERNEL DATA STRUCTURES – process table traversal – lookup, allocation and management of new structures - /proc internals – optimizations. (4)

VIRTUAL FILE SYSTEM AND THE LAYERING OF A FILE SYSTEM CALL FROM API TO DRIVER – Object-orientation patterns in kernel code – a review of OO implementation generics (C++ vtables, etc). (8)

KMEM AND VMEM ALLOCATORS. OO approach to memory allocation – Challenges of multiple CPUs and memory hierarchy – Overview of the kernel network stack implementation – Path of a packet through a kernel – Berkeley Packet Filter architecture – Linux Netflter architecture. (10)

TUTORIAL PRACTICE:
Case Studies

Total L: 45+P: 30=75

TEXT BOOK:
1. Robert Love, "Linux System Programming", O'Reilly, 2013

REFERENCES:
1. Yang Lixiang, Liang Wenfeng, "The Art of Kernel Linux design", CRC Press, 2016
2. Rami Rosen, "Linux Kernel Networking : Implementation and Theory", Apress, 2014.

18XWAM STATISTICAL LEARNING

3 2 0 4

THEORETICAL FOUNDATIONS : Function Spaces: Banach Spaces, Cauchy Sequences, Holder spaces, Sobolev spaces, reproducing kernel Hilbert spaces (RKHS),Concentration of Measure. (10)

LINEAR REGRESSION: Low Dimensional Linear Regression**,** Ridge Regression, Lasso Regression. (8)

NONPARAMETRIC REGRESSION : Kernel Estimators, Polynomial Estimators, Linear Smoothers, Cross Validation, Data Splitting, Additive Models, SpAM algorithm (7)

LINEAR CLASSIFICATION: Review of Classification Models, Newton's Method for Logistic Regression, Comparison of Logistic Regression with Linear Discriminant Analysis, Regularized Logistic Regression, SVM. (7)

NON-PARAMETRIC CLASSIFICATION: Plugin methods, k-NN, Boosting. (6)

MINIMAX RISK: Bounds of minimax risk, Le Cam's method, Fano's method, Tsybakov's method, Hypercubes. (7)

TUTORIAL PRACTICE:
Solve the following problems using R
1. Auto Regression, Ridge Regression and Lasso Regression for predictions.
2. Kernel PCA for non-linear datasets
3. Non linear SVM using different kernel functions
4. Classification using LDA and boosting

Total L: 45+P: 30 = 75

TEXT BOOKS:
1. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "An introduction to Statistical learning", Springer, 2013.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "Elements of Statistical Learning: Data Mining, Inference and Prediction", Springer, 2013.

REFERENCES:
1. Vladimir N Vapnik, "Statistical learning theory", Wiley, 1998.
2. Robert Schapire, Yoav Freund, "Boosting : Foundations and Algorithms", The MIT Press, 2012.

18XWAN VIRTUAL AND AUGMENTED REALITY

3 2 0 4

INTRODUCTION TO VR AND AR: Overview of class, logistics, history of VR/AR. (5)

THE GRAPHICS PIPELINE AND OPENGL: Overview and Transformations: rotation, translation, scaling, model view matrix, projection matrix, Lighting and Shading. (7)

OPENGL SHADING LANGUAGE (GLSL):GLSL vertex and fragment shaders. (5)

THE HUMAN VISUAL SYSTEM: Perception of depth, color, contrast, resolution, Stereo Rendering. (5)

HEAD MOUNTED DISPLAY OPTICS: Magnifier designs, stereo rendering for HMDs, lens distortion correction, advanced HMD optics. (7)

INERTIAL MEASUREMENTS UNITS: gyros, accelerometers, magnetometers, sensor fusion, complementary filter, Arduino (6)

POSITIONAL TRACKING: Tracking with the light house, advanced positional tracking. **SPATIAL SOUND**. (5)

PANORAMIC IMAGING AND CINEMATIC VR: VR Engines and Other Aspects of VR (latency, eye tracking, post-rendering warp) (5)

TUTORIAL PRACTICES:

1. Lab: Hello, WebGL!
2. Lighting and shading with GLSL
3. Stereo rendering, anaglyph
4. Building Own Head Mounted Display
5. Build Your Own IMU, Arduino Programming
6. Positional Tracking
7. Spatial Sound
8. Content creation with unity (Optional)

Total L: 45+P: 30=75

TEXT BOOKS:

1. Marschner, Shirley, “Fundamentals of Computer Graphics”, CRC Press, 2016.
2. La Valle, “Virtual Reality”, Cambridge University Press, 2016.

REFERENCES:

1. Jos Dirksen, "Learning Three.js: The JavaScript 3D Library for WebGL", Packt Publishing, 2013
2. Jacobo Rodriguez, "GLSL Essentials: Enrich your 3D scenes with the power of GLSL!", Packt Publishing, 2013.

OPEN ELECTIVES

18XWO1 ENTERPRENEURSHIP

3 2 0 4

INTRODUCTION TO ENTREPRENEURSHIP: Definition – Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs – Importance or Entrepreneurship. Seminar in R5 & R6. (5)

CREATIVITY AND INNOVATION: The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. (6)

DEVELOPING AN EFFECTIVE BUSINESS MODEL: The Importance of a Business Model – Starting a small scale industry - Components of an Effective Business Model. (5)

APPRAISAL OF PROJECTS: Importance of Evaluating Various options and future investments- Entrepreneurship incentives and subsidies – Appraisal Techniques. (8)

FORMS OF BUSINESS ORGANIZATION: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. (4)

FINANCING THE NEW VENTURE: Determining Financial Needs – Sources of Financing – Equity and Debt Funding – Case studies in Evaluating Financial Performance. **(**8)

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**.** (5)

INTELLECTUAL PROPERTY PROTECTION AND ETH ICS: Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges. (4)

TUTORIAL PRACTICE:

Case studies

Total L: 45+T: 30=75

TEXT BOOKS:

1. Donald F.Kuratko and Richard M.Hodgetts, “Entrepreneurship”, South-Western, 2003.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2010.

REFERENCES:

1. S.L.Gupta, Arun Mittal, “Entrepreneurship Development”, International Book House, 2012.
2. G. S. Sudha, “Management and Entrepreneurship Development”, Indus Valley Publication, 2009.
3. V. Badi, N. V. Badi , Business Ethics, R, Vrinda Publication, 2012.
4. Prasanna Chandra Projects- Planning, Analysis, Financing, Implementation andreview, TATA McGraw Hill, 2012.

18XWO2 COMPUTER FORENSICS

3 2 0 4

COMPUTER AND FORENSICS: Introduction – Stand-alone computer crimes –Computer evidence – Computer Forensics evidence and courts –Internet laws and statutes; Forensics process – Securing evidence – Law enforcement and methodology. (8)

FORENSICS EVIDENCE: Sources – Seizure – Collection – Integrity – Handling; Acquisition and Duplication of data. (8)
DATA ANALYSIS: Metadata extraction – File Signature analysis – System analysis – Examining unallocated space – Data carving – Recovering deleted data and partitions (6)

WINDOWS FORENSICS: Registry Analysis – Executable file analysis – Recycle Bin Forensics – Evidence Recovery from Print and Spool files. (5)

INTERNET FORENSICS: Domain Name Ownership Investigation – Email Forensics – Messenger Forensics – Browser Forensics. (6)

MOBILE DEVICE FORENSICS: Hand-held devices and Forensics – Reconstructing user's activities and deleted data. (4)

MEMORY FORENSICS AND MALWARE ANALYSIS: Memory data collection and Examination – Analyzing Windows and Linux systems for malware – Reverse Engineering tools and techniques. (6)

ANTI-FORENSICS: Erasing Evidence. (2)

TUTORIAL PRACTICE:
1. Implementation of data analysis techniques.
2. Implementation of system analysis concepts.
3. Implementation of email forensics concepts.
4. Implementation of hand-held device forensics activities.

Total L: 45+T: 30=75

TEXT BOOKS:

1. Marjie T. Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson Education, 2013.
2. Linda Volonino, Reynaldo Anzaldua, Jana Godwin, "Computer Forensics: Principles and Practices", Pearson/Prentice Hall, 2007

REFERENCES:

1. Chuck Easttom, "System Forensics, Investigation, and Response", Jones & Bartlett Publishers, 2014.
2. SatishBommisetty, RohitTamma, Heather Mahalik, "Practical Mobile Forensics", Packt Publishing Ltd, 2014.
3. Robert Jones, "Internet Forensics ", O'Reilly Media, 2005.

18XWO3 WIRELESS NETWORKS

3 2 0 4

WIRELESS FUNDAMENTALS: 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. (7)

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. (8)

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. (8)

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. (8)

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 (6)

FUTURE TRENDS: Emerging WLAN Related Technologies – 802.11 Trends – Cellular – 802.16 – 802.20 – 802.22 – UWB, Cognitive Radios, RFID – 4G and Data Communications Convergence. (8)

TUTORIAL PRACTICE:
1. Study of OMNET++/NS-2 simulator.
2. Simulation of a IEEE 802.11 LAN under various conditions using chosen simulator.
3. Simulation of a priority MAC protocol using chosen simulator.
4. Simulation of different routing protocols using simulators.
5. Simulation of TCP over error-prone wireless network using simulator.
6. Development of Mobile application using blue tooth.

Total L: 45+T: 30 = 75

TEXT BOOKS:

1. Gary. S. Rogers and John Edwards, "An Introduction to Wireless Technology", Pearson Education, 2012.
2. SivaRam Murthy C and B.S Manoj, "Ad hoc Wireless Networks Architecture and Protocols", Pearson Education, 2005.
3. Kaveh Pahlavan, Prashant K. Krishnamurthy, "Principles of Wireless Networks : A Unified Approach", John Wiley, 2011.
4. William Stallings, "Wireless Communication and Networks", Pearson Education, 2009.

REFERENCES:

1. Dharma Prakash Agrawal and Qing-An Zeng, "Introduction to Wireless and Mobile Systems", Thomson Press, 2007.
2. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks-An Information Processing Approach", Elsevier, 2004.
3. Clint Smith, P.E. and Daniel Collins, "3G Wireless Networks", Tata McGraw Hill, 2007.

4. Ivan Stojmenovic, “Handbook of Wireless Networks and Mobile Computing”, John wiley, 2006.
5. SavoGlisic, “Advanced Wireless Communications 4G Technologies”, Wiley Publications, 2006.

18XWO4 RANDOMIZED ALGORITHMS

3 2 0 4

INTRODUCTION: Randomized algorithms, randomized quick sort, Karger’s min-cut algorithm Las Vegas and Monte Carlo algorithms, computational models and complexity classes. (5)

MOMENT, DEVIATION AND TAIL INEQUALITIES: Occupancy problem**,** Markov and Chebyshev inequalities- randomized selection- coupon collector’s problem, the Chernoff bound- routing in a parallel computer- a wiring problem. (7)

PROBABILISTIC METHODS: Overview of the method-maximum satisfiability - finding a large cut, Expander graphs. (5)

MARKOV CHAINS AND RANDOMWALKS: Markov chains, Random walk on graphs - connectivity in undirected graphs – Expanders and rapidly mixing random walks. (6)

DATA STRUCTURES AND GRAPH ALGORITHMS: Random Treaps, hashing – hash tables – perfect hashing, skip lists **-** Fast in-cut. (6)

ONLINE ALGORITHMS: Paging problem-adversary models- paging against an oblivious adversary-relating the adversaries-the adaptive online adversary, k-server problem. (5)

PARALLEL AND DISTRIBUTED ALGORITHMS: Sorting on a PRAM – Maximal Independent sets. (4)

NUMBER THEORETIC ALGORITHMS:, Polynomial roots and factoring, primality testing. (3)

DERANDOMIZATION: The method of Conditional Probabilities – Derandomizing max-cut algorithm – Constructing pairwise independent values modulo a prime - Pairwise independent – large cut. (4)

TUTORIAL PRACTICE:
1. Implementation of randomized quick sort and solve real time problems using it.
2. Find solution for s-t min-cut problem adapting min cut algorithm.
3. Implementation of randomized selection and problems related to it.
4. Implementation of treap data structure.
5. Problems using randomized hash table.
6. Implement the shortest path and fast min-cut algorithms.
7. Implementation of randomized primality testing.
8. Implement the K-server on-line algorithms.

Total: L: 45+T: 30 = 75

TEXT BOOKS:
1. Motwani R and RaghavanP,“Randomized Algorithms”, Cambridge University Press, 2010.
2. Michael Mitzenmacher and Eli Upfal, “Probability & Computing: Randomized Algorithms and Probabilistic Analysis”, Cambridge University Press, 2009.

REFERENCES:
1. Thomas H Cormen, Charles E Leiserson and Ronald L Rivest, “Introduction to Algorithms”, MIT Press, 2009.
2. AnanyLevitin, “Introduction to Design and Analysis of Algorithms”, Pearson Education, 2011.

18XWO5 APPLIED GRAPH THEORY

3 2 0 4

BASIC CONCEPTS: Graphs - directed and undirected, subgraphs, graph models, degree of a vertex, degree sequence, Havel-Hakimi theorem, Hand-shaking lemma. Connectivity, walk, path, distance, diameter. Isomorphic graphs. Common classes of graphs – regular, complete, petersen, cycle, path, tree, k-partite, hypercube, Spanning trees – Matrix tree theorem, graph decomposition. (6)

CONNECTIVITY: Vertex and edge connectivity, Vertex and edge cuts, relationship between vertex and edge connectivity, bounds for connectivity. Harary’s construction of k-connected graphs. (8)

EULERIAN AND HAMILTONIAN GRAPHS: Eulerian graphs, Route inspection problem, Hamiltonian graphs, Gray codes and Hypercubes, Travelling sales person problem. (8)

MATCHING, VERTEX-COLORING AND DOMINATION: Matching (unweighted), Perfect matching, Hall’s theorem, assignment problem, augmenting path algorithm. Vertex-coloring – bounds, assignment of frequencies, fast register allocation, scheduling problem. Dominating set, domination number, bounds, connected dominating set in Ad Hoc Networks. (11)

PLANAR GRAPHS: Properties, Kuratowski’s theorem, Hopcroft Tarjan Planarity testing algorithm. (5)

RANDOM GRAPHS: Random graph – Definitions of G(n, p) and G(n, M) models, power law degree distribution, Web graph models, applications to social networks. (7)

TUTORIAL PRACTICE:
Case Studies

Total L:45+T:30=75

TEXT BOOKS:
1. Anthony Bonato, “A Course on Web Graphs”, American Mathematical Society, 2008.
2. Haynes T W, Hedetniemi and Slater P J, “Fundamentals of Domination in Graphs”, CRC Press, 2015.
3. Jonathan Gross and Jay Yellen, “Graph Theory and its Applications”, CRC Press, 2005.

REFERENCES:
1. Douglas B West, “Graph Theory”, Prentice Hall, 2009.
2. Bondy J A, Murty U S R, “Graph Theory”, Springer, 2013.

18XWO6 NETWORK FORENSICS

3 2 0 4

INTRODUCTION : Footprints - Concepts in Digital Evidence - Network Forensics Investigative Methodology (OSCAR) - Sources of Network-Based Evidence - Evidence Acquisition (6)

TRAFFIC ANALYSIS: Protocol Analysis - Packet Analysis - Flow Analysis – Higher Layer Traffic Analysis (8)

STATISTICAL FLOW ANALYSIS: Process Overview – Sensors - Flow Record Export protocols - Collection and Aggregation – Analysis. (7)

NETWORK INTRUSION DETECTION AND ANALYSIS: Why Investigate NIDS/NIPS? -Typical NIDS/NIPS Functionality - Modes of Detection - Types of NIDS/NIPSs - NIDS/NIPS Evidence Acquisition - Comprehensive Packet Logging - Snort (9)

EVENT LOG AGGREGATION, CORRELATION, AND ANALYSIS: Sources of Logs - Network Log Architecture - Collecting and Analyzing Evidence – Switch Evidence – Router Evidence – Firewall Evidence (6)

WEB PROXIES: Why Investigate Web Proxies? - Web Proxy Functionality - Evidence - Squid - Web Proxy Analysis - Encrypted Web Traffic (9)

TUTORIAL PRACTICE:
1. Analysis of the packets and flow analysis using Wireshark and tshark.
2. Analysis of higher level protocols like DHCP, DNS, SMTP
3. Familiarize with various tools like netflow, silk for flow analysis
4. Familiarize with Network Intrusion detection tools like Snort
5. Log analysis and event correlation
6. Web proxy analysis.

Total L: 45+T: 30=75

TEXT BOOKS:
1. Davidoff, Sherri, and Jonathan Ham, “ Network forensics: tracking hackers through cyberspace” Vol. 2014. Upper Saddle River: Prentice hall, 2012.

REFERENCES:
1. Investigating Network Intrusions and Cybercrime, EC Council, 2016.
2. Jessy Bullock, Jeff Parker, Wireshark for Security Professionals: Using Wireshark and the Metasploit Framework , Wiley, 2017.
3. Bejtlich, Richard. The practice of network security monitoring: understanding incident detection and response. No Starch Press, 2013.

18XWO7 APPLIED NUMERICAL ANALYSIS

3 2 0 4

TYPES OF ERRORS: Different types of error. (3)

SOLUTION OF ALGEBRAIC EQUATIONS: Newton Raphson method, Modified Newton Raphson method, Method of false position, Graffe’s root squaring method, Bairstow’s method. (4)

SOLUTION OF ALGEBRAICSIMULTANEOUS EQUATIONS: Gauss – Jordan elimination, Cholesky method, Crout’s method, Gauss – Jacobi method, Gauss – Seidel method. Matrix Inverse by Gauss – Jordan method. (6)

EIGENVALUES AND EIGENVECTORS: Power method for finding dominant eigenvalue and inverse power method for finding smallest eigenvalue, Jacobi method for symmetric matrices. (7)
INTERPOLATION AND CURVE FITTING: Finite difference operators-Interpolating Polynomials, Divided Difference, Spline Curves, Bezier Curves and B-Spline Curves.Solution of linear second order difference equations with constant coefficients. (7)

NUMERICAL DIFFERENTIATION AND INTEGRATION: Numerical Differentiation using Newton forward and backward formulas. Numerical Integration: Newton –Cotes formula, Trapezoidal rule, Simpson”s $(1/3)^{rd}$ and $(3/8)^{th}$ rule . Gaussian Quadrature Applications of Cubic Splines. (8)

PARTIAL DIFFERENTIAL EQUATIONS: Classification of partial differential equations of second order. Liebmann’s method for Laplace equation and Poisson equation, Explicit method and Crank – Nicolson method for parabolic equations. Explicit method for hyperbolic equations. (10)

TUTORIAL PRACTICE:
1. Solution of algebraic and transcendental equations

2. Solving linear system of equations by direct and iterative methods
3. Computing Eigenvalues and Eigenvectors
4. Interpolation with unequal intervals and equal intervals
5. Numerical Differentiation and Integration
6. Numerical solutions of Solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equation

Total L: 45+T: 30=75

TEXT BOOKS:

1. Steven C. Chapra and Raymond P. Canale, "Numerical Methods for Engineers with Software and Programming Applications", McGraw Hill, 2011.
2. Curtis F. Gerald, and Patrick O. Wheatley, "Applied Numerical Analysis" Pearson, 2011.
3. Yousef Saad. "Numerical methods for large eigen value problems", University Press, 2011.

REFERENCES:

1. Richard L. Burden and Dougglas Faires J., "Numerical Analysis", Thomson Brooks/Cole, 2005.
2. Brian Bradie, "A Friendly introduction to Numerical Analysis", Pearson, 2006.

18XWO8 ENVIRONMENTAL SCIENCE AND GREEN COMPUTING

3 2 0 4

NATURAL RESOURCES, ECOSYSTEMS AND BIODIVERSITY: Environment, Definition, Scope and importance, Forest resources, Use and overexploitation, Water resources: Use and over utilization. Eco system; Structure and functions of an eco system, energy flow in the eco system. Bio Diversity; values of biodiversity, biodiversity at global, national and local levels – threats to bio diversity. Conservation of bio diversity – In-situ & Ex-situ conservation. (9)

ENERGY SOURCES: Growing energy needs, Renewable and non renewable energy sources, Hydro power, Solar Power: Photovoltaic Energy – Motivation for going Solar – Solar Electricity – PV cells. Wind Power: – Using the Wind: Generating Power at Remote Sites,– Measuring the Wind – Estimating the output. Use of alternate energy sources. (9)

SOCIAL ISSUES AND THE ENVIRONMENT: From unsustainable to sustainable development, Urban problems related to energy, Water conservation, Rain water harvesting, Watershed management, Environment and human health, Role of information technology in environment and human health. Environment Protection Act: Air (Prevention and Control of Pollution) Act – Water Act, Forest Conservation Act, Wildlife Protection Act, Introduction to EIA and ISO 14000. (9)

ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT: Definition – causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and nuclear hazards. Disaster management - floods, earthquake, cyclone and landslides. Solid waste management - causes, effects and control measures of municipal solid wastes (Biomedical wastes, hazardous wastes). Role of an individual in prevention of pollution. (9)

GLOBAL ATMOSPHERIC CHANGE& GREEN FUNDAMENTALS: The Atmosphere of Earth – Global Temperature – Global Energy Balance , The Greenhouse Effect - Environmental Issues and Green Computing, Electronic waste management: Introduction;- Environment and society, producer responsibility legislation – the Waste Electrical and Electronic Equipment (WEEE) directive, Materials Composition of WEEE: Mobile Phones – Television – Washing Machines, - Current and new electronic waste recycling technology- Future perspectives of electronic scrap. (9)

TUTORIAL PRACTICE:

Case Studies

Total L: 45+T: 30=75

TEXT BOOKS:

1. Mackenzie L. Davis, and David A. Cornwell, "Introduction to Environmental Engineering", Tata McGraw Hill, 2010.
2. Chetan Singh Solanki, "Solar Photovoltaics", PHI, 2011.
3. Siraj Ahmed, "Wind Energy : Theory and Practice", PHI, 2011.
4. Mahajan S. P. Pollution Control in Process Industries, Tata McGraw Hill, 1985.
5. R. E. Hester and R. M. Harrison, "Electronic Waste Management", Royal Society of Chemistry, 2009.

REFERENCES

1. William W. Nazarodd and Lisa Alvarez-Cohen, "Environmental Engineering Science", Wiley-India, 2010
2. Anubha Kaushik and Kaushik C P, "Environmental Science and Engineering", New Age International, 2005.
3. Martha Maeda, "How to Solar Power your Home", Atlantic Publishing Group, 2011.
4. Paul Gipe, "Wind Power – Renewable Energy for Home, Farm and Business", Sterling Hill Publications, 2008.
5. Klaus Hieronymi, RamzyKahhat, Eric Williams, "E-Waste Management : From Waste to resource", Routledge – Taylor and Fransis, New York, 2012.
6. Diane GowMcdilda, "The Everything Green Living Book", Adams Media, 2007.

18XWO9 QUANTUM MECHANICS AND FUNDAMENTALS OF QUANTUM COMPUTATION

3 2 0 4

WAVE MECHANICAL CONCEPTS AND FORMALISM: wave nature of particles – Interpretation of wave function- principle of super position- wave packet- uncertainty principle - Schrödinger's time dependent and independent wave equations – Postulates of quantum mechanics – vector space-Linear and Hermitian operators - simultaneous measurability of observable (7)

ONE DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS: Square well potential with rigid walls- Square well potential with finite walls- Square potential barrier – Linear Harmonic Oscillator (6)

THREE DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS: Schrödinger's equation in spherical polar coordinates- The hydrogen atom- Angular momentum-spin (8)

QUANTUM COMPUTATION: History of quantum computation and quantum information-qubits-qubit gates-quantum circuits-quantum teleportation-quantum entanglement (12)

QUANTUM COMPUTER-PHYSICAL REALIZATION: Guiding principles-conditions for quantum computation-Harmonic oscillator and optical photon quantum computer-physical apparatus -quantum computation-drawbacks (12)

TUTORIAL PRACTICE:

Graphical visualisation with MATLAB

1. Square well potential with rigid walls
2. Square well potential with finite walls
3. Square potential barrier
4. Linear Harmonic Oscillator

Total L: 45 + T:30=75

TEXT BOOKS:

1. David J Griffiths, "Introduction to Quantum Mechanics", Cambridge University Press, 2017
2. Aruldhas G, "Quantum Mechanics", PHI, 2011.
3. Micheal A Nielsen, Isaac L Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 2010.

REFERENCES:

1. Mathews P M and Venkatesan K, "A Text book of Quantum Mechanics", Tata McGraw Hill, 2007.
2. Dirac P A M, "Principles of Quantum Mechanics", Oxford University Press, 2006.
3. Edward L Wolf, "Quantum Nanoelectronics", Wiley Vch Verlag GmbH & Co, Weinheim, 2009.
4. Eisberg R, and Resnick R. "Quantum Physics of Atoms, Molecules, Solids", Nuclei and Particles, Wiley-India, 2007.

18XWOA COMPUTATIONAL FOUNDATIONS FOR ROBOTICS

3 2 0 4

INTRODUCTION: Robots and their applications in industry, mobile and service applications, Configurations of industrial and mobile robots. Robot controllers, drives, actuators and sensors, Spatial descriptions and Transformations: Positions, orientations and frames, Mappings, translations, rotations and transformations, transformation arithmetic, Transform equations, representation of orientation, free vector transformation, Introduction to ROS. (8)

FORWARD AND INVERSE KINEMATICS: Link co-ordinates, D-H Representation, Arm equation -Two axis and three axis, robots**,** Inverse kinematics of two axis and three axis robots, Maneuverability – Workspace – Control. (9)

LOCALIZATION AND MAPPING: Challenges in mobile robots, Introduction - Bayes filter – Kalman Filter - Extended Kalman Filter - Information Filter - Histogram Filter - Particle Filter –Localization- Map Representation- Probabilistic Map based Localization-Monte carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization – Mapping - Metrical maps - Grid maps - Sector maps – Hybrid Maps – SLAM (10)

DECISION MAKING: Discrete planning and dynamic programming principles, Configuration space abstraction, Sampling-based planners for mobile robots, Feedback-based planning for mobile robots- Feedback in discrete spaces, wave-front functions, Potential and navigation functions for mobile robots. (9)

PLANNING AND NAVIGATION: Overview of the three computational components and their interaction, sensing, planning, and control - Global path planning – A* Algorithm - local path planning - Road map path planning- Cell decomposition path planning-Potential field path planning-Obstacle avoidance – Path control. Markov Decision Process (MDP) in discrete spaces, optimal control and steering methods- Nonlinear optimization and gradient methods. (9)

TUTORIAL PRACTICE:

1. Robot Operation System (ROS) basics
2. Localization
3. Path planning and navigation
4. Multi-robot coordination

Total L: 45 + T: 30 = 75

TEXT BOOKS:

1. John J. Craig, "Introduction to Robotics: Mechanics and Contro", Pearson Education, 2008
2. Steven M. LaValle, "Planning Algorithms", Cambridge University Press, 2006.
3. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George A. Kantor, Wolfram Burgard, Lydia E. Kavraki, and Sebastian Thrun, "Principles of Robot Motion:Theory, Algorithms, and Implementations", (PRMTAI), MIT Press, 2005.

REFERENCES:

1. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, "Robot Modeling and Control", Wiley, 2006.
2. Kevin M. Lynch and Frank C. Park, "Modern Robotics: Mechanics, Planning, and Control", Cambridge University Press, 2017.

3. Roland Siegwart, Illah Reza Nourbakhsh and DavideScaramuzza, “Introduction to Autonomous Mobile Robots”, MIT Press, 2004.

18XWOB MATHEMATICAL MODELLING

3 2 0 4

INTRODUCTION TO MODELING: Modeling process, Overview of different kinds of model. (3)

EMPIRICAL MODELING WITH DATA FITTING: Error function, least squares method; fitting data with polynomials and splines. (4)

CAUSAL MODELING AND FORECASTING: Introduction, Modeling the causal time series, forecasting by regression analysis, predictions by regression. Planning, development and maintenance of linear models, trend analysis, modeling seasonality and trend, trend removal and cyclical analysis, decomposition analysis. Modeling financial time series. Econometrics and time series models. Non seasonal models: ARIMA process for univariate and multivariate. (8)

INVENTORY MODELS: Classic Economic Order Quantity (EOQ) Model, EOQ with price breaks, Multi-item EOQ with Storage limitation, Dynamic EOQ , Probabilistic EOQ model , No setup model, Setup model (s-S Policy). (7)

PORTFOLIO MODELING AND ANALYSIS: Portfolios, returns and risk, risk-reward analysis, asset pricing models, mean variance portfolio optimization, Markowitz model and efficient frontier calculation algorithm, Capital Asset Pricing Models (CAPM). (8)

MODELING WITH BIOINFORMATICS: Introduction, Biological data- types, mode of collection, documentation and submission. Sequence alignment- Definition, significance, dot matrix method, dynamic programming- Global and local alignment tools, scoring matrices and gap penalties. Multiple sequence alignment: Iterative methods. Hidden Markovian models, statistical methods, position specific scoring matrices. (15)

TUTORIAL PRACTICE:

1. Algebraic Models: Linear, Quadratic, and Exponential.
2. Polynomial curve fitting and cubic spline curve fitting.
3. Time series analysis and forecasting models.
4. Portfolio optimization models.
5. Cox-Ross-Rubinstein (CRR) model.
6. Risk analysis models.
7. Pair wise sequence alignment using dynamic programming.
8. Multiple sequence alignment using Hidden Markovian models

Total L: 45+P: 30=75

TEXT BOOKS:

1. Giordano F R, Weir M D and Fox W P,“A First Course in Mathematical Modeling”, Brooks/Cole, 2008.
2. Mount, DW, “Bioinformatics Sequence and genome analysis”, Cold Spring Harbor Laboratory, 2004.

REFERENCES:

1. Hamdy A Taha, “Operation Research- An Introduction”, Pearson Education, 2014.
2. Christoffersen P, “ Elements of Financial Risk Management”, Academic Press, 2012.
3. Capinski M. and Zastawniak T,“Mathematics for Finance: An Introduction to Financial Engineering”, Springer, 2010.
4. Alexander Isaev, Introduction to Mathematical Methods in Bioinformatics, Springer, 2006.