SYLLABUS FOR

M.Sc. (Computer Science)

(Two years Program)

(Academic Session 2021-23)

DEPARTMENT OF COMPUTER SCIENCE RAVENSHAW

UNIVERSITY

CUTTACK, 753003

Ravenshaw University
Course Structure of M.Sc. (Computer Science) 2021-2023

FIRST SEMESTER

Subject Code	Subject Name	Mid Term Marks	End Term Marks	Credit
CSC -1.1	Probability and Stochastic Process	20	80	4
CSC -1.2	Advanced Computer Architecture	20	80	4
CSC -1.3	Advanced Data Structure	20	80	4
CSC -1.4	Computer Graphics	20	80	4
CSC -1.5	Advanced Data and Computer Networks	20	80	4
CSC -1.6	Advanced Data Structure Lab	25	50	2
CSC -1.7	Computer Graphics Lab	25	50	2
Total		500 (Theory) + 150 (Practical) =650		24

SECOND SEMESTER

Subject Code	Subject Name	Mid Term Marks	End Term Marks	Credit
CSC -2.1	Linear Algebra and Numerical Optimization	20	80	4
CSC -2.2	Data Mining and Data Warehousing	20	80	4
CSC -2.3	Artificial Intelligence	20	80	4
CSC -2.4	Design and Analysis of Algorithms	20	80	4
CSC -2.5	Elective – I	20	80	4
CSC -2.6	Linear Algebra and Numerical Optimization Lab	25	80	2
CSC -2.7	Design and Analysis of Algorithms Lab	25	50	2
Total		500 (Theory) + 150 (Practical) =650		24

THIRD SEMESTER

Subject Code	Subject Name	Mid Term Marks	End Term Marks	Credit
CSC -3.1	Soft computing	20	80	4
CSC -3.2	Cryptography and Network Security	20	80	4
CSC -3.3	Machine Learning	20	80	4
CSC -3.4	Elective – II	20	80	4
CSC -3.5	Elective – III	20	80	4
CSC -3.6	Soft computing Lab	25	50	2
CSC -3.7	Machine Learning Lab	25	50	2
Total		500 (Theory) + 150 (Practical) =650		24

FOURTH SEMESTER

Subject Code	Subject Name	Mid Term Marks	End Term Marks	Credit
CSC-4.1	Elective – IV	20	80	4
CSC-4.2	Elective – V	20	80	4
CSC-4.3	Comprehensive Viva-voce	-	100	4
CSC-4.4	Dissertation	-	250	12
Total	200 (Theory) + Viva-voce (100) + 250 (200 (Dissertation Evaluation) + 50 (Presentation)) = 650			24

Total Marks: 650+650+650+550=2500
Total Credits: 24+24+24+24=96

Note: Elective-I, Elective-II and Elective-IV are chosen from Group-A
Elective-III & Elective-V are chosen from Group-B

Group-A

A1. Parallel Computing
A2. Internet of Things
A3. Complex Networks
A4. Digital Signal Processing
A5. Network Science
A6. Mobile Ad hoc Network
A7. Software Evolution
A8. Quantum Computing
A9. Digital Image Processing
A10. Embedded Systems
A11. Systems Modeling & Simulation
A12. Bioinformatics
A13. Time Series Analysis and Prediction
A14. Mobile Communications
A15. Compiler Design
A16. Deep Learning
A17. Computational Finance

Group-B

B1. Cloud Computing
B2. Natural Language Processing
B3. Wireless Sensor Networks
B4. Advanced Software Engineering
B5. Information Theory and Coding Techniques

B6. Cognitive Radio Networks
B7. Computational Neuroscience
B8. Multimedia and Computer Visions
B9. Big Data Analytics
B10. Web Mining and Knowledge Discovery

VALUE ADDED COURSES

Subject Code	Subject Name	End Term Marks	Credit
VA-1	.Net Framework	50	2
VA-2	Android Programming	50	2

ADD-ON COURSES

Subject Code	Subject Name	End Term Marks	Credit
AO-1	Internet Technology	50	2
AO-2	Cyber Security	50	2

FIRST SEMESTER

Probability and Stochastic Process (CSC-1.1)
Full Marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The objective of the course is to introduce the basic principles, techniques and application of Probability and Stochastic Process. The course is oriented towards conditional probability (Baye's Rule), random variables and its probability function, expected value of random variable, the Central Limit Theorem, probability distributions, fundamentals of stochastic process and its application in Queuing System.

Learning Outcomes:

After successful completion of this course, students would be able to:

- Understand concepts of probability, Independent and Dependent Events, conditional probability.
- Understand concepts of discrete and continuous random variable, probability function of random variables, and application of random variables in real life problem.
- Calculate expected value, variance of random variable, joint probability distribution. random variable and its distributions of function. Obtain knowledge of various discrete and continuous probability distributions and their application in real life problem.
- Understand fundamentals of stochastic process and its related terminologies, understand Markov chains and its application.
- Apply stochastic process in Queuing System in real life problem i.e., in shopping mall queuing problem, parking area of vehicle problem, order of items in online shopping problem etc.

Unit I

Probability: Introduction to Probability, Sample Space and Events, The complement of an Event, Mutually Exclusive Events, Additional Rules for Probability, Independent and Dependent Events, Conditional Probabilities, , Bayes Formula.

Unit II

Random variables-What is random variable. Cumulative distribution function, Discrete Random Variables: Definition of probability mass function, The Bernoulli Random Variable, The Binomial Random Variable, The Geometric Random Variable, The Poisson Random Variable.

Continuous Random Variables: Definition of probability density function, The Uniform Random Variables, Exponential Random Variables, Gamma Random Variables, Normal Random Variables.

Unit III

Expectation of Random Variables: The Discrete Case and the Continuous Case. Expectation of a Function of a Random Variables, Jointly Distributed Random Variables: Joint Distribution Function, Independent Random Variables. Covariance and Variance, Moment Generating Functions. Markov's and Chebyshey's Inequality, Central Limit Theorem.

Unit IV

Stochastic processes: Definition with examples, Markov chains, Chapman Kolmogorov equations, Classification of states, Limiting Probabilities, some applications: The gambler's Ruin problem.

The Exponential Distribution: Definition, Properties of the Exponential Distribution.

The Poisson Process: Counting Processes, Definition of Poisson Process, Inter-arrival and Waiting Time Distributions, Properties of Poisson Processes, Conditional Distribution of the Arrival Times.

Unit V

Continuous-time Markov Chains. Birth-and-death processes, Transition probability function, Limiting Probability.

Queuing Theory: Preliminaries, Steady State Probabilities, A single Server Exponential Queuing System (M/M/1), A single server Exponential Queuing System Having Finite Capacity, Network of Queues. A Queuing System with Bulk Service.

Books:

Texts:

1. Introduction to Probability Models by Sheldon M. Ross, Academic Press Harcourt India Private Limited.

References:

1. An Introduction to Probability and Statistics by V. K. Rohatgi and A.K. Md. Ehasanes Saleh, Second edition, John Wiley and Sons.

Advanced Computer Architecture (CSC-1.2)
Full Marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The primary objective of Computer Organization and Architecture is to understand the concept of digital and binary system. The representation of data and digital logic circuits used in the computer system, it describes the design principles of electronic logic gates and combinational logic circuits and their implementation.

Course Outcomes:

Upon successful completion of this course, the student shall be able to:

- Understand number systems, conversion, and Fixed- and Floating-point representation, rules of Boolean algebra.
- Understand Boolean algebra, Encoder, Decoder, Multiplexer, DE multiplexers, Registers and Counter.
- Determine the different types of addressing modes, types of memory.
- Compare inter processor communication and synchronization.
- Summarize pipeline and vector processing, input output devices.

Unit I

Information Representation: Number systems, Binary numbers, Sign Magnitude & 2's complement representation. Fixed and Floating point, IEEE-754 Single Precision format, IEEE-754 Double Precision format, Precision and range, BCD code, ASCII and EBCDIC

Digital Electronics: Boolean Algebra, Logic gates, Truth Tables, Combinational circuits, Karnaugh map, Flip flops, Sequential circuits.

Unit II

Combination RTL Components: Integrated circuits, Multiplexer, Demultiplexers, Decoder, Encoder, Registers, Shift Registers, Binary Counters, Memory Unit - RAM, ROM. Parity generators and checkers, Adder/Subtracter, Programmable Logic Devices- PLA, PAL, ROM. Sequential RTL components : Registers counters.

Unit III

Central Processing Unit: General Register Organization, Stack Organization, Reverse Polish Notation, Machine Language instructions, addressing modes, Instruction types, Instruction set selection, Instruction cycle and execution cycle. Fundamental of assembly language Programming using 8085 microprocessor, RISC vs CISC

Unit IV

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

Multiprocessors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor Arbitration, Interprocessor communication and Synchronization, Cache Coherence.

Unit V

Pipeline and Vector Processing: Parallel processing, Pipelining, Arithmetic Pipeline, Instruction pipeline, RISC Pipeline, Vector Processing, Array Processing.

Input-Output devices and characteristics, Input-output mechanism: Memory-mapped I/O, Programmed I/O, Interrupts, Direct Memory Access.

Books:

Texts:

1. J. L. Hennessy & D. A. Patterson – Computer Architecture – A Quantative approach 2nd Edition –Mergan Kaufman Pub – 1996
2. V. C. Hammacher, Z. G. Vranesic, S. G. ZAky – Computer Organization McGraw Hill 1996
3. Mano M, Computer System and Architecture (3rd Ed) (PHI)

Reference:

1. K. Hwang – Advanced Computer Architecture, McGraw Hill, 1993
2. D. Sima, T. Fountation, P. Kacsak – Advanced Computer Architecture – A design space Approach, Addison Wesley, 1997

Advance Data Structure (CSC-1.3)
Full Marks – 100 (Mid Semester: 20; End Semester: 80)

OBJECTIVES

- To understand the fundamentals of different data structure.
- To be able to learn design principles and concepts of algorithms.
- To have a mathematical foundation in analysis of algorithm.

LEARNING OUTCOMES

Upon Completing the Course, Students will be able to:

- Learn the basic types for data structure, implementation and application.
- Know the strength and weakness of different data structures.
- Use the appropriate data structure in context of solution of given problem.
- Develop programming skills which require solving given problem. Use different design technique for algorithm.

Unit I

Performance analysis: time complexity and space complexity of .Algorithms, List ADTs (Singly, Doubly and Circular), Implementations and its different types of operations

Array ADTs: one, two, and multi-dimensional array, Row and column major order calculations, Array ADT implementations and its different types of operations.

Stacks and Queues: ADTs, Implementations and Applications.

Unit II

Trees ADT, Binary tree, Terminologies and Memory representation, Binary Search tree, Expression tree, Binary Heap tree, Threaded binary tree and AVL tree.

Introduction to Red Black trees, multi-way search Trees, B Trees, Advanced Tree ADTs, and Tree Traversals.

Unit III

Priority Queue ADTs, Graphs: Terminologies and representation, Directed Graphs and Undirected Graph, Spanning Trees, Shortest Path Algorithms, Graph Traversals: BFS, DFS

Unit IV

Searching Techniques: Linear and Binary, Performance Analysis: Best, Average, and Worst time complexity and space complexity.

Sorting Techniques: Bubble Sort, Insertion Sort Selection Sort, Quick Sort, Heap Sort, Radix Sort ,Merge Sort , Bucket Sort, and Counting Sort, Performance Analysis: Best, Average, and Worst time complexity and space complexity.

Unit V

Hash table representation: hash functions, collision resolution, separate chaining, open addressing, linear probing: quadratic probing, double hashing, rehashing, Garbage collection and Compaction.

Introduction to Designing Techniques: Divide and Conquer, Dynamic Programming, Greedy Algorithm and Backtracking algorithm.

Books:

Texts:

1. Debasis Samanta, Classic Data Structures, PHI, Second Edition, 2014.
2. Langsam, Augenstein and Tanenbaum, Data structures using C and C++, PHI, 2010.

Reference:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++‖, Pearson Education, 2002.
2. Aho Hopcroft Ullman, Data Structures and Algorithms‖, Pearson Education, 2002.
3. S.Sahni, Data structures, Algorithms and Applications in C++, University Press (India) , 2nd edition, 2008.
4. Michael, T.Goodrich, R.Tamassia and Mount, Data structures and Algorithms in C++, Wiley student edition, John Wiley and Sons, 2008.

Computer Graphics (CSC-1.4)

Full Marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The basic objective of the course is-

- To understand the concept of representation of information in graphical and pictorial way.
- Different types display of information by computer.
- Two dimension and three-dimension transformation and translation.

Learning Outcomes:

Upon successful completion of this course, the student shall be able to:

- Understand the applications of computer graphics, display device and operating principle.
- Identify the different Line, circle and ellipse drawing Algorithms.
- Analyze the 2D transformation, clipping.
- Demonstrate 3D transformation and viewing.
- Classify the visible surface detection methods, Illuminating models.

Unit I

A survey of computer graphics: Computer Aided Design, Presentation Graphics, Computer Art, Entertainment, Education Training, Visualization, Image Processing, Graphical User Interface. Overview of graphics system: Video Display Devices, Raster Scan Systems, Random Scan Systems, Input Devices, Hard-copy Devices, Graphics Software. Output primitives: Points and lines, DDA and Bresenham's Line Drawing Algorithm, Midpoint circle algorithm, Filled area primitives. Attributes of output primitives: Line attributes, Curve attributes, Colour and grayscale levels, Area-fill attributes, Character attributes, Bundled attributes.

Unit II

Two dimensional geometric transformations: Basic Transformation (Translation, Rotation, Scaling), Matrix representation and homogenous coordination, Composite Transformation, Reflection, Shear. Two dimensional viewing: The viewing Pipe-line, Viewing Coordinate Reference frame, Window-to-viewport coordinate transformation. Clipping: Line Clipping (Cohen Sutherland Algorithm), Polygon clipping (Sutherland-Hodgemen Algorithm)

Unit III

Three dimensional object representation: Polygon Surfaces, Quadratic surfaces, Spline Representations, Beizer Curves and surfaces, B-Spline Curves and surfaces

Unit IV

Three dimensional geometric and modeling transformations: Translation, Rotation, Scaling, Reflections, Shears, Composite Transformation. Three dimensional viewing: Viewing pipeline, Viewing coordinates, Projections (Parallel and Perspective).

Unit V

Visible-surface detection methods: Classification of visible-surface detection algorithms, back-face detection, Depth-Buffer method, A-Buffer method, Scan-line method, Depth- sorting method. Illumination Models: Basic illumination models, Displaying light intensities, Halftone Patterns and Dithering Technique, Polygon Rendering Methods, (Gouraud and phong shading)

Books:

Texts:

1. Computer Graphics C Version, by D. Heam and M. P. Baker, 2nd Edition, Pearson Education, 2002.

References:

1. Marschner, S., & Shirley, P. (2018). Fundamentals of computer graphics. CRC Press.
2. Foley, J. D., Van Dam, A., Feiner, S. K., Hughes, J. F., & Phillips, R. L. (1994). Introduction to computer graphics (Vol. 55). Reading: Addison-Wesley

Advanced Data and Computer Networks (CSC – 1.5)
Full Marks–100 (Mid Semester: 20 Marks; End Semester: 80 Marks)

Objectives:

The basic objective on the course is-

- To understand the concept of information exchange via communication media.
- To understand the different types of communication medium and transmission modes
- To understand the errors in communication and detect and correct error during information exchange over network.

Learning Outcomes:

Upon successful completion of this course, the student shall be able to:

- Describe Data Communication method and Networking Models, modes of transmission.
- Identify the types of Error and the approach for correction of error.
- Discuss ISDN, X.25 protocols and frame relay.
- Apply the routing algorithm to transfer data and to control traffic.
- Implement LAN using switch, bridge.

Unit I

Introduction: Data Communication, Network Protocols and Standards, Point to Point and MultiPoint line configuration, Network Topologies: Mess, Star, Tree, Bus, Ring, Transmission Modes: Simplex, Half Duplex, Networks: LAN, MAN, WAN. The OSI Models: Function of Layers. TCP/IP Protocol Suit, Signals: Analog and Digital signals, Periodic and A periodic signal, Encoding and Modulating: Digital to Digital conversion. Unipolar. Polar Bipolar, Analog to Digital conversion AM, FM, PM.

Unit II

Transmission of Digital data: Parallel and Serial transmission. DTE/DCE interface, Modems, Guided and Unguided transmission media. Transmission impairment, Performance, Multiplexing: Frequency division, Wave division and Time division multiplexing, the Telephone system, Digital Subscriber Line (DSL), Error Detection and Correction: Types of Error, Redundancy Checks (VRC, LRC, CRC), Error Correction

Unit III

Data Link Control: Line Discipline, Flow Control, Error Control, Data Link Protocol: Asynchronous and Synchronous Protocols, Character and Bit Oriented Protocols. Local Area Networks: IEEE 802 standards, Ethernet, Token Bus, Token Ring, FDDI Switching: Circuit Switching, Packet Switching, Message Switching

Unit IV

Integrated Services Digital Network (ISDN), Services, History, Subscriber's access to ISDN, The ISDN layers, Broadband ISDN. X.25: X.25 Layers, Protocols related to X.25, Frame Relay: Introduction, Frame Relay operation. Frame Relay layers, Congestion Control, Leaky bucket algorithm. Traffic control

Unit V

Networking and Internetworking Devices: Repeaters, Bridges, Routers, Gateways, Routing Algorithms, TCP/IP Protocol Suite: Overview, Network Layer, Addressing Subnetting, Transport Layer, Application Layer: Client Server Model, BOOTP, DHCP, DNS, Telnet, FTP, SMTP, SNMP, HTTP,WWW.

Books:

Texts:

1. Behrouz A Forouzen “Data Communications and Networking “Tata McGraw Hill.

References:

1. StallingW “Computer Communication Networks“ Prentice Hall
2. Tannenbaum A. S “Computer Networks” PHI
3. Bartee T.C “Data Communication, Network and systems” BPB
4. Schweber W L ”Data Communication“ McGrawHill
5. Steven W.R:TCP/IPIllustrated,Vol1,The protocols” Addition Wesley

SECOND SEMESTER

Linear Algebra and Numerical Optimization (CSC -2.1)
Full Marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The objective of the course is:

- To introduce Systems of Linear Equations and its related terminologies.
- To find out solution of Systems of Linear Equations.
- To familiarize with the concept of Eigen values, Eigen vectors, diagonalization of a matrix and their applications in different sectors.
- To introduce the basic principles, techniques, and application of linear programming problems.
- To introduce various types of one-dimensional Optimization Problem and their applications in different sectors.
- To introduce constrained and unconstrained optimization methods.

Course Outcomes:

After successful completion of this course, students would be able to:

- Solve a given system of linear equations. Understand the concepts of vector spaces, subspaces, bases, dimension, and their properties.
- Compute the Eigen values and the Eigen vectors of a matrix.
- Solve linear programming problems with different approaches.
- Compute minimum value of a function in different one-dimensional optimization techniques.
- Compute minimum and maximum value of a function in LPP and NLPP.

Unit 1

Definition of a Vector Space, Linear Combinations, Linear Span, Convex Sets, Linear Independence and dependence, Basis, Dimension, Rank and Nullity of a matrix, Solution of Systems of Linear Equations.

Unit 2

Definition of Eigen Value and Eigen Vector, Characteristic Polynomial, Similar matrices, Diagonalization, Singular value decomposition and principal components, Positive and nonnegative definite matrices.

Unit 3

Graphical solution of linear programming problems, Simplex Method - Computational procedure, Artificial variable techniques, Two-phase simplex method, Big M-method, Concept of duality. Conversion of primal to dual and vice-versa, and its solution using both simplex and graphical methods. Dual simplex method, Revised simplex method.

Unit 4

One dimensional Optimization: One dimensional Optimization: Introduction, function comparison methods, polynomial interpolation, iterative methods.

Function comparison methods: Bisection Method, Fibonacci Method, Golden Section Search Method.

Unconstrained Gradient based optimization methods: Gradient based optimization methods: Method of

Steepest Descent, Conjugate Gradient method,

Newton type methods (Newton's method, Marquardt's method), Quasi- Newton method.

Unit 5

Constrained Optimization Methods: Lagrange multipliers, Kuhn-Tucker conditions, Convex Optimization, Penalty function techniques, methods of multiplier. Linearly constrained problems, Cutting plane method. Gradient projection method.

Books:

Texts:

1. Optimization: Theory and Practice by M.C. Joshi and K. Moudgalya, Narosa Publishing House, New Delhi, First Edition, 2004.
2. Kanti Swarup, P. K. Gupta & Man Mohan , Operation Research-2008 , Sultan Chand & Sons Pub.
3. Gilbert Strang, Wellesey, Introduction to Linear Algebra, Fourth Edition, , Cambridge Press/Cengage Learning, 2009

Reference:

1. David C. Lay, Linear Algebra and Its Applications, Person Education, Third Edition, 2014.
2. N.S.Kambo, Mathematical Programming Techniques, McGraw Hill, 2005.
3. Numerical Optimization, Jeorge Nocedal and Stephen J. Wright, Springer, 2nd Edition,1999.
4. Linear and Nonlinear Programming, David G. Luenberger and Yinyu Ye, Fourth Edition, 2015
5. Convex Optimization by Stephen Boyd and Lieve Vandenberghe, Cambridge University Press, 7th Printing, 2009.
6. Numerical Optimization with Applications, Suresh Chandra, Jayadeva, Aparna Mehera, Narosa Publishing House, New Delhi, First Edition 2013.

Data Mining and Data Warehousing (CSC -2.2)
Full Marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The primary objective of this course is to introduce data mining and integration of data mining system with a data warehouse system. To become familiar with the concept of data pre-processing and data warehouse, OLAP technology for data mining.

- To understand Fundamentals of data mining and its different classification, Major issues in Data Mining and Data Preprocessing.
- Implementation of data warehouse and development of Data Cube Technology.
- Understanding mining Frequent Patterns, Associations and Correlations.
- To analyze different techniques of Classification and Prediction.
- The basics of Cluster Analysis.

Learning Outcomes:

Upon successful completion of this course, the student shall be able to:

- Fundamentals of data mining Functionalities, Classification, major issues in Data Mining.
- Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization.
- Multidimensional Data Model, Data Warehouse Architecture, Efficient Methods for Data Cube Computation.
- Mining Frequent Patterns, Associations and Correlations
- Issues Regarding Classification and Prediction
- Different Classification Methods
- Evaluating the accuracy of a Classifier or a Predictor
- A Categorization of Major Clustering Methods
- Clustering High-Dimensional Data and Outlier Analysis

Unit I

Data Warehousing: Data warehousing Components, Building a Data warehouse, Data Warehouse Architecture, DBMS Schemas for Decision Support, Data Extraction, Cleanup, and Transformation Tools, Metadata, reporting, Query tools and Applications, Online Analytical Processing (OLAP), OLTP and Multidimensional Data Analysis, Data Cube, Efficient Methods for Data Cube Computation, Data Generalization by Attribute-Oriented Induction

Unit II

Data Mining Basics: Introduction, application areas in data mining, KDD process. Getting to know your data: Data Objects and attributes types. Data pre-processing: Why pre-process data? Data cleaning, data integration, data transformation and reduction.

Unit III

Graphical Methods for data mining exploration: Histograms, Boxplots, Quantile Plots, Bagplots, Glyph Plots, Scatterplots, Dynamic Graphics, Coplots, Dot Charts, Plotting Points as Curves, Biplots.

Unit IV

Mining frequent Patterns, Associations and Correlations: Introduction, Market Basket Analysis, Frequent Item-set Generation using Apriori algorithm, Rule generation. Alternative Methods for Generating Frequent Item sets using FP-Growth Algorithm, Evaluation of Association Patterns. From association analysis to correlation analysis.

Unit V

Clustering: Overview, K-Means, K Medoid, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, Graph- Based Clustering, Scalable Clustering Algorithms. Visualizing Clusters: Dendogram, TreeMaps, Rectangle Plots, Data image.

Books:

Texts:

1. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining Concepts and Techniques, Elsevier, Third Edition, 2011.
2. Wendy L. Martinez, Angel R. Martinez and Jeffrey L. Solka, Exploratory Data Analyis with Matlab, CRC Press (Taylor & Francis Group), Second Edition, 2010.

Reference:

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson Education, 2007
2. Kelleher, John D., Brian Mac Namee, and Aoife D'arcy. Fundamentals of machine learning for predictive data analytics: algorithms, worked examples, and case studies. MIT press, 2020.

Artificial Intelligence (CSC – 2.3)

Full Marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The primary objective of this course is -

- To learn the basic concepts of AI principles and approaches.
- To develop the basic understanding of the building blocks of AI.

Learning Outcomes:

Upon successful completion of this course, the student shall be able to:

- Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
- Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
- Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
- Demonstrate proficiency developing applications in an 'AI language', expert system shell, or data mining tool.
- Demonstrate proficiency in applying scientific method to models of machine learning.

Unit I

Introduction to AI, Application areas of AI, State-Space-Search: Production system design, Production system characteristic. Search Techniques Blind search: Depth first search, Breadth first search.

Heuristic search Techniques: Hill Climbing, Best first search, Branch and bound, A*, AO*.

Unit II

Game playing: Min-Max Search, Alpha-Beta Cutoff.

Knowledge Logic: Skolemizing queries, Unification algorithm, Modes Ponens, Resolution.

Unit III

Structured knowledge representation: Semantic nets, Frames, Conceptual dependencies, Scripts.

Unit IV

Expert System: Expert System need & Justification, Rule based architecture, Non production system architecture, Case studies of expert system: MYCIN, R1. Learning: Concept of learning, Types of learning, Genetic algorithm, Neural network.

Unit V

Natural language processing: Introduction syntactic processing, semantic analysis, discourse, and pragmatic processing.

Handling uncertainty: Probabilistic reasoning, Use of certainty factor, Knowledge organization & management: Introduction, HAM.

Books:

Texts:

1. Rich & Knight (Chapters 1.1,2,3,5,9,10.1,10.2,12.1, 12.2, 12.3, 15.1-15.4, 17.1-17.6)
2. Dan W. Patterson (Chapters 4.1-4.4, 5.3, 11.1,11.4, 15.1-15.4)

Reference:

1. N.J. NilsonNorvig“Artificial Intelligence a Modern Approach”.

Design and Analysis of Algorithm (CSC-2.4)
Full Marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The objective of the course is to.

- Design and analysis of algorithms and find complexity on them.
- Find the complexity of different sorting algorithm.
- Understand the dynamic programming and greedy algorithms
- Analyze and implementation of Graph Algorithms
- Demonstrate NP-Completeness and Approximation Algorithms

Learning Outcomes:

Upon successful completion of this course, the student shall be able to:

- Identify the different design technique of algorithm.
- Analyze the different sorting algorithm based on time and space.
- Analyze the different approaches of designing algorithm like dynamic programming and greedy algorithms
- Discuss different graph algorithm.
- Solve NP-Completeness and Approximation Algorithms

Unit I

Introduction to design and analysis of algorithms, Growth of functions, Recurrences, Solution of recurrences by Substitution, Recursion tree and Master method, Worst case analysis of Merge sort, Quick sort and Binary search

Heapsort: Heaps, Building a heap, The Heapsort algorithm, Priority Queue, Lower bounds for sorting

Unit II

Dynamic Programming: Matrix-chain multiplication, Elements of dynamic programming, Longest common subsequence

Greedy Algorithms: An activity- selection problem, Elements of greedy strategy, Fractional knapsack problem, Huffman codes

Unit III

Data structures for Disjoint Sets: Disjoint set operations, Linked-list representation of disjoint sets, Disjoint-set forests.

Graph Algorithms: Elementary Graph Algorithms: Representations of graphs, Breadth-first search, Depth-first search, Minimum Spanning Trees: Kruskal and Prim's algorithms, Single- Source Shortest Paths: The Bellman-Ford and Dijkstra's algorithm, All-Pairs Shortest Paths: The Floyd-Warshall Algorithm

Unit IV

Maximum Flow: Flow Networks, The Ford-Fulkerson method, Polynomials and the FFT: Representation of polynomials, The DFT and FFT, String Matching: The naïve string- matching algorithm, The Rabin-Karp algorithm.

Unit V

NP-Completeness: Polynomial time, Polynomial-time verification, NP-completeness and reducibility, NP-completeness proofs, NP-completeness problems, Approximation Algorithms: The vertex-cover problem, The travelling-salesman problem, The set-covering problem, The subset-sum problem

Books:

Texts:

1. Introduction to Algorithms: T. H. Cormen, C. E. Leiserson, R. L. Rivest (PHI), Second Edition.
2. E. Horowitz, S. Sahani, S. Rajsekharan," Fundamentals of Computer Algorithms", Second Edition, Universities Press, 2007

Reference:

1. Algorithm Design – Goodrich, Tamassia, Wiley India.
2. Algorithms By Sanjay Dasgupta, Umesh Vazirani – McGraw-Hill Education

Software Evolution (CSC -2.5) (Elective – 1)
Full marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The objective of the course is to study how software development and maintenance is taking place in an organization. Legacy information of software development.

At the end of the course, the students will be able to:

- Do models of software engineering and reengineering concepts.
- Understand Legacy information of software development and maintenance.
- Migration planning and its analysis.
- Re-structuring and reuse of software.
- Refactoring methods and Cognition Models for Program Understanding.

Learning Outcomes:

Upon successful completion of this course, the student shall be able to understand:

- How maintenance is done in an organization.
- software engineering and reengineering concepts.
- Legacy information of software development and maintenance.
- Migration planning and its analysis.
- Re-structuring and reuse of software.
- Refactoring methods and Cognition Models for Program Understanding.

Unit I

Introduction to Evolution and Maintenance, Classification of Software Maintenance: Intention-based, Activity-based, and Evidence-based. Categories of Maintenance Concepts: Product, Types, Organization Processes, Peopleware. Evolution of Software Systems: SPE Taxonomy, Laws of S/W Evolution, Empirical Studies, Evolution of FOSS Systems, Maintenance of COTS-based Systems.

Maintenance Models: Reuse-Oriented Model, Staged-Model for Closed Source Software (CSS) and Open Source Software (OSS), and Change Mini-Cycle Model, IEEE? EIA and ISO/IEC Maintenance Process, Software Configuration Management.

Unit II

Reengineering Concepts, A General Model of Software Reengineering, Reengineering Process, Code Reverse Engineering, Techniques used for Reverse Engineering, De- compilation Versus Reverse Engineering, Data Reverse Engineering, Reverse Engineering Tools.

Legacy Information Systems, Wrapping, Migration, Migration Planning, Migration Methods: Cold Turkey, Database First, Database Last, Composite Database, Chicken Little, Butterfly, Iterative.

Unit III

Impact Analysis, Impact Analysis Process: Identifying the SIS, Analysis of Traceability Graph, Identifying the Candidate Impact Set, Dependency-Based Impact Analysis: Call Graph, Program Dependency Graph, Ripple Effect, Computing Ripple Effect, Change Propagation Model: Recall and Precision of Change Propagation Heuristics, Heuristics for Change Propagation, Empirical Studies.

Unit IV

Re-factoring, Activities in a Re-factoring Process, Formalisms for Re-factoring: Assertions, Graph Transformation, Software Metrics, Examples of Re-factorings, Initial Work on Software Restructuring, Factors Influencing Software Structure, Classification of Restructuring Approaches, Restructuring Techniques. Reuse: Benefits of Reuse, Reuse Models, Factors Influencing Reuse, Success Factors of Reuse. Reuse Capability, Economic Models of Software Reuse: Cost Model of Gaffney and Durek, Cost Model of Gaffney and Cruickshank, Business Model of Poulin and Caruso. Domain Engineering, Application Engineering, Domain Engineering Approaches.

Unit V

Program Comprehension, Goal of Code Cognition, Knowledge, Mental Model, Understanding Code, Cognition Models for Program Understanding: Letovsky Model, Shneiderman and Mayer Model, Brooks Model, Soloway, Adelson, and Ehrlich Model, Pennington Model, Integrated Meta-model, Protocol Analysis, Visualization for Comprehension.

Books:

Texts:

1. Software Evolution and Maintenance: A Practitioner's Approach, Priyadarshi (Piyu) Tripathy, and Kshirasagar (Sagar) Naik, Wiley, Hoboken, NJ, 2015.

Reference:

1. Software Maintenance Concepts and Practice, Grubb P., and Takang A, 2e, World Scientific, 2003.

THIRD SEMESTER

Soft Computing (CSC -3.1)

Full marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The primary objective of this course is to introduce the basic principles, techniques, and applications of soft computing techniques in real world problems.

- Artificial Intelligence, Various types of production systems, characteristics of production systems.
- Neural Networks, architecture, functions, and various algorithms involved.
- Fuzzy Logic, Various fuzzy systems, and their functions.
- Genetic algorithms, its applications**,** and advances**.**

Learning Outcomes:

At the end of the course the student should be able to

- Learn about soft computing techniques and their applications
- Analyze various neural network architectures and Understand perceptron and counter propagation networks.
- Analyze the genetic algorithms and their applications.
- Develop application on different soft computing techniques like Fuzzy, GA and Neural network
- Describe about hybrid soft computing techniques and its applications along with the fuzzy logic concepts and fuzzy system.
- Effectively use existing software tools to solve real problems using a soft computing approach

Unit I

(Artificial Neural Network) Introduction – Fundamental concept – Evolution of Neural Networks – Basic Models of Artificial Neural Networks – Important Terminologies of ANNs

– McCulloch-Pitts Neuron – Linear Separability – Hebb Network. Supervised Learning Network: Perceptron Networks – Adaline – Multiple Adaptive Linear Neurons – Back- Propagation Network – Radial Basis Function Network.

Unit II

(Artificial Neural Network) Associative Memory Networks: Training Algorithms for Pattern Association – Auto associative Memory Network – Hetero associative Memory Network – Bidirectional Associative Memory – Hopfield Networks – Iterative Auto associative Memory Networks – Temporal Associative Memory Network. Unsupervised Learning Networks: Fixed weight Competitive Nets – Kohonen Self-Organizing Feature Maps – Learning Vector Quantization – Counter propagation Networks – Adaptive Resonance Theory Networks – Special Networks.

Unit III

(Fuzzy Set Theory) Introduction to Classical Sets and Fuzzy sets – Classical Relations and Fuzzy Relations – Tolerance and Equivalence Relations – Noninteractive Fuzzy sets – Membership Functions: Fuzzification – Methods of Membership Value Assignments – Defuzzification – Lambda-Cuts for Fuzzy sets and Fuzzy Relations – Defuzzification Methods.

Unit IV

(Fuzzy Set Theory) Fuzzy Arithmetic and Fuzzy Measures: Fuzzy Rule Base and Approximate Reasoning: Truth values and Tables in Fuzzy logic – Fuzzy Propositions – Formation of Rules – Decomposition and Aggregation of rules – Fuzzy Reasoning – Fuzzy Inference Systems (FIS) – Fuzzy Decision Making – Fuzzy Logic Control Systems.

Unit V

(Genetic Algorithm) Introduction – Basic Operators and Terminologies in GAs – Traditional Algorithm vs. Genetic Algorithm – Simple GA – General Genetic Algorithm – The Scheme Theorem – Classification of Genetic Algorithm – Holland Classifier Systems – Genetic Programming. Applications of Soft Computing: A Fusion Approach of Multispectral Images with SAR Image for Flood Area Analysis – Optimization of Travelling Salesman Problem using Genetic Algorithm Approach

Books:

Texts:

1. S.N. Sivanandan and S.N. Deepa, Principles of Soft Computing, Wiley India, 2007.
2. S. Rajasekaran and G.A.V.Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI, 2003.

Reference:

1. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997.
2. J.S.R.Jang, C.T.Sun and E.Mizutani, Neuro-Fuzzy and Soft Computing, PHI, Pearson Education,2004.

Cryptography and Network Security (CSC-3.2)
Full marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The primary objective of this course is to introduce the basic principles, techniques, and applications of Cryptography, emphasizing on the teaching of these fundamentals, instead of providing an expertise of specific software tools or programming environments. It provides an opportunity to learn how to

- Secure your message Transmission
- In depth knowledge behind cryptographic approaches for solving real time problems
- To understand basics of Cryptography and Network Security
- To be able to secure a message over insecure channel by various means.
- To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
- To understand various protocols for network security to protect against the threats in the networks.

Learning Outcomes:

The student who successfully completes this course will be able to:

- Analyze and design classical encryption techniques and block ciphers and data encryption standard.
- Understand and analyze public-key cryptography, RSA and other public-key cryptosystems such as Diffie-Hellman Key Exchange, ElGamal Cryptosystem, etc.
- Understand key management and distribution schemes and design User Authentication
- Analyze and design hash and MAC algorithms, and digital signatures.
- Design network application security schemes, such as PGP, S/ MIME, IPSec, SSL, TLS, HTTPS, SSH, etc.
- Know about Intruders and Intruder Detection mechanisms, Types of Malicious software.

Unit I

Overview of Cryptography, Substitution and affine cipher , Polyalphabetic Cipher and their cryptanalysis, Perfect Security, Block Cipher, Data Encryption Standard (DES),2DES,3DES, Differential and linear Cryptanalysis, Block Cipher Design Principles, Block Cipher modes of operation, Advanced Encryption Standard..

Unit II

Principles of Public-Key Cryptosystems, The RSA Algorithm, Key Management, Diffie- Hellman Key Exchange and Cryptanalysis, Authentication Functions, Message Authentication Codes (MAC), Hash Functions, Security of Hash Functions and MAC, Secure Hash Algorithm, HMAC.

Unit III

Discrete Logarithms, ElGamal System, Schnorr signature scheme, The ElGamal signature scheme, The digital signature algorithm, Provable secure signature schemes

Unit IV

Elliptic curve over the reals, Elliptic curves modulo a prime, Properties of Elliptic cures Point compression and ECIes, Computing point multiples on Elliptic curves, Elliptic curve digital signature algorithm, ECElGamal Cryptosystem, ElGamal EC Digital signature scheme, Elliptic curve factorization, Elliptic curve primality test.

Unit V

Network Security Practice: Kerberos, X.509 Authentication Service, Public Key Infrastructure, E-Mail Security

(Pretty Good Privacy), IP Security (Architecture, Authentication Header, Encapsulation Security Payload, Combining Security Associations, Key Management), Web Security (Secure Sockets Layer and Transport Layer Security).

Books:

Texts:

1. W. Stallings – Cryptography and Network Security Principles and Practice, Pearson Education Asia, 3rd Edition, 2000.
2. D. Stinson - Cryptography: Theory and Practice, CRC Press, 2006

Reference:

3. Bernard Menezes," Network Security and Cryptography", Cengage Learning.
4. Atul Kahate, "Cryptography and Network Security", TMH

Machine Learning (CSC -3.3)

Full Marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The objective of the course is to study and analyze data and their interpretation. Ultimately processing the data in an intellectual way to achieve business requirement.

At the end of the course, the students will be able to:

- Do analysis on decision tree learning algorithm.
- Neural network, hypothesis accuracy estimation.
- Supervised Learning to obtain a predicted output.
- Unsupervised Learning on data.
- Re in-forcement learning.

Learning Outcomes:

Upon successful completion of this course, the student shall be able to understand:

- Decision tree learning algorithm.
- Neural network, hypothesis accuracy estimation.
- Supervised Learning to obtain a predicted output.
- Unsupervised Learning on data.
- Re in-forcement learning.

Unit I

Supervised Learning 1: Overview of supervised learning, classification, and regression problems, K-nearest neighbourhood (KNN) classifier, Multiple linear regression, Shrinkage methods (Ridge regression, Lasso regression ,elastic net), Logistic regression, Linear Discriminant Analysis, Feature subset selection .

Unit II

Model Assessment and Selection: Loss function, test and training error,Bias, Variance, and model complexity, Bias-variance trade off, Bayesian approach and BIC, Cross- validation, Boot strap methods, Performance of Classification algorithms(Confusion Matrix, Precision, Recall and ROC Curve).

Unit III

Supervised Learning 2: SVM for binary and multiclass classification, Reproducing Kernels, SVM for regression, Regression and classification trees, ensemble learning and Random forest.

Unit IV

Unsupervised Learning: Clustering (K-means, spectral clustering), Feature Extraction (Principal Component Analysis (PCA), kernel PCA, Independent Component Analysis (IDA)), Non-negative matrix factorization and collaborative filtering, Mixture of Gaussians and its applications to clustering, anomaly detection, and novelty detection.

Unit V

Boosting, Bayesian Learning, and Reinforcement Learning: Boosting methods(AdaBoost, gradient boosting,

XG boost), Bayes Theorem and concept learning, Maximum likelihood and least- squared error hypotheses, Bayes optimal Classifier, Naïve Bayes Classifier, Bayesian belief networks,

Introduction to Reinforcement learning, the learning task, Q learning.

Lab implementation of the above methods and algorithms using Python.

Books:

Texts:

1. Trevor Hastie, Robert Tibshirani,Jerome Friedman , *The Elements of Statistical Learning-Data Mining, Inference and Prediction*, Second Edition, Springer Verlag, 2009.
   [Chapters: 2, 3(3.1-3.4, 3.6), 4(4.3-4.4), 7(excluding 7.8, 7.9, 7.12), 8.5, 9(9.2), (10.1, 10.4-10.5, 10.8, 10.10, 10.14), 13(13.1-13.3), 14(14.3.1, 14.3.6-14.3.8, 14.5, 14.7.2), 15]
2. S.Hakin, Neural Network-a comprehensive Foundation, Pearson Education, second Edition, 1999, Chapter 6.
3. Tom M. Mitchell, Machine Learning, McGraw Hill Education, Indian Edition, 2013.
   Chapter 6 (6.1 - 6.4, 6.7, 6.9, 6.10, 6.11), 13(13.1-13.3).
4. Andreas C. Muller and Sarah Guido, Introduction to Machine Learning with Python-A guide for data scientists, O'Relly, (SPD), 2017 (**For lab only)** [Relevant portions]

References:

1. Gareth James. Daniela Witten. Trevor Hastie. Robert Tibshirani -*An introduction to statistical learning with applications in R*, Springer, 2013.
2. C. M. Bishop –Pattern Recognition and Machine Learning, Springer, 2006.
3. Ethem Alpaydin,Introduction to Machine Learning,PHI, 2010.

Image Processing (CSC -3.4) (Elective-II)
Full Marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

- To teach various conventional image processing concepts which will help to understand the recent advances and to implement real-time applications.

Learning Outcomes:

- Student will able to get adequate knowledge to learn state-of-the-art in the field Computer Vision techniques to implement various real-time image processing applications.

Unit I

Digital image representation, image formation model, Sampling and quantization, Relationship between pixels, Fourier transforms, Discrete Fourier transforms, Properties of 2- D Fourier transforms, Discrete Cosine Transforms.

Unit II

Image enhancement in the spatial methods, Gray level transformations, Histogram processing, Histogram equalization, Histogram matching, Spatial filtering, Image restoration and degradation process, Noise models, Noise filtering models.

Unit III

Color Image processing: Color models, Converting RGB to HSI and vice-versa, Pseudocolor processing, Full-color image processing, Color transformations, Smoothing and sharpening.

Unit IV

Image Compression: Fundamentals, Image compression model, Element of information theory, Error-free compression, Lossy compression standards.

Unit V

Image segmentation: Detection of discontinuities, Edge linking and boundary dictation, Thresholding, Region-oriented segmentation, the use of motion in segmentation.

Books:

Texts:

1. R. C. Gonzalez & R.E. Woods - Digital Image Processing, Pearson Education

References:

1. M.Sonka, V. Hlavac, R.Boyle, Image processing Analysis and Machine Vision Thomson Learning.

Cloud Computing (CSC-3.5) (Elective-III)
Full Marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The primary objective of this course is to introduce Cloud computing, Types and evolution of cloud computing. To become familiar with the concept Virtualization and Cloud security challenges.

- To understand Fundamentals of Cloud computing and Types of cloud services, Benefits and challenges of cloud computing.
- Understanding Service providers and Introduction to Map Reduce, GFS, HDFS, Hadoop.
- To analyze different collaborations on Calendars, Schedules and Task Management etc.
- The need for Virtualization and it's types
- The basics of Cloud security challenges and Standards for application developers, Standards for Messaging, Standards for Security.

Learning Outcomes:

Upon successful completion of this course, the student shall be able to:

- Fundamentals of Cloud computing, Benefits and challenges of cloud computing, Usage scenarios and applications and Issues in cloud.
- Understanding Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service, monitoring as a Service, Communication as a Service as well as Service providers.
- Collaborating on Calendars, Schedules and Task Management, Event Management, Contact Management, Project Management, Word Processing, Database.
- Collaborating via Web-based communication tools, Social Networks, Blogs and Wikis.
- Virtualization, Pro and Cons, Types of Virtualizations
- Virtual Machine Properties, Interpretation, and binary Translation, HLLVM, Hypervisors, Xen, KVM, VMWare, VirtualBox, Hyper–V
- Cloud security challenges, Common standards for application developers, Messaging and Security.

Unit I

Cloud computing definition, Private, public and hybrid cloud, Types of cloud services: IaaS, PaaS, SaaS, Benefits and challenges of cloud computing, Evolution of cloud computing, Usage scenarios and applications, Business models around cloud, Major players in cloud computing, Issues in cloud, Eucalyptus, Nimbus, Open Nebula, CloudSim.

Unit II

Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service, Monitoring as a Service, Communication as a Service, Service providers: Google App Engine, Amazon EC2, Microsoft Azure, Sales force, Introduction to MapReduce, GFS, HDFS, Hadoop Framework.

Unit III

Collaborating on Calendars, Schedules and Task Management, Collaborating Event Management, Contact Management, Project Management, Collaborating on Word Processing, Database: Storing and Sharing Files, Collaborating via Web-based communication tools, Evaluating Web mail Service, Collaborating via Social Networks, Collaborating via Blogs and Wikis.

Unit IV

Need for Virtualization, Pro and Cons of Virtualization, Types of Virtualization, System VM, Process VM, Virtual Machine Monitor, Virtual Machine Properties, Interpretation and binary Translation, HLL VM, Hypervisors, Xen, KVM, VMWare, Virtual Box, Hyper – V.

Unit V

Cloud security challenges, Software as a Service Security, Common Standards, The Open Cloud Consortium, The Distributed Management Task Force, Standards for application developers, Standards for Messaging, Standards for Security, End user access to cloud computing, Mobile Internet device and the cloud.

Books:

Texts:

1. Cloud Computing for Dummies, by J. Hurwitz, R. Bloor, M. Kanfman, and F. Haiper, Wiley India Edition, 2010 (Unit I).
2. Cloud Computing Implementation Management and Security by J. Rittinghouse and J. Ransome, CRC Press, 2010 (Unit II).
3. Cloud Computing: A Practical Approach by A. Velte, T. Velte and R. Elsenpeter, Tata McGraw Hill, 2009 (Unit II).
4. Cloud Computing: Web-based Applications That Change the Way You work and Collaborate Online by M. Miller, Que Publishing, August 2008 (Unit III).
5. Virtual Machines by J. E. Smith and R. Nair, Morgan Kaufmann Publishers, 2006 (Unit IV).
6. http://cloud-standards.org/wiki/index.php?title=Main_Page (Unit –V).

Reference:

1. Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS), by M. Kavis, Wiley, 2014. e
2. Mastering In Cloud Computing by R. Buyya, C. Vecchiola and T. Selvi, Tata Mcgraw-Hill Education, 2013.
3. Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and more by K. Jamsa, Jones & Bartlett Larning Company LLC, 2013

FOURTH SEMESTER

Compiler Design (CSC -4.1) (Elective-IV)
Full Marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

- To provide a thorough understanding of the internals of Compiler Design.
- To explore the principles, algorithms, and data structures involved in the design and construction of compilers.
- Topics include context-free grammars, lexical analysis, parsing techniques, symbol tables, error recovery, code generation, and code optimization.

Learning Outcomes:

Upon successful completion of this course, the student shall be able to understand:

- Realize basics of compiler design and apply for real time applications.
- Introduce different translation languages
- Understand the importance of code optimization
- Know about compiler generation tools and techniques
- Working of compiler and non-compiler applications
- Compiler for a simple programming language

Unit I

Introduction: Overview and phases of compilation. Non-deterministic and deterministic finite automata (NFA & DFA), Conversion of NFA to DFA, Classification of grammars, regular grammar, regular expressions and regular languages, Context free grammars, ambiguous grammar.

Unit II

Scanners: Top-down parsing, LL grammars, Bottom-up parsing, Operator precedence grammar, LR grammars, Comparison methods Error handling.

Unit III

SLR parsers and construction of SLR parsing tables, LR (1) parsers and construction of LR (1) parsing tables, LALR parsers and construction of efficient LALR parsing tables, parsing using ambiguous grammars, Symbol table handling techniques, Organization for non-block and block structured languages

Unit IV

Syntax Directed Translation: Syntax directed definitions (SDD), inherited and synthesized attributes, dependency graphs, semantic rules, application of syntax directed translation. DAG for expressions, three address codes - quadruples and triples, types and declarations, translation of expressions, array references, type checking and conversions, translation of Boolean expressions and control flow statements, back patching, intermediate code generation for procedures. Run time storage administration, Static and Dynamic allocation.

Unit V

Intermediate forms of source program, Semantic analysis and code generation. Code optimization folding, peephole optimization, redundant sub-expression evaluation, redundant and un-reachable codes, Optimization with interactive loops. Basics of flow of control optimization

Books:

Texts:

1. A.V. Aho, R. Sethi & J.D. Ullman “Compilers Principles Techniques and Tools” Pearson Education

Reference:

1. Kenneth C. Louden “Compiler Construction Principles & Practice “Cengage Learning Indian Edition

Advanced Software Engineering (MCC -4.2)

Full Marks–100 (Mid Semester: 20 Marks; End Semester: 80 Marks)

Objectives:

The primary objective of this course is to introduce Information System Development. To become familiar with process and life cycle models, Software design and Software Reliability and Quality Management.

- To understand Fundamentals of System Analysis and Design and concepts on process and life cycle models.
- Introduction to software specification, Software design coding and testing.
- Understanding S/W quality, Service-oriented Software Engineering and Aspect-oriented Software Development.

Learning Outcomes:

Upon successful completion of this course, the student shall be able to understand:

- Fundamentals of Information System Development
- Understanding Evolution of Software Engineering and different life cycle models.
- Methods and strategies of Software design, coding and testing
- Software Reliability and Quality Management.
- ISO 9000: Modern Trends and Emerging Technologies.
- Agile software development, Extreme Programming (XP), Service-oriented and Aspect-oriented Software Development

Unit I

Introduction to Information System Development: Overview of System Analysis and Design, Categories of Information Systems, System development Strategies, Implementation and Evaluation, Tools for System development

Unit II

Introduction to software Engineering : Basic concepts about software and program and Evolution of Software Engineering, Basic concepts on process and life cycle models, Models:Waterfall,Prototype,Evolutionary,Incremental,spiral,V,RADMetc.,Requirement Analysis: Introduction to software specification, its needs and importance, formal specification methods, SRS: attributes of good SRS and organization of SRS document

Unit III

Software design: Methods and strategies, desirable design attributes, Concept of good design, Cohesion and coupling, Function-Oriented Software Design: structured system analysis and structured design, formal approach design, data flow oriented design, Software coding and testing: coding standard and guidelines, code review, software inspection, Testing: Unit, integration, system testing, black box and white box testing Incremental testing, formal proof of correctness, software matrix, Introduction to software verifications

Unit IV

Software Reliability and Quality Management: S/W and H/W reliability, Reliability Matrices, Software engineering management: introduction to capability maturity model, quality assurance and software cost

estimation (Delphi, COCOMO), Introduction to computer-aided, software engineering, Software reuse and maintenance

Unit V

S/W quality, ISO 9000: Modern Trends and Emerging Technologies: Humphrey's Capability Maturity Model, CMMI (Capability Maturity Model Integration), Agile software development, Extreme Programming (XP), Security Engineering, Service-oriented Software Engineering, Aspect-oriented Software Development.

Books:

Texts:

1. Rajib Mall," Fundamentals of Software Engineering", PHI.
2. James A. Senn,"Analysis and Design of Information Systems",McGrawHill

Reference:

1. R.S.Pressman, "Software Engineering – A Practitioner's Approach", McGrawHill.
2. P.Jalote, "An Integrated Approach To Software Engineering", Narosa, NewDelhi.
3. G.Booch,"Object-Oriented Analysis and Design", Benjamin/Cumming Publishing Co.NewYork.

Elective – A2

Internet of Things

Full marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

- To understand about the fundamentals of Internet of Things and its building blocks along with their characteristics
- To understand the recent application domains of IoT in everyday life
- To understand the protocols and standards designed for IoT and the current research on it.
- To understand the other associated technologies like cloud and fog computing in the domain of IoT.

Learning Outcomes:

- The students will be thorough about the technology behind the IoT and associated technologies.
- The students will be able to use the IoT technologies in practical domains of society.
- The students will be able to gain knowledge about the state of the art methodologies in IoT application domains.

UNIT-I

INTRODUCTION& CONCEPTS: Introduction to Internet of Things, Definitions and Characteristics of IoT, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Enbeedded Systems, IoT levels and Development Templates, IoT Level-1, IoT Level-2, IoT Level-3, IoT Level-4, IoT Level-5, IoT Level-6.

UNIT-II

IoT and M2M, Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization, IoT Platform Design Methodology, Introduction, IoT Design Methodology, Step1: Purpose and requirement specification, Step2: Process Specification, Step 3: Domain Model Specification, Step 4: Information Model Specification, Step 5: Service Specification, Step 6: IoT Level Specification, Step 7: Function View Specification, Step 8: Operational View Specification, Step 9: Device and Component Integration, Step 10: Application Development, IoT System Logocal Design Using Python, Introduction, Installing Python, Python Data Types and Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date Time applications, Classes, Python Packages of Interest for IoT.

UNIT-III

IoT Physical Devices and End Points: What is and IoT Device, Exemplary Device Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry pi interfaces, programming raspberry pi with python, other IoT devices. IoT physical servers and cloud offerings: introduction to cloud storage models and communication Networks, wamp-autobahn for IoT, xively cloud for IoT, python web application frame work-django, designing a RESTful web API, amazon web services for IoT, SkyNetIoT messaging platforms.

UNIT-IV

Data Analytics for IoT; Introduction AppacheHadoop, using HadoopMapReduce for Batch Data Analysis, Apache oozie, Apache Spark, Apache Storm, using Apache Storm for Real-time Data Analysis.

UNIT-V

Ethics: Characterizing the IoT, Privacy, Control, Distributing Control and Crowd Sourcing, Environment, Physical

Thing, Electronics, Internet Service, Solutions, Internet of Things as Part of Solution, Cautious Optimizing, The Open IoT definition.

Books:

Texts:

1. Internet Of Things-A Hands on Approach, by Arshdeep Bahga and Vijay Madisetti, University of Penn, http://www.internet-of-things-book.com/
2. Designing the Internet of Things, by Adrian McEwen and Hakim Cassimally, Wiley Publication.

Reference:

1. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems. By Ovidiu Vermesan and Peter Friess, River Publishers Series in Communication.

Elective – A10

EMBEDDED SYSTEMS

Full marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The course is designed to provide a concrete knowledge onEmbedded systems. Students shall be able to know about different concepts and techniques for developing Embedded devices. It will also help the students to efficiently implement the programming on Microcontroller boards which can be used for doing specific tasks at Real-Time environment.

Outcomes:

- Identify different types of Embedded Devices.
- Understand concepts used during development of Embedded Devices.
- Understand the concepts of Device Drivers.
- Learn the programming concept for creating and implementing features on ARM board.
- Understand basic interfacing techniques to communicate Embedded Devices with Real world objects having Real-Time Output.

UNIT I

Introduction to embedded systems, classifications, processor in the system, microcontroller,

introduction: 8051 architecture, features of 8051, basic assembly language programming concepts,instruction set, data transfer, logical operations, arithmetic operations, jump/call instructions, interrupt handler, addressing modes, an 8051 microcontroller design & testing

UNIT II

Interfacing of Keyboard, displays, ADC/DAC, stepper motor, dc motor; serial communication with PC using RS232, Serial Peripheral Interface (SPI), Inter-Integrated Circuit (I2C), serial communication with other microcontrollers/devices using I2C, SPI, RS232 and USB

UNIT III

Introduction to 16-bit micro-controllers, ATMEGA, PIC and ARM processors: General

architecture and their limitations, clocking unit, Real Time Clock and Timers, Reset Circuitry and Watchdog Timer; development tools: ATMEL assembler and simulator, ATMEL AVR studio; robotic control applications

UNIT IV

Basic functions of PLC, advantages over microcontroller, basic architecture, register basics, timer functions, counter function, ladder diagram, overview of PLC systems, I/O modules, power supplies,isolators, programming PLC, Alarm signal generation for a process (e.g. heating, cooling or threshold of a process etc.), direct digital control (DDC) algorithm

Unit V

Operating system services, I/O subsystem, Network operating system, Real Time and embedded system, Need of well tested and debugged Real time operating system (RTOS), Introduction to C/ OS- II.

Books:

Texts:

1. Embedded Systems: Architecture, programming and Design, by Raj Kamal, TMH New Delhi.
2. 8051 Microcontroller, by Mazidi and Mazidi, Penram Publishers, New Delhi.
3. Microcontrollers: Theory and Applications, by Ajay V. Deshmukh, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
4. Embedded Real time system Programming, by Sriram V. Iyer and Pankaj Gupta, TMH.

Reference Books:

1. PIC Controllers, by Mike Predko, MGH.
2. Embedded System Design, by F. Vahid & T. Gargivis, John Wiley and Sons.
3. Embedded System Design: An Introduction to Process Tools and Techniques, A. S.
4. Berger, CMP Books.

Elective – A12
Bioinformatics
Full marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

The primary goal of bioinformatics is to increase the understanding of biological processes. What sets it apart from other approaches, however, is its focus on developing and applying computationally intensive techniques to achieve this goal.

Outcomes:

A student completing a major in Bioinformatics shall be able to apply:

- knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics
- existing software effectively to extract information from large databases and to use this information in computer modeling
- problem-solving skills, including the ability to develop new algorithms and analysis methods
- an understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries

UNIT I

What is bioinformatics: an introduction and overview, application of bioinformatics in various fields of biology, scope of bioinformatics, overview of available bioinformatics resources on web: NCBI, EBI,EXPASY.

UNIT II

Genome sequence, ORFs, genes, DNA, structure properties and classification of amino acids, primary, secondary and quaternary structure of proteins, globular protein, protein folding, Protein tertiary Structure.

UNIT III

Basic concepts of sequence alignment: pairwise and multiple sequence alignment, significance of these methods in sequence analysis. Introduction to different online tools for sequence alignment, and interpretation of results.

Phylogeny: Phylogenetic analysis, Definition and description of phylogenetic trees and various types of trees, Method of construction of Phylogenetic trees [distance based method (UPGMA, NJ), Maximum Parsimony and Maximum Likelihood method]

UNIT IV

Current Advancements in Bioinformatics: Introduction to System Biology, Structural bioinformatics, Prediction of secondary structure- PHD and PSI-PRED methods. Tertiary Structure: homology modeling, fold recognition and ab-initio approaches. Structures of oligomeric proteins and study of interaction interfaces, Chemoinformatics, Immunoinformatics.

UNIT V

Overview of biological database, global biological database search, overview of various databases as follows:

Literature/Bibliographical database: PubMed, Nucleic acid sequence database: GenBank, EMBL, Protein sequence database: Uni Prot, PIR, TrEMBL, Protein family and domain database: Pfam, SMART, InterProscan, Prosite, BLOCKS, Superfamily, Gene3D, ProDom,PRINTS, Metabolic Pathway databae:KEGG, MetaCyc, BioCyc,

Protein structure database: PDB, CATH, SCOP, DALI, Enzyme, compound and reaction database: PubChem, LIGAND, BRENDA, ENZYME, Protein-protein interaction database: STRING, DIP, MINT, BIND

Text:

Books:

1. Introduction to Bioinformatics by Aurther M lesk.
2. Developing Bioinformatics Computer Skills, by Cynthia Gibas and Per Jambeck.

References:

1. Structural Bioinformatics, by J. Gu and P. Bourne (Edited), Wiley-Blackwell, 2009.

Elective – A14
Mobile Communications
Full marks – 100 (Mid Semester: 20; End Semester: 80)

Objectives:

- An understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.
- An ability to compare recent technologies used for wireless communication.
- An ability to explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks.
- An ability to explain multiple access techniques for Wireless Communication 5 An ability to evaluate design challenges, constraints and security issues associated with Ad-hoc wireless networks.

Outcomes:

- Demonstrate their understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.
- Compare different technologies used for wireless communication systems.
- Explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks.
- Demonstrate an ability explain multiple access techniques for Wireless Communication
- Demonstrate an ability to evaluate design challenges, constraints and security issues associated with Ad-hoc wireless networks.

UNIT I

Introduction to Wireless Networks: Evolution of Wireless Networks, Applications, Challenges, Overview of various Wireless Networks.

Wireless transmission: Frequencies for radio transmission, signals, antennas, Signal propagation.

Multiplexing (Space Division Multiplexing, Frequency Division Multiplexing, Time Division Multiplexing, Code Division Multiplexing, Orthogonal Frequency Division Multiplexing), Modulation (Amplitude shift keying, Frequency shift keying, Phase shift keying), spread spectrum (Direct Sequence Spread Spectrum ,Frequency Hopping Spread Spectrum).

UNIT II

Motivation for a specialized MAC: Hidden and exposed terminal, Near and far terminals.

SDMA, FDMA, TDMA: Fixed TDM, Classical Aloha, Slotted Aloha, Carrier sense multiple access, Demand assigned multiple access, PRMA packet reservation multiple access, Reservation TDMA, Multiple access with collision avoidance, Polling, inhibit sense multiple access, CDMA: Spread Aloha multiple access

UNIT III

GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, New data services,

Mobile IP : Goals, assumptions and requirements, Entities and terminology, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimizations, Reverse tunneling , IPv6, IP micro-mobility support

UNIT IV

Wireless LAN : Infra red vs radio transmission, Infrastructure and ad-hoc network,

IEEE 802.11: System architecture, Protocol architecture, Physical layer(FHSS,DSSS), Medium access control layer (Basic DFWMAC-DCF using CSMA/CA, DFWMAC-DCF with RTS/CTS extension, DFWMAC-PCF with polling), MAC frames, MAC management(Registration,Handoff, Power Management).

UNIT V

Third Generation (3G) Cellular Systems: Introduction, 3G Spectrum Allocation, Third Generation Service Classes and Applications, Third Generation Standards.

Fourth Generation (4G): Introduction, Design Goals for 4G and Beyond and Related Research Issues, 4G Services and Applications, Challenges.

Books:

Texts:

1. Mobile Communications, by Jochen Schiller, 2nd Edition, Addison Wesley, 2003

Reference:

1. Wireless Networks, by P. Nicopolitidis, M. S. Obaidat, G. I. Papadimitriou, A. S. Pomportsis, John Wiley.

2. Principle of Wireless Networks, by Kaveh Pahlavan and Prashant Krishnamurthy.

Elective – B3
Wireless Sensor Networks
Full marks – 100 (Mid Semester: 20; End Semester: 80)

OBJECTIVES

- To understand the basics of Ad-hoc & Sensor Networks.
- To learn various fundamental and emerging protocols of all layers.
- To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.
- To understand the nature and applications of Ad-hoc and sensor networks.
- To understand various security practices and protocols of Ad-hoc and Sensor Networks.

LEARNING OUTCOMES

After completing the course, students will be able to:

- Explain the basic concepts of wireless sensor networks, sensing, and computing and communication tasks.
- Describe and explain radio standards and communication protocols adopted in wireless sensor networks.
- Describe and explain the hardware, software and communication for wireless sensor network nodes.
- Explain the architectures, features, and performance for wireless sensor network systems and platforms.
- Describe and analyze the specific requirements of applications in wireless sensor networks for energy efficiency, computing, storage and transmission.

UNIT I

Networked wireless sensor devices, Applications, Key design challenges.

Network deployment: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Coverage metrics, Mobile deployment.

UNIT II

Localization: issues & approaches, Coarse-grained & Fine-grained node localization, Network-wide localization, Theoretical analysis of localization techniques.

Synchronization: Issues & Traditional approaches, Fine-grained clock synchronization, and Coarse-grained data synchronization.

UNIT III

Wireless characteristics: Basics, Wireless link quality, Radio energy considerations, SINR capture model for interference.

Medium-access and sleep scheduling: Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contention-free protocols.

Sleep-based topology control: Constructing topologies for connectivity, constructing topologies for coverage

UNIT IV

Routing: Metric-based approaches, Routing with diversity, Multi-path routing, Lifetime-maximizing energy-aware routing techniques, Geographic routing, Routing to mobile sinks.

Data-centric networking: Data-centric routing, Data-gathering with compression, Querying, Data-centric storage and retrieval, The database perspective on sensor networks.

UNIT V

Dependability issues: Security Challenges, Threat and attack models, Quality of Service provisioning, Clock Synchronization, Supporting fault tolerant operations. Introduction to Tiny OS, Nes C, Sensor Simulator.

Books:

Texts:

1. Wireless Sensor Networks: Technology, Protocols, and Applications: Kazem Sohraby, Daniel Minoli, Taieb Znati, Wiley Inter Science.
2. Wireless Sensor Networks: Architectures and Protocols: Edgar H. Callaway, Jr. Auerbach Publications, CRC Press.

Reference:

1. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, Taieb Znati , Springer.

Elective – B2

Natural Language Processing

Full marks–100 (Mid Semester: 20 Marks; End Semester: 80 Marks)

Objectives:

- This course introduces the fundamental concepts and techniques of natural language processing (NLP). At the end of the course, the students will be able to:
- Gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- Design NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- Grasp the significance of natural language processing in solving real-world problems.
- To map the appropriate processing technique to a problem and implement the technique.
- Comprehend the state-of-the-art advanced NLP research articles and present them to an audience.
- Make them understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.
- Describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.
- Teach them to recognize the significance of pragmatics for natural language understanding.

Outcomes:

At the end of the course the student should be able to

- Understand approaches to syntax and semantics in NLP.
- Understand approaches to discourse, generation, dialogue and summarization within NLP.
- Understand current methods for statistical approaches to machine translation.
- Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP
- Distinguish among the various techniques, taking into account the assumptions, strengths, and weaknesses of each.
- Use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions.
- Analyze large volume text data generated from a range of real-world applications.
- Probabilistic model of defining language and techniques
- Applying Hidden Markov model and Speech Recognition
- Application of context free grammar and language parsing
- Differentiation of semantic and discourse in terms of NLP

Unit I

Introduction and Basic Text Processing - tokens, sentences, paragraphs, Arg Max Computation, WSD: Word Net, Word net, Application in Query Expansion, Wiktionary, semantic relatedness, Measures of Word Net Similarity,

Resnick's work on Word Net Similarity, Parsing Algorithms, Evidence for Deeper Structure, Top-Down Parsing Algorithms. Dirty Hands, Lexical resources, Word counts, Zipf's laws, Collocations, Concordances, Essential Information Theory, Entropy, Joint entropy and conditional entropy, Mutual information, The noisy channel model, Relative entropy or Kullback-Leibler divergence, The relation to language: Cross entropy, The entropy of English, Perplexity. Noun Structure; Top-Down Parsing Algorithms, Non-noun Structure and Parsing Algorithms, Probabilistic parsing; sequence labelling, PCFG, Probabilistic parsing, Probabilistic parsing: Training issues, Arguments and Adjuncts, Parts of Speech and Morphology, Nouns, pronouns, Words that a company nouns: Determiners and adjectives, Verbs, Other parts of speech, Phrase Structure, Phrase Dependency: Arguments and adjuncts, X' theory, Phrase structure ambiguity.

Unit-II

Corpus-Based Work : Corpora, Software, Tokenization, Morphology ,Sentences, Marked-up Data Markup schemes, Grammatical tagging, Words: Collocations, Frequency, Mean and Variance, Hypothesis Testing, Hypothesis testing of differences, Pearson's chi-square test ,Likelihood ratios ,Mutual Information, The Notion of Collocation ,Statistical Inference: n -gram Models over Sparse Data: : Forming Equivalence Classes, Reliability vs. discrimination, n-gram models, Building-gram models, Statistical Estimators, Maximum Likelihood Estimation, Laplace's law, Lidstone's law, and the Jeffreys-Perkslaw, Held out estimation, Cross-validation (deleted estimation), Good-Turing estimation ,Combining Estimators, Simple linearinterpolation,Katz'sbacking-off,Generallinearinterpolation,Language models for Austen.

Unit-III

Word Sense Disambiguation: Supervised and unsupervised learning, Pseudo words ,Upper and lower bound son performance, Supervised Disambiguation, Bayesian classification, An information-theoretic approach , Dictionary-Based Disambiguation ,Disambiguation based on sense definitions ,Thesaurus-based disambiguation, Disambiguation based on translations in a second-language corpus, One sense per discourse, one sense per collocation,UnsupervisedDisambiguation,LexicalAcquisition:EvaluationMeasures,VerbSubcategorization,AttachmentAmbiguity,HindleandRooth,GeneralremarksonPPattachment,SelectionPreferences, Semantic, Vectors space measures, Probabilistic measures, The Role of Lexical Acquisition in Statistical NLP , Markov Models, Hidden Markov Models, Finding the best state sequence, Implementation, Properties, and Variants, Multiple input observations , Part-of-Speech Tagging : 1 The Information Sources in Tagging, Markov model Taggers, The probabilistic model , The Viterbi algorithm, Hidden Markov Model Tagger, Applying to POS tagging, The effect of initialization on HMM training, Transformation-Based Learning of Tags ,learning algorithm, Tagging Accuracy and Uses of Taggers, Applications of tagging

Unit-IV

Probabilistic Context Free Grammars: Features of PCFGs, The Probability of a String, using inside probabilities, Using outside probabilities, Finding the most likely parse for a sentence,

Training a PCFG, Probabilistic Parsing, Parsing for disambiguation, Tree banks, Parsing models vs. language models, Weakening the independence assumptions of PCFGs, Tree probabilities and derivational probabilities, Phrase structure grammars and dependency grammars, Equivalent models, Use of the geometric mean, Non-lexicalized grammars, Lexicalized models using derivational histories, Dependency-based models, Statistical Alignment and Machine Translation, Text Alignment , Aligning sentences and paragraphs, Length-based methods ,Offset alignment by signal processing techniques, Lexical methods of sentence alignment , Word Alignment, Statistical Machine Translation, Clustering: Hierarchical Clustering , Single-link and complete-link clustering , Group-average agglomerative clustering, An application: Improving a language model Top-down clustering, Non-Hierarchical Clustering, K-means ,EM algorithm, Information Retrieval: Some Background on Information

Retrieval ,Common design features of IR systems, Evaluation measures, The probability ranking principle, The Vector Space Model, Vector similarity, Term weighting , Term Distribution Models , The Poisson distribution , The two-Poisson model, The K mixture, Inverse document frequency ,Residual inverse document frequency , Usage of term distribution models, Latent Semantic Indexing, Least-squares methods, Singular Value Decomposition, Latent Semantic Indexing in IR, Discourse Segmentation, Text Categorization, Decision Trees, Maximum Entropy Modeling, Generalized iterative scaling, Application to text categorization , k Nearest Neighbor Classification

Unit-V

Morphology, Graphical Models for Sequence Labelling in NLP, Forward Backward probability; Viterbi Algorithm, Phonology, Sentiment Analysis and Opinions on the Web, Machine Translation and MT Tools - GIZA++ and Moses. Text Entailment, POS Tagging, Phonology; ASR, Speech Synthesis, HMM and Viterbi, Precision, Recall, F-score, Map, Semantic Relations, UN, Towards Dependency Parsing., Universal Networking Language, Semantic Role Extraction, Baum Welch Algorithm, Entity Linking, Information Extraction, Back Propagation, Recurrent Neural network relevant to NLP, Language Generation, Applications– Sentiment Analysis, Spam Detection, Resume Mining, AInstein

Books:

Texts:

1. Daniel Jurafsky and James HMartin. Speech and Language Processing, 2e, Pearson Education, 2009.
2. Allen, James, Natural Language Understanding, Second Edition, Benjamin/ Cumming, 1995.

Reference:

3. Charniack, Eugene,Statistical Language Learning,MITPress,1993.
4. Jurafsky, Dan and Martin, James, Speechand Language Processing, Second Edition, Prentice Hall, 2008.
5. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
6. Shay Cohen, Bayesian Analysis in Natural Language Processing: Second Edition, Morgan & Claypool Publishers, 2019
7. Bernadette Sharp, Florence Sèdes, Wiesław Lubaszewski, Christopher D.Manning, Hinrich Schutze, Foundations of Statistical Natural Language Processing, Second Edition, 2000.

Android Programming

Objectives

- Android Application Development course is designed to quickly get you up to speed with writing apps for Android devices.
- The student will learn the basics of Android platform and get to understand the application lifecycle
- Android Developers design apps to be used on smartphones that utilize the Android operating system (OS).
- A number of apps can be designed for use on mobile devices, such as interactive games, media players, navigation software, and much more.

Outcomes

- By the end of the course, student will be able to write simple GUI applications, use built-in widgets and components, work with the database to store data locally, and much more.
- Job Objective To secure a challenging and rewarding position as Android Developer with an established organization that can utilize my skills and experience.
- Designed and coded from specifications, analyzed, evaluated, tested and implemented complex software apps.

Unit I

Introduction: History of Android, Introduction to Android Operating Systems, Android Development Tools, Android Architecture, Overview of object oriented programming using Java: OOPs Concepts: Inheritance, Polymorphism, Interfaces, Abstract class, Threads, Overloading and Overriding, Java Virtual Machine.

Unit II

Development Tools: Installing and using Eclipse with ADT plug-in, Installing Virtual machine for Android sandwich/Jelly bean (Emulator), configuring the installed tools, creating an android project – Hello Word, run on emulator, Deploy it on USB-connected Android device.User Interface Architecture: Application context, intents, Activity life cycle, multiple screen sizes.

Unit III

User Interface Design: Form widgets, Text Fields, Layouts, Button control, toggle buttons,Spinners (Combo boxes), Images, Menu, Dialog. Basics of Data Base: Introduction to SQ Lite

Books:

Texts:

1. Android application development for java programmers. By James C. Sheusi. Publisher:Cengage Learning, 2013.
2. James C. Sheusi, “Android application Development for Java Programmers”, Cengage Learning, 2013.

Reference:

1. M. Burton, & D. Felker, “Android Application Development for Dummies”, 2/e, Wiley India.

.NET FRAMEWORK

Objectives

The student will gain knowledge in the concepts of the .NET framework as a whole and the technologies that constitute the framework.

- The student will gain programming skills in C# both in basic and advanced levels.
- By building sample applications, the student will get experience and be ready for large–scale projects.

Outcomes

- After completion of the course the student will be able to use the features of Dot Net Framework along with the features of C#
- . NET Framework is used to create and run software applications.
- . NET apps can run on many operating systems

Unit I

Introducing C#: Understanding .NET, Overview of C#: Literals, Variables, Data Types, Operators, Expressions, Branching, Looping, Methods, Arrays: Strings, Structures, Enumerations.

OBJECT ORIENTED ASPECTS OF C# : Classes, Objects, Inheritance, Polymorphism, Interfaces, Operator Overloading, Delegates, Events, Errors and Exceptions.

Unit 2

APPLICATION DEVELOPMENT ON .NET : Building Windows Applications, Accessing Data with ADO.NET.

Unit 3

WEB BASED APPLICATION DEVELOPMENT ON .NET : Programming Web Applications with Web Forms, Programming Web Services.

Books:

Texts:

1. E. Balagurusamy, “Programming in C#”, Tata McGraw-Hill, 2004. (Unit I, II)
2. J. Liberty, “Programming C#”, 2nd ed., O’Reilly, 2002. (Unit III, IV, V)

Reference:

1. Herbert Schildt, “The Complete Reference: C#”, Tata McGraw-Hill, 2004.
2. Robinson et al, “Professional C#”, 2nd ed., Wrox Press, 2002.

Internet Technology

Objectives

- This course is intended to teach the basics involved in publishing content on the World Wide Web.
- This includes the 'language of the Web' – HTML, the fundamentals of how the Internet and the Web function, a basic understanding of graphic production with a specific stress on creating graphics for the Web, and a general grounding introduction to more advanced topics such as programming and scripting.
- This will also expose students to the basic tools and applications used in Web publishing.

Outcomes

- After Studying that subject student would have capability to make own web site and host their own web site on internet.
- Also, students would have enough knowledge about what are the technologies used in internet.
- Build dynamic web pages using JavaScript (Client-side programming).

Unit-1

Introduction to Networking: Brief idea about Server, Client, Protocol, Upload, Download, Hypertext, Hyperlink, Webpage, Website, WWW, Browser and Browsing.

HTML: HTML features, basic structure of an HTML document –creating an HTML document, mark up tags, heading, paragraphs, line breaks, working with text, lists, tables and frames, hyperlink, images and multimedia, forms and controls.

Unit-2

Style sheets: Need for CSS, introduction to CSS, basic syntax and structure, CSS features, creating style sheet, CSS properties, CSS styling (background, text format, controlling fonts), Types of CSS, Types of CSS selector.

Unit-3

JavaScript: Java Script features, Client side scripting, Simple JavaScript, How to develop JavaScript, simple JavaScript programs, variables, operators, datatypes, conditions, loops, array, functions, DHTML : Combining HTML, CSS and JavaScript, events and buttons, forms and validations.

Reference Book:

1. Achyut Godbole, Atul Kahate"Web Technologies:TCP/IP,Web/Java Programming, and Cloud Computing",Third Edition,McGraw Hill Education.
2. Raj Kamal, "Internet and Web Technologies", Tata McGraw-Hill.
3. Web Technologies – Black Book – DreamTech Press
4. Matt Doyle, Beginning PHP 5.3 (wrox-Willey publishing)
5. John Duckett, Beginning HTML, XHTML, CSS and Java script.
6. HTML, XHTML and CSS Bible, 5ed, Willey India-Steven M. Schafer.

Cyber security

Objectives

- Exhibit knowledge to secure corrupted systems, protect personal data, and secure computer networks in an Organization.
- Understand principles of web security and to guarantee a secure network by monitoring and analyzing the nature of attacks through cyber/computer forensics software/tools.
- To prepare students with the technical knowledge and skills needed to protect and defend computer systems and networks.

Outcomes

- Implement cyber security solutions and use of cyber security, information assurance, and cyber/computer forensics software/tools.
- Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation. Implement continuous network monitoring and provide realtime security solutions.
- Explain the concepts of confidentiality, availability and integrity in Information Assurance, including physical, software, devices, policies and people. Analyze these factors in an existing system and design implementations.

Unit 1

Cyber security fundamentals: Cyberspace, Cyber security, Importance of Cyber security, Hacker Types of malware: Worm, viruses, spyware, Trojans, Cyber security Breaches: Phishing, identity theft, harassment, cyber stalking, Types of Cyber attack: password attack, denial of service attack, passive attack, penetration testing.

Unit 2

Prevention tips, Mobile protection, Social network security, Prevention software: firewalls, virtual private networks, anti-virus and anti-spyware, routine updates.

Unit 3

Critical cyber threats: Critical cyber threats, cyber terrorism, Cyberwarefare, cyber espionage, Defense against hackers: cryptography, digital forensics, intrusion detection, and legal resource.

Books:

Texts:

1. Ozkaya, Erdal. 31. Cybersecurity: The Beginner's Guide, A comprehensive guide to getting started in cybersecurity. Packt Publishing, Limited, 2019. ProQuest Ebook Central, 2019.
2. Brooks, Charles J., Christopher Grow, Philip A. Craig Jr, and Donald Short. Cybersecurity essentials. John Wiley & Sons, 2018.
3. Raef Meeuwisse Cybersecurity for Beginners, Cyber Simplicity Ltd, 2nd edition ,2017.