RCOEM

Shri Ramdeobaba College of
Engineering and Management, Nagpur

SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR – 440013

An Autonomous College affiliated to
Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur, Maharashtra (INDIA)

PROGRAMME SCHEME & SYLLABI
2023 – 2024

M. Tech. (Computer Science and Engineering)

Published By

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ISO 9001 : 2015 CERTIFIED ORGANISATION

Vision of the Department

To continually improve the education environment, in order to develop graduates with strong academic and technical background needed to achieve distinction in the discipline. The excellence is expected in various domains like workforce, higher studies or lifelong learning.

To strengthen links between industry through partnership and collaborative development works.

Mission of the Department

To develop strong foundation of theory and practices of computer science amongst the students to enable them to develop into knowledgeable, responsible professionals, lifelong learners and implement the latest computing technologies for the betterment of the society.

Programme Educational Objectives

At the end of the programme the student will be able

1. To develop professionals with an ability to apply knowledge of Computer Science and Engineering in identifying, analyzing and formulating problems and designing their solutions.
2. To facilitate use of latest technologies and tools, multidisciplinary research and independent directed reflective learning.
3. To enable graduates in communicating effectively with the stakeholders, demonstrating professional ethics and engaging in lifelong learning for professional advancement.

Graduate Attributes

1. Scholarship of Knowledge
2. Critical Thinking
3. Problem Solving
4. Research Skill
5. Usage of modern tools
6. Collaborative and Multidisciplinary work
7. Project Management and Finance
8. Communication
9. Life-long Learning
10. Ethical Practices and Social Responsibility
11. Independent and Reflective Learning

Programme Outcomes

At the end of the program the student will exhibit

1. Ability to apply knowledge of Computer Science and Engineering in designing software systems.
2. Ability to understand the scope of problems through critical analysis with respect to computing domain.
3. Ability to formulate problems, propose algorithm and model efficient scalable systems.
4. Ability to augment domain knowledge by way of understanding effective methodologies and applying them to practice through experimentation.
5. Ability to apply techniques and tools in building reliable and maintainable software.
6. Ability to engage in multidisciplinary research and collaborate towards accomplishing common goal.
7. Ability to understand, design and develop software projects conforming specifications and budgetary constraints.
8. Ability to communicate effectively with leadership skills.
9. Ability to identify contemporary issues and engage in life-long learning for professional development.
10. Ability to understand professional ethics and demonstrate social ethical responsibility.
11. Ability to identify learning processes to become independent reflective learners.

Scheme of Examination of Master of Technology
M. Tech. (Computer Science and Engineering)
First Year (Semester - I)

Sr. No.	Category	Course Name	L	T	Credits	Maximum marks			ESE Duration (Hrs)	Category
						Internal Assessment	End Sem Exam	Total		
1.	CST701	Advanced Computer Architecture	4	0	4	50	50	100	3 Hours	PC
2.	CST702	Advance Data Structures	4	0	4	50	50	100	3 Hours	PC
3.	CSP702	Advance Data Structures Lab	0	2	1	50	--	50	–	PC
4.	HUT701	Technical Communication	3	0	3	50	50	100	3 Hours	FC
5.	CST703	Advanced Techniques in Data Management	4	0	4	50	50	100	3 Hours	PC
6.	CSP703	Advanced Techniques in Data Management Lab	0	2	1	50	--	50	–	PC
7.	CST704	Pattern Recognition	4	0	4	50	50	100	3 Hours	PC
8.	CSP705	Advanced Programming Lab - I	0	2	1	50	--	50	–	PC
9.	CSP706	Software Lab - I	0	2	1	50	--	50	--	PC
		TOTAL	**19**	**8**	**23**	**450**	**250**	**700**		

Category Details

Course code	Program Elective-I
PC	Programme Core
PE	Programme Elective
GE	Group Elective
OE	Open Elective
FC	Foundation Course

Scheme of Examination of Master of Technology
M. Tech. (Computer Science and Engineering)
First Year (Semester - II)

Sr. No.	Code	Course Name	L	P	Credits	Maximum marks			ESE Duration (Hrs)	Category
						Internal Assessment	End Sem Exam	Total		
1.	CST707	Analysis of Algorithm	4	0	4	50	50	100	3 Hours	PC
2.	CST708	Research Methodology	3	0	3	50	50	100	3 Hours	FC
3.	CST709	Program Elective - I	4	0	4	50	50	100	3 Hours	PE
4.	CST710	Group Elective - I	4	0	4	50	50	100	3 Hours	GE
5.	CST711	Open Elective - I	3	0	3	50	50	100	3 Hours	OE
6.	CSP712	Advanced Programming Lab - II	0	2	1	50	--	50	–	PC
7.	CSP713	Software Lab - II	0	2	1	50	--	50	–	PC
8.	CSP714	Seminar	0	2	1	50	50	100	--	PC
		TOTAL	**18**	**6**	**21**	**400**	**300**	**700**		

Course Code	Program Elective - I
CST709-1	Network Security
CST709-2	Deep Learning
CST709-3	Cloud Computing and Virtualization

Course Code	Group Elective - I
EET561	Electrical Power Distribution and Smart Grid
ENT560	VLSI Design Automation
CST710-1	Optimization Techniques in Artificial Intelligence
CST710-2	Social Network Analysis

Course Code	Open Elective - I
CST711-1	Advanced Programming Techniques

Scheme of Examination of Master of Technology
M. Tech. (Computer Science and Engineering)
Second Year (Semester - III)

Sr. No.	Course Code	Course Name	L	T	Credits	Maximum marks			ESE Duration (Hrs)	Category
						Internal Assessment	End Sem Exam	Total		
1.	CST801	Program Elective -II	4	0	4	50	50	100	3 Hours	PE
2.	CST802	Program Elective - III	4	0	4	50	50	100	3 Hours	PE
3.	CSP803	Project Phase-I	0	3	6	50	50	100	–	PC
		TOTAL	**8**	**3**	**14**	**150**	**150**	**300**		

Course code	Program Elective-II
CST801 - 1	Advanced Natural Language Processing
CST801 - 2	Advanced Digital Image Processing
CST801 - 3	Big Data Analysis
CST801 - 4	Industry Offered Elective

Course code	Program Elective-III
CST802-1	Information Retrieval
CST802-2	Advanced Machine Learning
CST802-3	Data Visualization Techniques

Scheme of Examination of Master of Technology
M. Tech. (Computer Science and Engineering)
Second Year (Semester - IV)

Sr. No.	Course Code	Course Name	L	T	Credits	Maximum marks			ESE Duration (Hrs)	Category
						Internal Assessment	End Sem Exam	Total		
1.	CSP804	Project Phase-II	0	6	12	200	200	400	–	PC
		TOTAL	**0**	**6**	**12**	**200**	**200**	**400**		

Syllabus for Semester I
M. Tech. (Computer Science and Engineering)

Course Code : CST701 **Course : Advanced Computer Architecture**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On successful completion of the course, students will be able to:

1. Understand the classification & architecture of modern computer systems.
2. Understanding & Implementation of performance enhancements techniques in advanced processors.
3. Able to compare the performance of different architectures and their applications.

Syllabus

Parallel Computer Models

The state of computing, Multiprocessors and multi-computers, Multivector and SIMD computers, Architectural development tracks. Program And Network Properties: Conditions of parallelism, Data and resource dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain size and latency, Program flow mechanisms, Control flow versus dataflow, Data flow architecture, Demand driven mechanisms, Comparisons off low mechanisms.

System Interconnect Architectures

Network properties and routing, Static interconnection networks, Dynamic interconnection Networks, Multiprocessor system interconnects Hierarchical bus systems, Crossbar switch and multiport memory, Multistage and combining network.

Processors and Memory Hierarchy

Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Vector and Symbolic processors, Pipelining, Basic concepts, instruction and arithmetic pipeline, data hazards, Exception handling, Pipeline optimization techniques, Compiler techniques for improving performance.

Memory Technology

Hierarchical memory technology, Inclusion, Coherence and Locality, Memory capacity planning, Virtual Memory Technology. Backplane Bus System: Backplane bus specification, Addressing and timing protocols, Arbitration transaction and interrupt, Cache addressing models, direct mapping and associative caches.

Pipelining and Instruction-level parallelism

Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch handling techniques, Arithmetic Pipeline Design, Computer arithmetic principles, Static arithmetic pipeline, Multifunctional arithmetic pipelines. ILP, Techniques for increasing ILP, superscalar, super pipelined and VLIW processor architectures.

Multi-core/Many-core Architectures

Array and vector processors, Multiprocessor architecture, taxonomy of parallel architectures, centralized shared-memory architecture, synchronization, memory consistency, interconnection networks, Distributed shared-memory architecture, Cluster computers, Non von Neumann architectures, data flow computers, reduction computer architectures, systolic architectures. GPU architecture: GPU basics and architecture, Graphics and Computing.

Text and Reference Books

1. Kai Hwang, "Advanced Computer Architecture"; TMH.
2. J.P. Hayes, "Computer Architecture and Organization"; MGH.
3. Harvey G. Cragon, "Memory System and Pipelined Processors"; Narosa Publication.
4. V. Rajaranam & C.S.R. Murthy, "Parallel Computer"; PHI.
5. R. K. Ghose, Rajan Moona & Phalguni Gupta, "Foundation of Parallel Processing"; Narosa Publications.
6. Kai Hwang and Zu, "Scalable Parallel Computers Architecture"; MGH.
7. RandiJ. Rost, "OpenGL Shading Language", Third Edition.
8. David B. Kirkand Wen-mei W.Hwu, "Programming Massively Parallel Processors: A Hands-on Approach", First Edition, ISBN-10: 123814723, ISBN-13: 978-0-12-381472-2, Morgan Kauffman, 2010.

Syllabus for Semester I
M. Tech. (Computer Science and Engineering)

Course Code : CST702 **Course : Advanced Data Structures**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On successful completion of the course, students will be able to

1. Understand and implement dynamic list ADTs and planar graphs.
2. Understand different static and dynamic randomization techniques.
3. Understand and analyze tree-based structures using red-black trees, B + -trees and splay trees.
4. Understand and apply dynamic programming to a varied set of problems.

Syllabus

Unit - I

Linked Lists: Singly Linked Lists and Operations, Doubly Linked Lists and Operation, Linked Stacks and Linked Queues.

Unit - II : Graphs

Classification, Representation, Breadth First Search, Depth First Search, Connected Components, Spanning Trees, Shortest Paths.

Unit - III : Dictionaries

Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

Hashing : Open Addressing and Separate Chaining, Collision Resolution, Cuckoo Hashing, Hopscotch Hashing, Extendible Hashing.

Unit - IV : Red Black Trees

Height of a Red Black Tree, Red Black Trees Bottom-Up Insertion, Top-Down Red Black Trees, Top-Down Deletion in Red Black Trees.

2-3 Trees : Advantage of 2-3 trees over Binary Search Trees, Search and Update Operations on 2-3 Trees.

Unit - V

B + -Trees : Advantage of B + -trees over BSTs, Height of B + -Tree, Search and Update Operations on B + -Trees.

Splay Trees : Splaying, Search and Update Operations on Splay Trees.

Unit - VI : Dynamic Programming

Basic Strategy, Multistage Graphs, All Pairs Shortest Path, Optimal Binary Search Trees, Travelling Salesman Problem, String Editing, Longest Common Subsequence Problem and its variations.

Text Books

1. Cormen, Leiserson, Rivest and Stein, Introduction to Algorithm, Third edition, PHI, 2009
2. Horowitz, Sahni and Rajasekaran, Computer Algorithms, Universities Press, 2000.
3. Goodrich and Tamassia, Algorithm Design, Wiley Publishers, 2002.

Reference Books

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Fourth Edition, Pearson Education, 2002.
2. Aho, Hopcroft and Ullman, Data Structures and Algorithms, Pearson Education, 2002.
3. Tanenbaum, Langsam and Augestien, Data Structures using C and C++, Prentice Hall of India, 2002.

Syllabus for Semester I
M. Tech. (Computer Science and Engineering)

Course Code : CSP702 | **Course : Advanced Data Structures Lab**

L : 0 Hrs, T : 0 Hrs, P: 2 Hrs, Per Week | **Total Credits : 01**

Course Outcomes

On successful completion of the course, students will be able to

1. Implement list ADTs & their operations and hash tables.
2. Implement graph ADT and estimate shortest paths & MSTs.
3. Implement algorithms for red-black trees and Splay trees.
4. Realize some problems using dynamic programming.

Syllabus

Experiments based on "CST702 – Advanced Data Structures" course syllabus.

Practical may preferably be conducted in C++ using generic programming or in Java and may include lab practice on topics (not limited to)

- Doubly Linked List and Application
- Hash Tables
- Graphs Traversals and/or Spanning Trees
- Shortest Paths in Graphs (Dijkstra's Method, Floyd's Method, Bellman-Ford's Method)
- Red-Black Tree, Splay Tree, 2-3 Trees
- Dynamic Programming – a minimum of 2 identified problems.

Reference Books

1. Goodrich and Tamassia, Data Structures and Algorithm in Java ISV (WSE), 6th Edition, Wiley Publishers, 2009.
2. Adam Drozdek, Data Structures and Algorithms in Java, 3rdEdition, Cengage Publication, 2008.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson Education, 2002.
4. Mark Allen Weiss, Data Structures and Problem Solving Using Java, 4th Edition, Pearson Education, 2010.
5. Tanenbaum, Langsam and Augestien, Data Structures using C and C++, Prentice Hall of India, 2002.

Syllabus for Semester I
M. Tech. (Computer Science and Engineering)

Course Code : HUT701 | **Course : Technical Communication**

L : 3 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week | **Total Credits : 03**

Course Objectives

The course aims to develop the skills of students for writing effective technical and research documents and applying effective strategies of verbal professional communication.

Course Outcomes

On completion of the course, students will be able to be achieve the following:

CO1 : Take notes, interpret and proof-read successfully, scientific and technical articles

CO2 : Understand the process of technical writing and the role of audience in effective communication.

CO3 : Develop professional writing skills and produce effective work place documents.

CO4 : Develop skills to enhance visual appeal of documents and produce effective reports.

CO5 : Evaluate and apply strategies of effective communication for employability needs.

Syllabus

Unit - I : Reading and Discussion Techniques

Scientific and technical reading (reading and discussion on 10-15 scientific and technical articles); Note-taking; Proof-reading; Listening and discussion after suggested reading, listening to podcasts, webcasts, etc.

Unit - II : Tools for Writing and Editing

Process of technical writing, audience recognition, tools of writing (the Cs of writing, mechanics, punctuations, using Fog Index, etc.)

Unit - III : Professional Writing

Letters and email writing: Applications, Enquiry, Complaint, Order, Follow-up, Cover/Transmittal, Sales.

Organizational communication: Notices, Agenda, Minutes of Meeting.

Unit - IV : Document Preparation and Reports

Basic formats and types of reports: Annual, Progress, Research, Project (Project Charter, Project Timeline), Market Search, Sales, Feasibility/Recommendation, Case Study evaluation.

Visual Appeal : Document Design, Graphics, Tables, User Manuals, Interpretation of data and Transcoding

Unit - V

Professional Speaking and Presentation Skills Public Speaking, Presentation Skills, Group Discussion.

Unit - VI : Communication for Employability

Pre-interview techniques (SWOT and Johari Window), Personal Interview, Job Application, Job Description and Resume, Creating LinkedIn Profile, Effectively using www.indeed.com and www.glassdoor.co.in for job purposes

Books

1. Sharon Gerson, Steven Gerson, Technical Communication: Process and Product, 2018, Pearson
2. Sanjay Kumar, Pushpa Lata, Communication Skills, 2nd Edition, Oxford Publication, 2018.
3. ShaliniVerma, Business Communication, Vikas Publishing House Pvt. Ltd., 2015.
4. P.D. Chaturvedi and Mukesh Chaturvedi, Fundamentals of Business Communication, Pearson Publications, 2012.
5. William Strunk Jr. and E.B. White The Elements of Style, Allyn& Bacon - A Pearson Education Company, 2000.
6. Courtland L. Bovèe, John Hill and Roshan Lal Raina, Business Communication Today, Pearson Publications, 2020.

Syllabus for Semester I
M. Tech. (Computer Science and Engineering)

Course Code : CST703 **Course : Advanced Techniques in Data Management**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Objectives

1. To review relational data model, relational schema, integrity constraints and demonstrating DDL, DML, DCL using SQL.
2. Introduce students with object oriented database and object relational mapping.
3. To impart students the basic concepts of data mining and warehousing & data mining techniques.
4. To familiarize students Mango DB No-SQL Database and trends in Data Mining.

Syllabus

Unit - I : Relational Data Model

Relational model concepts, Relational schema, Languages- DDL, DML, DCL, Data constraints, Integrity and Security, SQL.

Unit - II : Object oriented and Object - Relational Databases

Introduction to object oriented database development, Need for Complex Data Types, Object-Relational Databases, Complex Types, Inheritance, and Querying with Complex Types, Object relational mapping, Object oriented versus Object relational.

Unit - III : Data mining and Data Warehousing

Data mining introduction, Data preprocessing, Data warehousing & OLAP technology an overview, Multidimensional data model, Data warehouse architecture.

Unit - IV : No-SQL Databases

Introduction to No-SQL databases, Types of No-SQL databases, CAP theorem, Mongo DB No-SQL database. Mongo DB Data types, Mongo DB Operators, Database commands andqueries.

Unit - V : Mining data streams and Time-Series Data

Methodologies for Stream Data Processing and Stream Data Systems, Frequent-Pattern Mining in Data Streams Mining, Lossy count algorithm, Trend Analysis, ARIMA Model.

Unit - VI : Applications and Trends in Data Mining

Data Mining for Financial Data Analysis, Data Mining for the Retail Industry, Data Mining for the Telecommunication Industry, Data Mining for Biological Data Analysis, Data Mining in Other Scientific Applications, Data Mining for Intrusion Detection.

Course Outcomes

On successful completion of the course, students will be able to:

1. Understand and demonstrate the concepts of relational database, object relational database.
2. Understand the concepts of data warehousing and data mining and perform multidimensional data analysis.
3. Understand and demonstrate the concepts of Mango DB No-SQL.
4. Understand the techniques involved in mining of data stream and time series data & study applications and trends in data mining.

Text Books

1. "Database system concepts" by Silberschatz, Korth & Sudarshan (McGrawHill) 6th addition, MGRAW education.
2. "Data Mining: Concepts and Technique" by Jaiwai hen and Michekine kamber Second addition, ELSEVIER publication.
3. “Mongo DB: The Definitive Guide”, Shannon Bradshaw, Eoin Brazil and Kristina Chodorow; 3rd Edition; O' Reilly Media; 2019.

Reference Books

1. Elmasri and Navathe; “Fundamentals of Database Systems”, Addison Wesley 2000.
2. "Data Mining : Introductory and Advanced topics" by Marget h. Dunham, Pearson education.

Syllabus for Semester I, M.Tech
(Computer Science & Engineering)

Course Code : CSP703 **Course : Advanced Techniques in Data Management Lab**

L : 0 Hrs, T : 0 Hrs, P: 2 Hrs, Per Week **Total Credits : 01**

Course Outcomes

On completion of the course the student will be able to:

1. Understand the use of database languages such as DDL, DML, and DCL and Write simple, nested, multiple table, and advanced queries for data retrieval.
2. To demonstrate multidimensional data model and OLAP queries.
3. To demonstrate data preprocessing and data visualization.
4. To understand and demonstrate Mango DB No-SQL Database concepts.

Experiments Based on Advanced Techniques in Data Management (CST703)

- SQL queries
- Multidimensional data designing
- Data preprocessing and visualization
- Mongo DB

Tools : Orange, Weka, R programming/ Python (open source) and MySQL /Oracle

Text Books

1. "Database system concepts" by Silberschatz, Korth& Sudarshan (McGrawHill) 6th addition, MGRAW education.
2. "Data Mining: Concepts and Technique" by Jaiwai hen and Michekine kamber Second addition, Elsevier publication.
3. "R and Data Mining: Examples and Case Studies" by Yanchang Zhao, Elsevier publication.
4. "MongoDB: The Definitive Guide" (3rd Edition), Oreilly.

Reference Books

1. Elmasri and Navathe; "Fundamentals of Database Systems", Addison Wesley 2000.

Syllabus for Semester I, M.Tech
(Computer Science & Engineering)

Course Code : CST704 **Course : Pattern Recognition**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On successful completion of the course, students will be able to:

1. Understand the concept and application of statistical decision making in pattern recognition.
2. Understand the applications of parametric and Non-parametric decision making techniques in Machine Learning.
3. Understand the concept of supervised and unsupervised learning in pattern recognition.
4. Understand the implementation of various machine learning algorithms.

Course Syllabus

Unit - I : The concept learning task

General-to-specific ordering of hypotheses, Version spaces, Inductive bias, Decision Tree Learning, Over-fitting, Cross-Validation, and Experimental Evaluation of Learning Algorithms.

Unit - II : Instance-Based Learning

K-Nearest neighbor algorithm, weighted k-NN algorithm, Radial basis function network (RBFN).

Regression : Linear Regression, Logistic Regression.

Unit - III : Artificial Neural Networks

Linear threshold units, Perceptron, Multilayer networks and back- propagation, recurrent networks.

Unit - IV : Probabilistic Machine Learning

Maximum Likelihood Estimation, MAP Bayes Classifiers, Naive Bayes, Bayes optimal classifiers, Minimum description length principle.

Unit - V

Bayesian Networks, Inference in Bayesian Networks, Expectation Maximization (EM) algorithm.

Unit - VI

Unsupervised Learning: K-means Clustering, Hierarchical Clustering.

Support Vector Machine, Hidden Markov Models, and Ensemble learning: boosting, bagging, Random Forest.

Text Books

1. Tom Mitchell; Machine Learning- an Artificial Intelligence Approach, Volume-II; Morgan Kaufmann, 1986.
2. Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

Reference Books

1. Soumen Chakrabarti; Mining the Web: Discovering Knowledge from Hypertext Data, Morgan-Kaufmann, 2003.
2. A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988.
3. Ethem Alpaydin, Introduction to Machine Learning, PHI.

Syllabus for Semester I
M. Tech. (Computer Science and Engineering)

Course Code : CSP705 | **Course : Advanced Programming Lab - I**

L : 0 Hrs, T : 0 Hrs, P: 2 Hrs, Per Week | **Total Credits : 01**

Course Outcomes

On completion of the course the student will be able to

1. Design Python programs using different data and control structures.
2. Use Python Files, Modules and Packages to develop complex python programs.
3. Develop mathematical models and scientific applications in python using various libraries.
4. Perform exploratory data analysis using python.

Syllabus

Basics of Python Programming: Functions, Creating Modules in Python. Handling Strings in Python, String Operations.

Data Structures and its Applications: Lists-Operations, Slicing, Tuples, Sets, Dictionaries. Dealing with files in Python, Modules and Packages, SciPy, an Open Source Python- based library. Pandas, Numpy, Matplotlib, and Seaborn, etc.

Introduction to Web scrapping and its need in Application development to scrape the web with the help of standard libraries like Requests and Beautiful Soup.

Exploratory Data Analysis using Python. Data Pre-Processing using Python libraries.

Text Books

1. Python Programming Using Problem Solving Approach: Reema Thareja, Oxford University, Press; First edition.
2. Learning Python: Powerful object oriented programming, Mark Lutz, O'REILLY publications 5th addition
3. Introduction to Computing & Problem Solving with Python Jeeva Jose and P Sojan Lal Ascher
4. Problem Solving with Algorithms and Data Structures using Python by Brad Miller and David Ranum, 2nd addition

Reference Books

1. Allen Downey, Jeffrey Elkner, Chris Meyers,: Learning with Python, Dreamtech Press
2. The Python 3 Standard Library by Example (Developer's Library) by Doug Hellmann, second edition.

Syllabus for Semester I, M.Tech (Computer Science & Engineering)

Course Code : CSP706 **Course : Software Lab - I**

L : 0 Hrs, T : 0 Hrs, P: 2 Hrs, Per Week **Total Credits : 01**

Course Objectives

1. Understand UI/UX basics and its use in software industry
2. Understand basic use cases of UI/UX.
3. Develop small utilities using UI/UX tools
4. Develop and integrate UI/UX with basic programs

Course Outcomes

On successful completion of the course, students will be able to:

1. Design stylized static and dynamic web pages.
2. Develop web applications and libraries with efficient DOM manipulation.
3. Use data visualization tools to develop interfaces for use cases
4. Develop single page applications using voice technology, motion design, and animation.

Syllabus

HTML5

Creation of headers, paragraphs, links, importing of images, tables, designing of forms, and document structure of HTML, Multimedia based tags- audio, video, iframe, Creating Animations,

Style Sheets

CSS3 - Introduction to Cascading Style Sheets- Features-Core syntax - Style Sheets and HTML Style Rule, Text Properties

Client- Side Programming

Introduction to JavaScript, Syntax, Variables and Data Types, Statements, Operators, Literals, Functions, Objects-Arrays-Built-in Objects, Form Validation, DOM Manipulation, jQuery

Data Visualization CanvasJS Library, HighCharts Library Angular JS

Introduction, Features of AngularJS ,Model-View-Controller, Built-In Filters, Using AngularJS Filters, Controllers & Modules, Working with Angular Forms, Model Binding

React JS

React and JSX, React components – class and functional, lifecycle methods, props vs. state, event handling, conditional rendering

Text Books

1. "HTML and CSS: Design and Build Websites" by Jon Duckett, Wiley & Sons, 2011
2. "JavaScript and jQuery: Interactive Front-End Web Development", by Jon Duckett, John Wiley & Sons, 2011.
3. UI/UX design for designer and developers: by Nathan Clark.

Syllabus for Semester II
M. Tech. (Computer Science and Engineering)

Course Code : CST707 **Course : Analysis of Algorithm**

L : 4 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On successful completion of the course, students will be able to:

1. Understand the algorithm design paradigm, methods of analysis of algorithms and Classify algorithms in P and NP domains.
2. Understand applications of algorithms in real life problems, like searching, social network analysis, constraint handling and implementation of algorithms for distributed and parallel systems.
3. Understand the application of algorithms in Internet programming, search engines design and data compression.
4. Understand the applications of Randomized, Geometric and Numerical algorithms for solving Real life problems and designing solutions.

Syllabus

Algorithmic Paradigms : Dynamic Programming, Greedy, Branch - and - Bound Asymptotic complexity, Amortized analysis.

Graph Algorithms, Shortest paths, Flow networks, NP-completeness, Approximation algorithms, Randomized algorithms, Linear programming.

Geometric algorithms (range searching, convex hulls, segment intersections, closest pairs), Numerical algorithms (integer, matrix and polynomial multiplication, FFT, extended Euclid's algorithm, modular exponentiation, primarily testing, cryptographic computations), Internet Algorithms (text pattern matching, tries, information retrieval, data compression, Web caching).

Text and String handling Algorithms : Naïve algorithm, Knuth-Morris-Pratt Algorithm, Boyer-Moore-Algorithm, Krapp-Rabin Algorithm, Approximate String Matching.

Parallel Algorithms and Architectures : Approaches to Design of Parallel Algorithm, Performance Measures of Parallel Algorithm, Parallel Sorting.

Distributed Computation Algorithm : SPMD Distributed Computation Model, Message Passing, Distribution Even-Odd Transposition Sort, Distributed Depth First Search.

Text and Reference Books

1. Fundamentals of Computer Algorithms by Horowitz and Sahani, University Press, 2K, 2008
2. Introduction to Algorithm by Cormen, Rivest and Stein, PHI Publications NewDelhi, Second Edition, 2001
3. Design and Analysis of Computer Algorithms by A.Aho and John Hopcroft, Pearson Education, India.
4. Algorithm Design by Jon Kleinberg and Eva Tardus, Pearson Education, India.

Syllabus for Semester II
M. Tech. (Computer Science and Engineering)

Course Code : CST708 | **Course : Research Methodology**

L : 3 Hrs, P: 0 Hrs, Per Week | **Total Credits : 03**

Course Outcomes

1. Ability to critically evaluate current research and propose possible alternate directions for further work.
2. Ability to develop hypothesis and methodology for research
3. Ability to comprehend and deal with complex research issues in order to communicate their scientific results clearly for peer review.

Syllabus

Introduction to research methodology : Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of good Research, Necessity and Techniques of Defining the Problem, Meaning and need of Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Design, Research ethics, Stress management.

Literature review, Data collection and sampling design : Review concepts and theory, review previous findings, Sources of data: Primary and secondary data, Methods of data collection, Sampling fundamentals

Modelling and Analysis : Probability distributions, Processing and analysis of data, Data analysis skills, Distributions, Statistical and multivariate analysis, Correlation and regression, Fundamentals of Time series analysis, spectral analysis, Error analysis, Simulation techniques

Algorithmic processes in Computer science research domains : Soft computing, Artificial intelligence, NLP, Image processing, Data management techniques, Networks and security, Software systems

Research Reports : Structure and components of Research report, Types of report, Layout of research report, Mechanisms and tools for writing research report, LaTeX

Text and Reference Books

1. C. R. Kothari, Research Methodology Methods and Techniques, 2nd revised edition, New Age.
2. Richard I Levinamp; DavidS.Rubin,StatisticsforManagement,7/e.PearsonEducation,2005.
3. DonaldR.Cooper,PamelaS.Schindler,BusinessResearchMethods,8/e,TataMcGraw - HillCo. Ltd., 2006.
4. Bendat and Piersol, Random data: Analysis and Measurement Procedures, Wiley Interscience, 2001.
5. Shumway and Stoffer, Time Series Analysis and its Applications, Springer, 2000.
6. Jenkins, G. M., and Watts, D.G., Spectral Analysis and itsApplications,HoldenDay,1986.

Syllabus for Semester II
M. Tech. (Computer Science and Engineering)

Course Code : CST709-1 **Course : Network Security**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On completion of the course the student will be able to

1. Identify and investigate network security threat.
2. Apply cryptographic techniques and algorithm to build security related applications.
3. To understand necessary Approaches and Techniques to build protection mechanisms in order to secure computer networks.
4. Understand the security concepts in Wireless network

Syllabus

Unit - I : Introduction to Security

Security Goals, Different Types of Attacks on Networks, Threats, Vulnerabilities, Attacks, Data Integrity, Confidentiality, Anonymity Message and Entity Authentication Authorization, Non-repudiation, Cryptographic Techniques.

Unit - II : Principles of Cryptography

Symmetric Key Cryptography: DES, Block Cipher Modes of operation, Advanced Encryption Standard. Key distribution, Attacks.

Unit - III : Public key Cryptography

RSA, Cryptographic Hash functions, Authentication, Message Authentication Code (MAC), Digital Signatures, DSA Signatures.

Unit - IV : PKI and Security Practices

Digital Certificates, MD5, SHA, Challenge Response protocols-Authenticationapplications, Kerberos, X.509, Securing Email, Web Security.

Unit - V : Software Vulnerabilities

Buffer Overflow, Cross Site Scripting, SQL Injection,Case Studies on worms and viruses, Virtual Private Networks, Firewalls.

Unit - VI : Wireless Security

Security in Wireless Local Area Networks, Security in Wireless Ad Hoc and Sensor Networks, Security of the Internet of Things

Text Books

1. W. Stallings, "Cryptography and Network Security: Principles and Practice", Pearson Education, 7th edition, 2016.
2. BehrouzA.Forouzan,CryptographyandnetworksecurityMCGrawHill3rdEdition.
3. C. Kaufman, R. Perlman, M. Speciner, "Network Security: Private Communication in a Public World", Pearson Education, 2nd edition, 2002.

Reference Books

1. Applied Cryptography - Schnier.
2. J. Edney, W. A. Arbaugh, "Real 802.11 Security: Wi-Fi Protected Access and 802.11i", Pearson Education, 2004.
3. E. Rescorla, "SSL and TLS: Designing and Building Secure Systems", Addison-Wesley, 2001.
4. B. L. Menezes, "Network Security and Cryptography", Wadsworth Publishing Company Incorporated, 2012.
5. Handbook of Applied Cryptography - Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone: Online Version.

Syllabus for Semester II
M. Tech. (Computer Science and Engineering)

Course Code : CST709-2 **Course : Deep Learning**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On successful completion of the course, students will be able to:

1. Understand the basic concept and need of artificial neural networks.
2. Apply various optimizers in neural network training.
3. Use various machine learning techniques to avoid overfitting in neural networks.
4. Understand the concepts of auto encoders in Unsupervised Learning.

Course Syllabus

Unit - I : Feed forward Neural Networks, Back propogation, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam.

Unit - II : Bias Variance Tradeoff, L1 and L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout.

Unit - III : Autoencoders and relation to PCA, Regularization in autoencoders, Denoising auto-encoders, Sparse autoencoders, Contractive autoencoders

Unit - IV : Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization.

Unit - V : Convolutional Neural Network, The Convolution Layer, Softmax Activation function, Pooling Layer, Fully connected Layer, AlexNet, ResNet , GoogleNet,.

Unit - VI : Recurrent Neural Networks (RNN), Backpropagation Through Time(BPTT), Vanishing and Exploding Gradients, Solving the vanishing gradient problem with Long Short Term Memory(LSTM), Applications of RNN and LSTM in sequence modeling.

Text Books

1. Ian Good fellow and Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.
2. Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2019.
3. Dive into Deep Learning
4. Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

Reference Books

1. Soumen Chakrabarti; Mining the Web: Discovering Knowledge from Hypertext Data, Morgan-Kaufmann, 2003.
2. A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988.
3. Ethem Alpaydin, Introduction to Machine Learning, PHI.

Syllabus for Semester II
M. Tech. (Computer Science and Engineering)

Course Code : CST709-3 **Course : Cloud Computing and Virtualization**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On successful completion of the course, the student will be able to:

1. Articulate the concepts of cloud computing, its various deployment and service models.
2. Understand the concept of virtualization, virtualization techniques at different levels of abstraction, infrastructure and resource management.
3. Understand virtual machine live migration and fault tolerance mechanism.
4. To understand modern cloud storage, security, solutions for cloud programming models and services on cloud environments.

Pre-requisite : Operating Systems, Computer Architecture.

Unit - I : Introduction

Evolution of Cloud Computing –Underlying Principles of Parallel and Distributed Computing, Introduction to Cloud Computing, Gartner's Hype Cycle for Emerging Technologies, Comparisons: Cluster, Grid and Cloud, Cloud Computing at a Glance, Vision, A Close Look, The NIST Model, Cloud Cube Model. Cloud Fundamentals: Cloud Definition, Architecture, Characteristics, Applications, Benefits, Disadvantages, Deployment models and Service models.

Unit - II : Virtualization

Definition and Understanding of Virtualization. Virtualization Structure/Tools and Mechanisms, Issues with virtualization, virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, introduction to Various Hypervisors.

Techniques to design Virtual Machine Monitors, Hardware-assisted CPU virtualization, Full virtualization via dynamic binary translation, Para virtualization , virtualization techniques and types of virtualization. Characteristics of Virtualized Environments, Pros and Cons of Virtualization, Hypervisor.

Unit - III : Cloud issues

Virtual Infrastructures, Dynamic provisioning and resource management, Resource Allocation, Leases: Advance Reservation, Best Effort, Immediate, Deadline Sensitive and Negotiated, Swapping and Backfilling, Resource Allocation Measures, Task Scheduling, Task: Dependent and Independent, Job, Application, Workflow, Machine: Homogeneous and Heterogeneous, Mode: Immediate, Intermediate and Batch, Expected Time to Compute Matrix, Manager Server, Data Center.

Virtual Machine, Server, Makespan, Resource Utilization, Average Execution Time, Uncertainty. Load Balancing,

Unit - IV : Migration and Fault Tolerance

Virtualized Networks and Virtual Clusters. Process Migration and VM Migration. Live Migration, Vendor lock-in, Broad Aspects of Migration into Cloud, Type of migration, Migration of virtual Machines and techniques, live virtual machine migration- types. VM checkpointing and cloning, Containers, Fault Tolerance Mechanisms. Virtualization in Data Centers and Clouds. Cloud OS.

Unit - V : Cloud Security and Storage

Cloud Infrastructure Security, Identity and access management Architecture, IAM practices in the cloud, Cloud Security and Management, Security and Privacy issues in Cloud. Storage Systems and Storage Virtualization: Storage Devices, File Systems and Volumes, Storage Networks – NAS and SAN, Virtual Storage, Cloud Storage Platforms- Handling Large Data: Big Data Issues, Storage Models on cloud.

Unit - VI : Cloud Programming Model

Parallel and Distributed Programming Paradigms, Study of different Cloud computing Systems, Deployment of Web Services from Inside and Outside a Cloud Architecture. Introduction to Hadoop framework - MapReduce and its extensions to Cloud Computing, design of Hadoop File System and GFS. Cloud software environments, Services on the Cloud.

Text Books

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier – 2012
2. "Cloud Computing Principles and Paradigms", RajkumarBuyya, JamesBroberg, Andrzej Goscinski, Wiley Publishers.2011.

Reference Books

1. Jim Smith, Ravi Nair. Virtual Machines: Versatile Platforms for Systems and Processes. Morgan Kaufmann. 2005
2. Barrie Sosinsky, " Cloud Computing Bible" John Wiley & Sons, 2010
3. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance", O' Reilly 2009
4. Cloud Computing : A Practical Approach, Toby Velte, Anthony TVelte, Robert Elsenpeter, McGraw Hill,2009
5. Technical research papers from major journals and major conferences on cloud computing.

Syllabus for Semester II (Group Elective - I)
M. Tech. (Computer Science and Engineering)

Course Code : CST710-1 **Course : Optimization Techniques in Artificial Intelligence**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On successful completion of the course, students will be able to:

1. Understand the basics of optimization and natural computing. .
2. Apply genetic algorithm for optimization problem.
3. Understand and Apply Particle Swarm Optimization and Ant Colony Optimization for optimization problem.
4. Understand the concepts of Fuzzy logic, Artificial Neural Network and Optimization Algorithms.

Syllabus

Unit - I : Introduction

Optimization problem definition, Classification of Optimization Problem, Constraints, Feasible Region, Natural computing, Classification of Natural Computing and Evolutionary computing.

Unit - II : Genetic Algorithm

Basic Genetic Algorithm, Fitness function, Evaluation, Selection, Crossover and Mutation, Chromosome Encoding, Roulette wheel selection, genotype and phenotype. Optimization problem solving using Genetic Algorithm.

Unit - III : Fuzzy Set and Fuzzy Logic

Crisp sets and fuzzy sets, Fuzzy set and Operations on fuzzy sets, Fuzzy relations, Uncertainty and Fuzzy, Alpha Cuts, Linguistic variables, Fuzzy logic, Fuzzy Languages, Approximate Reasoning, Expert systems, Uncertainty modeling in expert system, Fuzzy control, Fuzzy clustering. Methods of Defuzzification, Fuzzy Logic based Optimization.

Unit - IV : Swarm Intelligence and Optimization

Collective Behavior and Swarm Intelligence, Social Insects, Particle Swarm Optimization (PSO) Algorithm, Optimization using PSO. Ant Colony Optimization concepts, Artificial Pheromone, Ant model to solve the traveling salesman problem.

Unit - V : Artificial Neural Network and Optimization

Artificial Neuron, Activation function, Supervised and Unsupervised Learning methods, Single layer and Multilayer Perceptron, Gradient Descent and Stochastic Gradient Descent (SGD), ADAM.

Unit - VI : Applications and Recent Trends

Real life Problems and their mathematical formulation as standard programming problems. Applications of ant colony optimization, PSO and genetics in solving real world problems.

Text Books and Reference Books

1. Leandro Nunes De Castro, Fernando Jose Von Zuben, "Recent Developments in Biologically Inspired Computing", Idea Group Publishing, 2005.
2. Klir and Yuan, “Fuzzy sets and Fuzzy logic – Theory and Applications”, Prentice Hall of India (2000).
3. Jacek M. Zurada , “Introduction to Artificial Neural System”, West Publishing Company.
4. S. Rajasekaran, G.A. VijayaLakshmi Pai, “Neural Network, Fuzzy Logic and Genetic Algorithm Synthesis and Applications”,PHI publication.

Syllabus for Semester II (Group Elective - I)
M. Tech. (Computer Science and Engineering)

Course Code : CST710-2 **Course : Social Network Analysis**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On successful completion of the course, students will be able to:

1. Understand the fundamental principles of social network analysis and applications.
2. Apply network-based reasoning to elicit social policy recommendations.
3. Understand the measures of network composition and structures in social phenomenon.
4. Understand the opportunities and challenges due to pervasive social network data on the internet

Syllabus

Social network data

Introduction & what's different about social network data? Nodes, boundaries, Modality Relations, Sampling ties, Multiple, Scales. Why formal methods? Using graphs to represent social relations. Using matrices to represent social relations. Connection and distance, Networks and actors, exchange, Connection ,demographics, Density, Reachability, Connectivity, Distance ,Walks etc., diameter, Flow.

Network centrality

Density, Reciprocity, Transitivity, Clustering, Krackhardt's Graph Theoretical Dimensions of Hierarchy. Ego networks, Centrality and power, Degree centrality Degree: Freeman's approach, Closeness, Between ness Centrality.

Cliques and Sub-groups

Groups and sub-structures, Bottom-up approaches ,Top-down approaches, Defining equivalence or similarity ,Structural equivalence, Automorphic, Regular equivalence, Measures of similarity and structural equivalence .

Measuring similarity/dissimilarity

Pearson correlations covariance's and cross-products, distances, Binary, Matches: Exact, Jaccard, Hamming, Visualizing similarity and distance, Describing structural equivalence sets :Clustering similarities or distances profiles, CONCOR 37

Automorphic Equivalence

Defining automorphic equivalence, Uses of the concept, Finding equivalence Sets, All permutations (i.e. brute force), Optimization by tabu search, Equivalence of distances: MaxsimSmall world network models, optimization, strategic network formation and search Concepts: Small worlds, geographic networks, decentralized search, Contagion, opinion formation, coordination and cooperation, SNA and online social networks

Reference Books

1. Hanneman, Robert A. and Mark Riddle. 2005. Introduction to social network methods. Riverside, CA: University of California
2. Stanley Wasserman and Katherine Faust; Social Network Analysis - Methods & Applications; Cambridge Univ. press; 1998.
3. John Scott: Social Network Analysis - A Handbook; Second Edition; SAGE Publication; 2000.
4. Charu Agrawal; Social Network Data Analytics; Springer; 2011.
5. Wouter Nooy, Andrei Movar and Vladimir Batagelj; Exploratory Social Network Analysis with Pajek; Cambridge Univ. press; 2005.

Syllabus for Semester II
M. Tech. (Computer Science and Engineering)

Course Code : CST711-1 **Course : Advanced Programming Techniques**

L : 3 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 03**

Course Outcomes

1. Use basic programming and object oriented concepts of Python programming.
2. Design advanced, multidisciplinary applications using built-in objects and standard libraries.
3. Understand basic concepts and programming of Java server pages.
4. Create JSP pages using the Expression Language, JSP Directives, Actions, Java Bean and Tags.

Syllabus

Python concepts : Expressions, values, types, variables, programs & algorithms, control flow I/O, the Python execution model.

Data structure : List, set, dictionary (mapping), tuple, graph (from a third-party library) List slicing (sub list), list comprehension (shorthand for a loop) Mutable and immutable data structures Distinction between identity and (abstract) value

Functions : Procedural abstraction, functions as values, recursion, function design methodology.

Introduction to Object Oriented concepts : Class, objects methods, inbuilt objects and library, programming example, etc.

Pattern matching : basics concept of Regular expressions and programming with inbuilt functions for pattern matching, searching and replacement.

Introduction to JSP : Introduction to Java Server Pages, Features of JSP, Access Models, Advantages of JSP over competing technologies.

Writing Java Server Pages : Developing a Simple Java server Pages, JSP Processing Model, Comments and Character Coding Conventions.

JSP Scripting Elements : Forms of Scripting Elements, Predefined Variables, Examples, using Elements.

JSP Directives, Actions, Java Bean and Tags : JSP Pages Directive, JSP Include Directive, jsp:include Action, jsp "forward Action, jsp : plugin Action, Java Beans, Custom tags, JSP Standard Tag Library.

Text and Reference Books

1. Martin C Brown., Python : The Complete Reference, Publisher McGraw Hill Education.
2. David Ascher and Mark Lutz, Learning Python, Publisher O'Reilly Media
3. Allen Downey, Jeffrey Elkner, Chris Meyers, Learning with Python, Dreamtech Press.
4. Jason Hunter and William Crawford, Java Servlet Programming, Publisher O'Reilly Media.
5. Jayson Falkner and Kevin Jones, Servlets and Java Server Pages: The J2EE Technology Web Tier, Publisher Addison-Wesley Professional

Syllabus for Semester II
M. Tech. (Computer Science and Engineering)

Course Code : CSP712 **Course : Advanced Programming Lab - II**

L : 0 Hrs, T : 0 Hrs, P: 2 Hrs, Per Week **Total Credits : 01**

Course Outcomes

On completion of the course the student will be able to

Course Outcomes

On successful completion of the course, students will be able to:

1. Implement supervised machine learning models using python.
2. Build artificial neural network models for classification and regression.
3. Apply various machine learning techniques to avoid overfitting in neural networks.
4. Design autoencoders for various applications.

Syllabus

Machine Learning using Python: Sci-kit Learn Library Implement Supervised Machine Learning models.

Implement Linear Regression Implement Perceptron Learning Algorithm. Implement Error Back Propogation learning algorithm. Implement various optimizers in neural network training.

Implementation of regularization and dropout in neural network training. Implement autoencoders for various applications.

Text Books

1. Introduction to Machine Learning with Python :A Guide for Data scientist, Sarah Guido, O'Reilly.
2. Advanced Deep Learning with Keras, Rowel Atienza ,Packt.com (E-Book)
3. Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

Reference Books

1. he Python 3 Standard Library by Example (Developer's Library) by Doug Hellmann, second edition.
2. Ian Good fellow and Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.

Syllabus for Semester II
M. Tech. (Computer Science and Engineering)

Course Code : CSP713 **Course : Software Lab - II**

L : 0 Hrs, T : 0 Hrs, P: 2 Hrs, Per Week **Total Credits : 01**

Course Outcomes

On successful completion of the course, students will be able to:

1. Design basic android applications using UI resources: Activity, Viewgroups and Intents and enhance user interactivity by using toast, notification, dialogs etc.
2. Effectively use Android's APIs for data storage, retrieval, preferences, files, databases, and content providers.
3. Understand and implement Android's communication APIs for SMS, utilize background services, location based services, broadcast receiver.

Syllabus

- UI Widgets and Layout Manager
- Activity, Intent & Fragment
- Android Menu
- Data Storage
- Android Service
- Android Notification, Dialog, SMS and Broadcast Receiver
- SQLite, Content Provider and Location Based Services

Text Books

1. Beginning Android Programming with Android Studio, 4Ed by J. F. DiMarzio, Wrox publication.
2. Professional Android 4 Application Programming by Reto Meier, Wiley Publication

Reference Books

1. Android Programming for Beginners - Second Edition by John Horton, Packt Publishing Pvt. Ltd.

Syllabus for Semester II
M. Tech. (Computer Science and Engineering)

Course Code : CSP714 **Course : Seminar**

L : 0 Hrs, T : 0 Hrs, P: 2 Hrs, Per Week **Total Credits : 01**

Course Syllabus

The students have to deliver the seminar on the recent happenings in the research domain and IT industry. They can formulate the project problem around the identified theme. Seminar presentation will be followed by the report submission.

Syllabus for Semester III
M. Tech. (Computer Science and Engineering)

Course Code : CST801-1 **Course : Advanced Natural Language Processing**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Objectives

1. To familiarize the concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
2. To relate mathematical foundations, Probability theory with Linguistic essentials such as syntactic and semantic analysis of text.
3. To apply the Statistical learning methods and cutting-edge research models to solve NLP problems.

Course Outcome

1. Apply the Principles and Process of Human Languages using computers.
2. Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural languages with respect to morphology.
3. Perform POS tagging for a given natural language and Select a suitable language modelling technique based on the structure of the language.
4. Create Linguistics CORPUS based on Text Corpus method.
5. Realize semantics and pragmatics of natural languages for text processing.
6. Develop Statistical Methods for Real World NLP Applications.

Unit - I : Introduction to NLP, Morphology

Introduction to NLP, Stages of NLP, Ambiguity, Information Theory Essentials , Linguistic Essentials : Parts of Speech and Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer.

Unit - II : Markov Model and POS Tagging

Markov Model: Hidden Markov model, Fundamentals, Probability of properties, Parameter estimation, Variants, Multiple input observation. The Information Sources in Tagging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging.

Unit - III : Syntax and Semantics

Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, WordNet, Thematic Roles, Semantic Role Labelling with CRFs.

Unit - IV : Language Modelling

Corpus based work, Statistical Inference: n -gram Models over Sparse Data, Methodological Preliminaries, Supervised Disambiguation: Bayesian classification, An information- theoretic approach, Dictionary-Based Disambiguation: Disambiguation based on sense, Thesaurus-based disambiguation, Disambiguation based on translations in a second-language corpus.

Unit - V : Probabilistic Parsing and Disambiguation

Probabilistic Context Free Grammars and Probabilistic parsing The Probability of a String, Problems with the Inside-Outside Algorithm, Parsing for disambiguation, Treebanks, Parsing models vs. language models, Phrase structure grammars and dependency, Lexicalized models using derivational histories, Dependency-based models.

Unit - VI : NLP Applications

Statistical Alignment and Machine Translation, Text alignment, Word alignment, Information extraction, Text mining, Information Retrieval, NL interfaces, Sentimental Analysis, Question Answering Systems, Social network analysis.

Text Books

1. Christopher D. Manning and Hinrich Schutze, "Foundations of Natural Language Processing" , 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003.
2. Daniel Jurafsky and James H. Martin "Speech and Language Processing", 3rd edition, Prentice Hall, 2009.

Reference Books

1. James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012.

Syllabus for Semester III
M. Tech. (Computer Science and Engineering)

Course Code : CST801-2 **Course : Advanced Digital Image Processing**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On successful completion of the course, students will be able to:

1. Learn and use different approaches to image enhancement and image analysis.
2. Apply various image segmentation methods with effective object recognition and classification techniques.
3. Understand the need for image transform and compression and able to apply different compression techniques.

Syllabus

Introduction

Intensity transformation function, Histogram processing, Spatial Filtering: Smoothing and sharpening, Frequency Domain Filtering: Smoothing and Sharpening.

Image Morphology

Dilation, Erosion, Opening, Closing, Boundary extraction, Region filling, Hit or Miss Transform, Thinning, Thickening, Skeletonization, Pruning.

Image Segmentation

Pixel-based method: thresholds level adjustment, continuity-based method:-multi- thresholding, detection of regions of interest thresholding and binarization, region growing, watershed algorithm, Edge Detection : Computing the gradient, Robert, Prewitt, Sobel operators, Second derivative-Laplacian, Canny edge detector, Edge linking-Local processing, Hough transform.

Image Transform

Discrete Sine Transforms, Discrete cosine transform, Discrete Fourier Transform, karhunen - Loeve transform, Slant transform, Walsh-Hadamard, Haar Transform.

Image Analysis and Image Registration

Representation of shapes and contours, shape factors, Fourier descriptors, statistical analysis of texture, Law's measures of texture energy, Fourier domain analysis of texture, structural analysis of texture, Image Registration: Feature Detection, Feature matching, Transform model estimation, image Re-sampling and Transformation.

Image Coding and Data Compression

Lossy versus lossless compression, distortion measures and fidelity criteria, fundamental concepts of coding (direct source coding, Huffman coding, run-lenght coding, arithmetic coding, Lempel-Ziv coding, Lempel-Ziv coding, contour coding.

Object Recognition and Classification

Pattern and pattern classes, Statistical Decision Making (Bayesian Classifiers), Non- Parametric Decision Making (Histogram based, k Nearest Neighbors), neural Networks (Single and Multi layer perceptron, Back propagation algorithem).

Textbooks and Reference Books

1. Gonzalez and Richard E Woods, Digital Image Processing, Addison-Wesley, 2000, 3rd Edition.
2. S Jayaraman, S Esakkirajan, Digital Image Processing, McGraw Hill Education.
3. Barbara Zitova, Jan Flusser Image registration methods: a survey image and Vision Computing 21 (2003) 977-1000 Elsevier journal.
4. Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing Analysis and Machine Vision, Brooks, 1999
5. Gonzalez, Steven Eddins and Richard E Woods Digital Image Processing using MATLAB, Prentice- Hall, 200 3 rd Edition.
6. Anil K Jain, Fundamentals of Digital Image Processing, Prentice-Hall India, 2001.

Syllabus for Semester III
M. Tech. (Computer Science and Engineering)

Course Code : CST801-3 **Course : Big Data Analytics**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On successful completion of the course, students will:

1. Understand issues related to real-world data mining.
2. Understand the analysis process.
3. Have hands-on experience with analyzing diverse data types, using modern statistical computer tools.

Syllabus

A New paradigm for Big Data

What is Big Data?; The evolution of Big Data; Scaling with traditional database; Desired properties of a Big Data system; Problems with fully incremental architectures; Lambda architecture; Recent trends in technology. Business problems suited to Big Data analytics.

Data Quality

Structured, unstructured and semi-structured data; the Black Swan and incomplete data; The issues in data representation/interpretation; Biases; Ishikawa diagram, Interrelationship digraph and Force field analysis. Data model for Big Data - The properties of data; Fact-based model; Graph schemas; Serialization framework.

Big Data Tools

Zoo Keeper, Hive, Pig, Mahout, R and RHipe. Hadoop - Power through distribution, cost-effectiveness. HBase and Other Big Data databases - Evolution from flat files to the three V's; Transition to Big Data databases; Graph databases; Document databases; Key-value databases and Column-oriented databases.

The Nuts and Bolts of Big Data

The Storage Dilemma; Building a Platform; Processing Power; Choosing the Best Approach. Data Storage - Using the Hadoop Distributed File System; the Hadoop ecosystem; Recomputation algorithms versus incremental algorithms; Map Reduce: a paradigm for Big Data computing; Low-level nature of Map Reduce and Pipe diagrams. Best practices for Big Data analytics.

Big Data solutions in the real world

The Importance of Big Data to business; Analyzing data in motion; Improving business processes with Big Data analytics. Big Data Do's and Don'ts.

Text Books and References

1. Pries, Kim H. and Dunnigan, Robert; Big Data Analytics - A Practical Guide for Managers; CRC Press; 2015.
2. Ohlhorst, Frank; Big Data Analytics - Turning Big Data into Big Money; John Wiley and Sons; 2013.
3. Loshin, David; Big Data Analytics - From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph; Morgan Kaufmann; 2013.
4. Marz, Nathan and Warren, James; Big Data - Principles and Best Practices of Scalable Real-Time Data Systems; Manning Publication; 2015.
5. Prajapati, Vignesh; Big Data Analytics with R and Hadoop; Packt Publishing; 2013.
6. Hurwitz, Judith et al.; Big Data for Dummies; John Wiley and Sons; 2013.
7. White, Tom; Hadoop - The Definitive Guide; O'Reilly Media; 2009.
8. Lublinsky. Boris et al.; Professional Hadoop Solutions; John Wiley and Sons (Wrox); 2013.

Syllabus for Semester III
M. Tech. (Computer Science and Engineering)

Course Code : CST802-1 **Course : Information Retrieval**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On successful completion of the course, students will be able to:

1. Understand issues in information retrieval.
2. Learn metadata organization for effective information access.
3. Understand, analyze and implement different language models.

Syllabus

Boolean retrieval, the term vocabulary and postings lists, Dictionaries and tolerant retrieval, Index construction, Index compression.

Scoring, Term weighting and the vector space model computing scores in a complete search system, Evaluation in information retrieval.

Relevance feedback and query expansion, XML retrieval, Probabilistic information retrieval.

Language models for information retrieval, Text classification and Naive Bayes, Vector space classification, Support vector machines and machine learning on documents.

Flat clustering, Hierarchical clustering, Matrix decompositions and latent semantic indexing, Web search basics, Web crawling and indexes, Link analysis

Text and Reference Books

1. An Introduction to Information Retrieval: Christopher D. Manning, Prabhakar Raghavan, HinrichSchütze, Cambridge University Press.
2. Speech and Language Processing: Jurafsky Dan and Martin James, Pearson Publication.
3. Natural Language Understanding: Allen James, Pearson Publication.

Syllabus for Semester III
M. Tech. (Computer Science and Engineering)

Course Code : CST802-2 **Course : Advanced Machine Learning**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Outcomes

On successful completion of the course, students will be able to:

1. Use probability concepts to build directed graphical models and Markov networks.
2. Solve problems using Restricted Boltzmann Machines and Markov chains.
3. Apply auto encoder model to find solution of a given problem.
4. Generate new data by using generative adversarial networks

Course Syllabus

Unit - I : Directed Graphical Models

Recap of Probability Theory, Joint Distributions, representations of joint distribution, graphical representation of joint distribution, reasoning in a Bayesian network, Causal Reasoning, Evidential Reasoning, Independencies encoded by a Bayesian network (Case 1: Node and its parents), Independencies encoded by a Bayesian network (Case 2: Node and its non-parents), Independencies encoded by a Bayesian network (Case 3: Node and its descendants)

Unit - II : Markov Networks

Markov Networks : Motivation, Factors in Markov Network, Local Independencies in a Markov Network, Using joint distributions for classification and sampling, concept of a latent variable.

Unit - III : Restricted Boltzmann Machines

Introduction to Restricted Boltzmann Machines, RBMs as Stochastic Neural Networks, Unsupervised Learning with RBMs, Computing the gradient of the log likelihood, Motivation for Sampling.

Unit - IV : Markov Chains

Introduction to Markov Chains, Need of Markov Chains, Setting up a Markov Chain for RBMs, Training RBMs using Gibbs Sampling, Training RBMs using Contrastive Divergence.

Unit - V : Variational Autoencoders

Revisiting Autoencoders, Variational Autoencoders: The Neural Network Perspective, Variational autoencoders: (The graphical model perspective), Neural Autoregressive Density Estimator, Masked Autoencoder Density Estimator.

Unit - VI : Generative Adversarial Networks

The purpose of GAN, An analogy from the real world, The building blocks of GAN, GAN Components, Introduction to GANs, Adversarial Relationship in a GAN,GAN Discriminator - Discriminative Models, GAN Generator - Generative Models, Applications of GAN.

Text Books

1. Ian Good fellow and Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.
2. Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2019.
3. Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

Reference Books

1. Deep Learning From Scratch: Building with Python from First Principles by Seth Weidman published by O` Reilley.
2. Grokking Deep Learning by Andrew W. Trask published by Manning Publications.

Syllabus for Semester III
M. Tech. (Computer Science and Engineering)

Course Code : CST802-3 **Course : Data Visualization Techniques**

L : 4 Hrs, T : 0 Hrs, P: 0 Hrs, Per Week **Total Credits : 04**

Course Objectives

To expose you to visual representation methods and techniques that increases the understanding of complex data

Syllabus

Unit - I : Introduction to Data Visualization

Acquiring and Visualizing Data, Simultaneous acquisition and visualization, Applications of Data Visualization, Keys factors of Data Visualization (Control of Presentation, Faster and Better JavaScript processing, Rise of HTML5, Lowering the implementation Bar) Exploring the Visual Data Spectrum: charting Primitives (Data Points, Line Charts, Bar Charts, Pie Charts, Area Charts), Exploring advanced Visualizations (Candlestick Charts, Bubble Charts, Surface Charts, Map Charts, Infographics). Making use of HTML5 CANVAS, Integrating SVG

Unit - II : Basics of Data Visualization - Tables

Reading Data from Standard text files (.txt, .csv, XML), Displaying JSON content Outputting Basic Table Data (Building a table, Using Semantic Table, Configuring the columns), Assuring Maximum readability (Styling your table, Increasing readability, Adding dynamic Highlighting), Including computations, Using data tables library, relating data table to a chart

Unit - III : Visualizing data Programmatically

Creating HTML5 CANVAS Charts (HTML5 Canvas basics, Linear interpolations, A Simple Column Chart, Animations), Starting with Google charts (Google Charts API Basics, A Basic bar chart, A basic Pie chart, Working with Chart Animations).

Unit - IV : Introduction to D3.js

Getting setup with D3, Making selections, changing selection's attribute, Loading and filtering External data : Building a graphic that uses all of the population distribution data, Data formats you can use with D3, Creating a server to upload your data, D3's function for loading data, Dealing with Asynchronous requests, Loading and formatting Large Data Sets

Unit - V : Advanced Data Visualization

Making charts interactive and Animated: Data joins, updates and exits, interactive buttons, Updating charts, Adding transactions, using keys Adding a Play Button: wrapping the update phase in a function, Adding a Play button to the page, Making the Play button go, Allow the user to interrupt the play, sequence.

Unit - VI : Information Dashboard Design

Introduction, Dashboard design issues and assessment of needs, Considerations for designing dashboard-visual perception, Achieving eloquence, Advantages of Graphics _Library of Graphs, Designing Bullet Graphs, Designing Sparklines, Dashboard Display Media, Critical Design Practices, Putting it all together - Unveiling the dashboard.

Course Outcomes:

On completion of the course the student will be able to

1. Apply the fundamental concepts of data visualization.
2. Apply core skills for visual analysis.
3. Apply visualization techniques for various data analysis tasks.
4. Design information dashboard.

Reference Books

1. Jon Raasch, Graham Murray, Vadim Ogievetsky, Joseph Lowery, "JavaScript and jQuery for Data Analysis and Visualization", WROX.
2. Ritchie S. King, Visual story telling with D3" Pearson.
3. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
4. A Julie Steele and Noah Iliinsky, Designing Data Visualizations: Representing Informational Relationships, O'Relly.
5. Andy Kirk, Data Visualization: A Successful Design Process, PAKT.
6. Scott Murray, Interactive Data Visualization for Web, O'Relly.
7. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
8. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014.