ACADEMIC REGULATIONS, COURSE STRUCTURE AND DETAILED SYLLABUS

Effective from the Academic Year 2022-23 onwards

M. Tech. Two Year Degree Course

(MR22 Regulations)

in

Computer Science and Engineering **(CSE)**

Department of

Computer Science and Engineering

MALLA REDDY ENGINEERING COLLEGE (Autonomous)

(An UGC Autonomous Institution, Approved by AICTE and Affiliated to JNTUH, Hyderabad)
Recognized under section 2(f) &12 (B) of UGC Act 1956, Accredited 3rd time by NAAC with 'A++' Grade, NIRF Rank Band 201-250, ARIIA Band Performer, NBA Tier-I Accredited (B.Tech.- CE, EEE, ME, ECE &CSE, M.Tech. - SE, EPS, TE)
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MALLA REDDY ENGINEERING COLLEGE (Autonomous)
COMPUTER SCIENCE AND ENGINEERING (CSE)

Proposed Course Structure for PG - M.Tech. (Computer Science and Engineering) Programme (MR-22 Regulations)

I YEAR - I SEMESTER							
S. No	**Category**	**Course Code**	**Name of the course**	**Contact hours/week**			**Credits**
				L	**T**	**P**	
1	PCC	C5101	Advanced Data Structures	3	0	0	3
2	PCC	C5102	Ethical Hacking and Computer Forensic	3	0	0	3
3	PEC - I	C5103 C5104 C5105	1. Big Data Analytics 2. Data Science 3. Machine Learning	3	0	0	3
4	PEC - II	C5106 C5107 C5108	1. Cloud & Mobile Application and Development 2. Introduction to Intelligent Systems 3. Software Architecture and Design Patterns	3	0	0	3
5	PCC	C5109	Advanced Data Structures Lab	0	0	4	2
6	PCC	C5110 C5111 C5112	1. Big Data Analytics Lab 2. Data Science Lab 3. Machine Learning Lab — PEC-1 Lab	0	0	4	2
7	HSMC	C0H08	Research Methodology and IPR	2	0	0	2
8	AC	C00A4	English for Research Paper Writing	2	0	0	0
			Total	**16**	**0**	**8**	**18**
	Total Contact Hours			**24**			

Professional Elective- I and Professional Elective- I Lab must be of same course.

I YEAR - II SEMESTER							
S. No	**Category**	**Course Code**	**Name of the course**	**Contact hours/week**			**Credits**
				L	**T**	**P**	
1	PCC	C5113	Advanced Algorithms	3	0	0	3
2	PCC	C5114	Advanced Computer Architecture	3	0	0	3
3	PCC	C5115	Database Programming with PL/SQL	2	0	0	2
4	PEC-III	C5116 C5117 C5118	1. Deep Learning 2. Advanced Computer Networks 3. Natural Language Processing	3	0	0	3
5	PEC-IV	C5119 C5120 C5121	1. Bioinformatics 2. Nature Inspired Computing 3. Robotic Process Automation	3	0	0	3
6	PCC	C5122	Advanced Algorithms Lab	0	0	4	2
7	PEC	C5123 C5124 C5125	1. Deep Learning 2. Advanced Computer Networks 3. Natural Language Processing — PEC-III Lab	0	0	4	2
8	AC	C00A5	Audit Course- II	2	0	0	0
			Total	**14**	**0**	**12**	**18**
	Total Contact Hours			**26**			

Professional Elective- III and Professional Elective- III Lab must be of same course.

II YEAR I - I SEMESTER							
S. No	Category	Course Code	Name of the course	Contact hours/week			Credits
				L	T	P	
1	PEC-V	C5126 C5127 C5128	1. Digital Forensics 2. High Performance Computing 3. Quantum Computing	3	0	0	3
2	OEC	C00A	Open Elective	3	0	0	3
3	PROJ	C51P1	Technical Seminar	0	0	4	2
4	PROJ	C51P2	Project /Dissertation Phase - I	0	0	16	8
			Total	**6**	**0**	**20**	**16**
	Total Contact Hours			**26**			

	II YEAR I - II SEMESTER						
S. No	Category	Course Code	Name of the course	Contact hours/week			Credits
				L	T	P	
1	PROJ	C51P3	Project /Dissertation Phase - II	0	0	32	16
			Total	**0**	**0**	**32**	**16**
		Total Contact Hours		**32**			

Audit Course I&II:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by yoga
8. Personality Development Through Life Enlightenment Skills

Open Electives for other Departments:

1. IPR
2. Fault Tolerance Systems
3. Intrusion Detection Systems
4. Digital Forensics
5. Optimization Techniques
6. Cyber Physical Systems
7. Graph Analytics

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: C5101	ADVANCED DATA STRUCTURES	L	T	P
Credits: 3		3	-	-

Prerequisites: Data structures and Object Oriented Programming

Course Objectives:
This course provides the students to learn and understand the theoretical and practical solutions for the fundamental design, analysis, and implementation of basic data structures like Stacks, Queues, Heaps, Searching, Sorting, Trees and Graphs, Significance of algorithms in the computer field, various aspects of algorithm development.

Module I: Introduction to Algorithms and Representations [10 Periods]
Algorithms Notations: Algorithms, Performance analysis- time complexity and space complexity, Asymptotic Notation, Big Oh, Omega and Theta notations, Complexity Analysis Examples.

Data structures and Representations: Linear List ADT, Array representation, Linked representation, Vector representation, Singly Linked Lists: Insertion-Deletion-Search operations, Doubly Linked Lists: Insertion-Deletion operations, Circular lists, Representation of 1D and 2D arrays, sparse matrices and their representation.

Module II: Linear Data Structures [9 Periods]
Stack and Queue: Stack and Queue ADTs, array and linked list representations, infix to Postfix Conversion using Stack, Implementation of recursion, Circular Queue: Insertion-Deletion, Dequeue ADT, Array and Linked List Representations, Priority Queue ADT.

Heap: Implementation using Heaps, Insertion into Max Heap, Deletion from Max Heap, java.util package: Array List, Linked List, Vector classes, Stacks and Queues, Iterator.

Module III: Searching and Sorting [9 Periods]
A: Searching
Linear and binary search methods, Hashing-Hash functions, Collision Resolution methods-Open Addressing, Chaining, Hashing in java.util- HashMap, HashSet, Hash table.

B: Sorting
Bubble, Insertion, Quick, Merge, Heap, Radix, Comparison of sorting methods.

Module IV: Non-Linear Data Structures-I [10 Periods]
Trees: Ordinary and Binary trees terminology, Properties of Binary trees, Binary tree ADT, representations, recursive and non-recursive traversals, Threaded binary trees.

Graphs: Graphs terminology, Graph ADT, Representations, Graph Traversals/Search Methods-DFS and BFS, Java code for Graph Traversals, Applications of Graphs-Minimum Cost Spanning Tree using Kruskal's algorithm, Dijkstra's algorithm for Single Source Shortest Path Problem.

Module V: Non-Linear Data Structures-II **[10 Periods]**

Search Trees: Binary search tree, Binary search tree ADT, insertion, deletion and searching operations, Balanced search trees, AVL trees-Definition and examples only, Red Black trees, Definition and examples.

B-Trees: Definition, insertion and searching operations, Trees in java.util- Tree Set, Tree Map Classes, Tries (examples only), Comparison of Search trees. Text compression, Huffman coding and decoding, Pattern matching-KMP algorithm.

TEXT BOOKS

1. S. Sahni, "**Data structures Algorithms and Applications in Java"**, Universities Press.
2. Clifford A. Shaffer, "**Data structures and Algorithm analysis in Java"**, 3rd Edition, Courier Corporation.

REFERENCE BOOKS

1. Deitel and Deitel, "**Java for Programmers**", Pearson Education.
2. R. Lafore, "**Data structures and Algorithms in Java**", Pearson Education.

E-RESOURCES

1. https://www.cise.ufl.edu/~sahni/cop3530/presentations.htm
2. https://books.google.co.in/books?id=KK3DAgAAQBAJ&printsec=frontcover&dq=data+structures+and+algorithm+analysis+in+java
3. https://www.cse.msu.edu/~cse802/Papers/sammon.pdf
4. http://nptel.ac.in/courses/106102064/1/

Course Outcomes:

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

1. **Understand** the fundamental concepts related to basic data structures.
2. **Design** and Analyze the implementation of linear data structures.
3. **Apply** the concept related to different searching and sorting techniques.
4. **Learn** and implement the concept of nonlinear data structures.
5. **Acquire** knowledge regarding search trees and applications.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3		2			
CO2			3	2		
CO3					3	1
CO4	3	2				
CO5			3			2

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: C5102	ETHICAL HACKING AND COMPUTER FORENSIC	L	T	P
Credits: 3		3	-	-

Prerequisites: Cryptography and Network Security

Course Objectives:
The objective of this course is to make the students to study about fundamental in ethical hacking and learn computer forensics, be familiar with forensics tools and to acquire knowledge in analyzing and validating forensics data.

UNIT – I: Introduction: [9 Periods]

Hacking Impacts, The Hacker Framework: Planning the test, Sound Operations, Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Final Analysis, Deliverable, Integration Information Security Models: Computer Security, Network Security, Service Security, Application Security, Security Architecture Information Security Program: The Process of Information Security, Component Parts of Information Security Program, Risk Analysis and Ethical Hacking

UNIT – II: The Business Perspective: [9 Periods]

Business Objectives, Security Policy, Previous Test Results, Business Challenges Planning for a Controlled Attack: Inherent Limitations, Imposed Limitations, Timing is Everything, Attack Type, Source Point, Required Knowledge, Multi-Phased Attacks, Teaming and Attack Structure, Engagement Planner, The Right Security Consultant, The Tester, Logistics, Intermediates, Law Enforcement. Preparing for a Hacking case study example Technical Preparation, Social Engineering,

Module III: Introduction To Computer Forensics [11periods]
A: Computer Forensics
Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation.

B: Incident Response
Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

Module IV: Evidence Collection And Forensics Tools [10 periods]
Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

Module V: Analysis And Validation [9 periods]
Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics

TEXT BOOKS:

1. EC-Council, "Ethical Hacking and Countermeasures Attack Phases", Cengage Learning
2. Michael Simpson, Kent Backman, James Corley, "Hands-On Ethical Hacking and Network Defense", Cengage Learning
3. Nelson, Phillips, Enfinger, Steuart, "**Computer Forensics and Investigations**", Cengage Learning, India Edition, 2008.

REFERENCE BOOKS

1. John R.Vacca, "Computer Forensics", Cengage Learning, 2005.
2. Richard E.Smith, "Internet Cryptography", 3 rd Edition Pearson Education, 2008.
3. MarjieT.Britz, "Computer Forensics and Cyber Crime": An Introduction", 3rdEdition, Prentice Hall, 2013.
4. James S. Tiller, "The Ethical Hack: A Framework for Business Value Penetration Testing", Auerbach Publications, CRC Press

E-RESOURCES

1. https://repo.zenk-security.com/Magazine%20E-book/EN-Ethical%20Hacking.pdf
2. http://ebook.eqbal.ac.ir/Security/Forensics/Guide%20to%20Computer%20Forensics%20and%20Investigations.pdf.
3. http://cybersd.com/sec2/lect/Chapter%207.pdf
4. http://nptel.ac.in/courses/106105031/
5. https://nptel.ac.in/courses/106/105/106105217/

Course Outcomes

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

1. **Discuss** the hacking framework, computer security and ethical hacking.
2. **Apply** security in view business perspective.
3. **Explain** computer forensics.
4. **Use** forensics tools
5. **Analyze** and validate forensics data

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2		1		1	2
CO2	2					3
CO3		1		3	2	2
CO4	3		2	2		
CO5	3		2	3		3

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: C5103	BIG DATA ANALYTICS (Professional Elective – I)	L	T	P
Credits: 3		3	-	-

Pre-Requisites: Data Mining

Course Objectives:

This course provides the students to understand big data for business intelligence, learn business case studies for big data analytics, understand noSQL big data management and to perform map-reduce analytics using Hadoop and related Tools.

Module I: Introduction to Big data **[10 Periods]**

What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

Module II: NoSQL **[10 Periods]**

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer replication, sharding and replication, consistency, relaxing consistency,

version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.

Module III: HDFS **[10 Periods]**

A: Hadoop

Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts,

B: I/O

Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures.

Module IV: Mapreduce **[10 Periods]**

MapReduce workflows, Module tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats

Module V: Data Models **[8 Periods]**

Hbase, data model and implementations, Hbase clients, Hbase examples, praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration. Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.HiveQL queries. Hive database tables, views, functions and Indexes

TEXT BOOKS

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "**Big Data, Big Analytics: Emerging"**
2. Tom White, "**Hadoop: The Definitive Guide**" 3rd Edition, O'reilly.

REFERENCE BOOKS

1. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
4. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
5. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
6. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
7. Alan Gates, "Programming Pig", O'Reilley, 2011.
8. DT Editorial Services by BIG DATA Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization

E-RESOURCES

1. http://newton.uam.mx/xgeorge/uea/Lab_Prog_O_O/materiales_auxiliares/Big_Java_4th_Ed.pdf
2. http://www.isical.ac.in/~acmsc/WBDA2015/slides/hg/Oreilly.Hadoop.The.Definitive.Guide.3rd.Edition.Jan.2012.pdf
3. https://static.googleusercontent.com/media/research.google.com/en//archive/mapreduce-osdi04.pdf
4. http://www.comp.nus.edu.sg/~ooibc/mapreduce-survey.pdf
5. http://freevideolectures.com/Course/3613/Big-Data-and-Hadoop/18

Course Outcomes:

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

1. **Develop** simple applications using concepts like stack, queues and classes.
2. **Analyze** file systems such as GFS and HDFS.
3. **Design** applications by applying Map reduce concepts.
4. **Build** up programs by making use of I/O.
5. **Explore** and inspect the big data using programming tools like Pig and Hive.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	2	3	3
CO2	3	3	2	3	3	2
CO3	1	3	3	2	3	3
CO4	3	3	3	3	2	3
CO5	3	2	3	1	3	3

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: C5104	DATA SCIENCE (Professional Elective – I)	L	T	P
Credits: 3		3	-	-

Prerequisites: Probability and Statistics

Course Objectives:

This course will make the students to provide with the knowledge and expertise to become a proficient data scientist, demonstrate an understanding of statistics and machine learning concepts that are vital for data science, understanding R and produce Program code to statistically analyze a dataset and critically evaluate data visualizations based on their design and use for communicating stories from data.

Module I: Fundamentals of Data science and R programming [9 Periods]

A: Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

B:R Programming, R data types and objects, reading and writing data, sub setting, R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

Module II: Maintenance of Data and R Fundamental Concepts [10 Periods]

A: Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

B: R Fundamental Concepts: control structures, vectors, arrays, Lists, components, functions, data frames, factors tables, Classes, Statistical Analysis with R

Module III: Data analysis [9 Periods]

A: Basics of Data Analysis

Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT.

B: Algorithms

Basic machine learning algorithms, Linear regression, SVM, Naive Bayes**.**

Module IV: Data visualization [10 Periods]

Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

Module V:**Data Science-Applications [10 Periods]**

Applications of Data Science, Technologies for visualization, Bokeh (Python), Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

TEXT BOOKS

1. Alberto Boschetti, Luca Massaron, "**Python Data Science Essentials**", Packt Publications, 2nd Edition,2016.
2. Davy Cielen, Arno Meysman, Mohamed Ali, "**Introducing Data Science: Big Data,**

Machine Learning, and more, using Python tools", Manning Publications; First Edition, 2016.
3. R Programming for Data Science by Roger D. Peng
4. The Art of R Programming by Prashanth singh, Vivek Mourya, Cengage Learning
5. India

REFERENCE BOOKS

1. Cathy O'Neil and Rachel Schutt. "**Doing Data Science, Straight Talk From The Frontline**". O'Reilly.
2. Jure Leskovek, AnandRajaraman and Jeffrey Ullman." **Mining of Massive Datasets**". v2.1,Cambridge University Press.

E-RESOURCES

1. https://www.analyticsvidhya.com/blog/2016/02/complete-tutorial-learn-data-science-scratch/
2. https://www.edureka.co/blog/learn-python-for-data-science/
3. https://www.cs.upc.edu/~robert/teaching/estadistica/rprogramming.pdf

Course Outcomes:

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

1. **Understand** the fundamentals of data science and R programming
2. **Explain** how data is collected, managed and stored for data science and R Programming fundamental concepts.
3. **Analyze** the data by applying various techniques.
4. **Explore** data visualization techniques.
5. **Investigate** several applications in data science.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3					
CO2		3	2			
CO3					3	
CO4				2	3	
CO5	3		2			1

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: C5105	MACHINE LEARNING (Professional Elective – I)	L	T	P
Credits: 3		3	-	-

Prerequisites: Artificial Intelligence

Course Objectives:
This course provides the students tolearn the concept of how to learn patterns ,fundamentals in python and concepts from data without being explicitly programmed in various IOT nodes, design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances, explore supervised and unsupervised learning paradigms of machine learning and to investigate Deep learning technique and various feature extraction strategies.

Module I:Supervised Learning and Introduction to Python [10 Periods]
A: Introduction to Python - Python Basics, Objects- Python Objects, Standard Types, Other Built-in Types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib

B:Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive BayesLinear models: Linear Regression, Logistic Regression, Generalized Linear ModelsSupport Vector Machines, Nonlinearity and Kernel Methods. Beyond Binary Classification: Multi-class/Structured Outputs, Ranking.

Module II: Unsupervised Learning [9 Periods]
Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)

Module III: Machine Learning algorithms [9 Periods]
A: Machine Learning Algorithms
Evaluating Machine Learning algorithms and Model Selection.
B: Ensemble Methods.
Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random forests)

Module IV: Sparse Models [9 Periods]
Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning.

Module V: Learning techniques [11 Periods]
Scalable Machine Learning (Online and Distributed Learning), A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference - Recent trends in various learning techniques of machine learning and classification methods for IOT applications, various models for IOT applications.

TEXT BOOKS

1. Tom M. Mitchell, "**Machine Learning**", MGH, 1st Edition, 2013.
2. Stephen Marsland, "**Machine Learning: An Algorithmic Perspective**", Chapman and Hall / CRC, 2nd Edition, 2014.
3. Core Python Programming, Wesley J. Chun, Second Edition, Pearson., 2nd Edition, 2006

REFERENCE BOOKS

1. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman," The Elements of Statistical Learning", Springer 2009 (freely available online)
3. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
4. Core Python Programming, Wesley J. Chun, Second Edition, Pearson., 3nd Edition, 2012

E-RESOURCES

1. http://www.zuj.edu.jo/download/machine-learning-tom-mitchell-pdf/
2. https://www.learnpython.org/
3. http://index-of.es/Python/Core.Python.Programming.2nd.Edition.Wesley.Chun.2006.pdf
4. http://index-of.es/Python/Core.Python.Applications.Programming.3rd.Edition.pdf
5. https://www.davekuhlman.org/python_book_01.pdf
6. http://www.ntu.edu.sg/home/egbhuang/pdf/ieee-is-elm.pdf
7. www.fxpal.com/publications/a-genetic-algorithm-for-video-segmentation-and-summarization.pdf
8. http://nptel.ac.in/courses/106106139/
9. http://nptel.ac.in/courses/106105152/

Course Outcomes:

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

1. **Identify** the way of extracting features that can be used for a particular machine learning approach in various IOT and Fundamentals in python
2. **Explore** unsupervised learning techniques
3. **Compare** and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
4. **Analyze** various machine learning approaches and paradigm mathematically.
5. **Investigate** various learning approaches.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	3	3	2
CO2	3	3	2	2	2	2
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	3

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: C5106	CLOUD & MOBILE APPLICATION AND DEVELOPMENT (Professional Elective-II)	L	T	P
Credits: 3		3	-	-

Prerequisites: Cloud Computing

Course Objectives:
This course enables the students to learn the basic fundamentals in mobile cloud, architecture, classification and associated cooperation approaches, study the utilization of resources in mobile clouds, study about the maintenance, simulate and develop mobile cloud applications.

Module I: Fundamentals of Mobile cloud **[10 Periods]**
Mobile Connectivity Evolution: From Single to Multiple Air Interface Devices, Network Evolution: The Need for Advanced Architectures.

Module II: Approaches **[9 Periods]**
Mobile Clouds: An Introduction, Cooperation and Cognition in Mobile Clouds, Mobile Cloud Classification and Associated Cooperation Approaches.

Module III: Utilization of resources **[9 Periods]**
A: Resource sharing
Sharing Device Resources in Mobile Clouds.
B: Enabling technologies
Wireless Communication Technologies, Building Mobile Clouds.

Module IV: Maintenance of Mobile Cloud **[10 Periods]**
Mobile Cloud Formation and Maintenance, Cooperative Principles by Nature, Social Mobile Clouds, Green Mobile Clouds: Making Mobile Devices More Energy Efficient.

Module V: Mobile apps **[10 Periods]**
Mobile Clouds Applications, Future Developments of Mobile Clouds.
Android OS design and Features – Android development framework, Android Application Lifecycle – Activities, Activity lifecycle, activity states, monitoring state changes

TEXT BOOKS

1. Frank H. P. Fitzek, Marcos D. Katz, "**Mobile Clouds: Exploiting Distributed Resources in Wireless, Mobile and Social Networks**", Wiley Publications, ISBN: 978-0-470- 97389-9, Jan 2014.
2. Dijiang Huang Huijun Wu, "**Mobile Cloud Computing: Foundations and Service Models**", Morgan Kaufmann, First Edition, 2018.
3. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox) , 2012
4. Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013

REFERENCE BOOKS

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, and Michael Morgano, **Android for Programmers: An App-Driven Approach**, Prentice Hall, November 3, 2011.
2. Richard Rodger, "**Beginning Mobile Application Development in the Cloud**", Wiley, 2011.

E-RESOURCES

1. https://leseprobe.buch.de/images-adb/8d/01/8d01a05a-1854-4e56-ae54-ce8fcd5c6237.pdf
2. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118801338
3. http://nptel.ac.in/courses/106105167/31

Course Outcomes:

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

1. **Understand** the fundamentals of Mobile cloud.
2. **Analyze** classification and associated cooperation approaches.
3. **Investigate** several technologies and implement the way of sharing resources.
4. **Explore** the formation of mobile cloud and know about its maintenance.
5. **Develop** Mobile applications.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2			1		3
CO2	2	1			1	2
CO3			3	2		
CO4		1		2	2	1
CO5	2		1		2	3

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: A5107	INTRODUCTION TO INTELLIGENT SYSTEMS	L	T	P
Credits: 3	(Professional Elective - II)	3	-	-

Prerequisites: Artificial Intelligence, Data Structures

Course Objectives:

The aim of the course is to introduce to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach. It explores the essential theory behind methodologies for developing systems that demonstrate intelligent behaviour including dealing with uncertainty, learning from experience and following problem solving strategies found in nature.

Module I: Fundamentals of Intelligent systems-I [9 Periods]

Biological foundations to intelligent systems I: Artificial neural networks, Back propagation networks, Radial basis function networks, and recurrent networks.

Module II: Foundations to Intelligent systems-II [10 Periods]

Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Module III: Search Techniques [9 Periods]

A: Search Techniques-I

Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search.

B: Search Techniques-II

Heuristic search methods: best-first search, admissible evaluation functions, hill climbing search, Optimization and search such as stochastic annealing and genetic algorithm.

Module IV: Knowledge Representation [10 Periods]

Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures.

Module V: Learning and evolutionary algorithms [10 Periods]

Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning. Recent trends in Fuzzy logic, Knowledge Representation.

TEXT BOOKS

1. James M. Keller, Derong Liu, David B. Fogel, "**Fundamentals of Computational Intelligence: Neural Networks, Fuzzy Systems, and Evolutionary Computation**", John Wiley & Sons, 13-Jul-2016.
2. Elaine Rich, "**Artificial Intelligence**", Tata McGraw-Hill Education, 2004.

REFERENCE BOOKS

1. Luger G.F. and Stubblefield W.A. (2008)," **Artificial Intelligence: Structures and strategies for Complex Problem Solving**". Addison Wesley, 6th edition.
2. Russell S. and Norvig P. (2009). "**Artificial Intelligence: A Modern Approach**". Prentice-Hall, 3rd edition.

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1. https://books.google.co.in/books?id=c1fzgQj5lhkC&printsec=frontcover&dq=intelligent+systems&hl=en&sa=X&ved=0ahUKEwilrbLv0LncAhUKaI8KHVO2Cd8Q6AEIKDAA#v=onepage&q=intelligent%20systems&f=false
2. http://www.nptelvideos.in/2012/11/intelligent-systems-and-control.html
3. https://freevideolectures.com/course/2348/intelligent-systems-and-control

Course Outcomes:

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

1. **Demonstrate** knowledge of the fundamental principles of intelligent systems.
2. **Understand** the algorithms and its applications
3. **Analyze** and compare the relative merits of a variety of AI problem solving techniques. and indexes.
4. **Explore** various knowledge representation techniques**.**
5. **Learn and apply** the evolutionary and learning algorithms**.**

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**		3		1	2
CO2		2				
CO3	2		2	2	2	1
CO4	3	1	2			
CO5	2		2	1		2

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: C5108	SOFTWARE ARCHITECTURE AND DESIGN PATTERNS (Professional Elective-II)	L	T	P
Credits: 3		3	-	-

Prerequisites: Software Engineering

Course Objectives:
This course makes the students to learn the different types of Software Architectures and analyze various architectures such as Comprehensive and Quantitative approaches to implement the different types of Design patterns such as Creational, Structural and Behavioral patterns.

Module I: Introduction to Software Architecture [10 Periods]
Envisioning Architecture: Architecture Business Cycle, Software Architecture, Architectural patterns, reference models, reference architectures, architectural structures and views.
Creating Architecture: Quality Attributes, Achieving qualities, Architectural styles and patterns, Designing Architecture, Documenting Software Architectures, Reconstructing Software Architecture.

Module II: Analyzing Architectures [9 Periods]
Comprehensive Approach: Architecture Evaluation, Architecture design decision making ATAM.
Quantitative Approach: Decision Making Context, Basics of CBAM, Implementing CBAM, Case Study.

Module III: Moving from one to many system [9 Periods]
A: Software Product Lines
Overview, Software Product Lines, Scoping, Building Systems from Off-the-Shelf Components.
B: Architecture
What Makes Software Product Lines Difficult? Software Architecture in Future.

Module IV: Design Pattern Catalog-1 [10 Periods]
Patterns: Pattern Description, Organizing catalogs, role in solving design problems, selection and usage.
Creational and Structural Patterns: Abstract factory builder, factory method, prototype, singleton, adapter, bridge, composite, façade, flyweight, Proxy.

Module V: Design Pattern Catalog-2 [10 Periods]
Behavioral Patterns: Chain of responsibility, command, Interpreter, iterator, mediator, memento, observer, state, strategy, template method, visitor. Case Studies: A-7E–A case study in utilizing architectural structures.

World Wide Web: A Case study in interoperability, Air Traffic Control-Case Study in designing for high availability,Celsius Tech – Case Study in product line development.

TEXT BOOKS

1. Len Bass, Paul Clements & Rick Kazman, "**Software Architecture in Practice**", Third Edition, Pearson Education, 2013.
2. Erich Gamma, "**Design Patterns**", Pearson Education, 1995.

REFERENCE BOOKS

1. Luke Hohmann, "**Beyond Software Architecture**", Addison Wesley, 2003.
2. ParthaKuchana, "**Software Architecture Design Patterns in Java**", Auerbach Publications; 1st Edition, 2004.

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1. http://disi.unal.edu.co/dacursci/sistemasycomputacion/docs/SWEBOK/Addison%20Wesley%20-%20Software%20Architecture%20In%20Practice%202nd%20Edition.pdf
2. https://goo.gl/XHf4Skr
3. http://handbookofsoftwarearchitecture.com
4. http://technav.ieee.org/tag/1570/software-architecture
5. http://www.springer.com/in/book/9783319658308#otherversion=9783319658315
6. http://ndl.iitkgp.ac.in/document/xttk-4kfhvUwVlXBW-YWRHK2WM4hGzyP-7P1EGjmLQteaTTfT9e5x3lNfo1dkNFKA2TH8BFRA34WT93f7vOClg
7. http://ndl.iitkgp.ac.in/document/xttk-4kfhvUwVlXBW-YWRHHjhOkwn-Nw1F1n-B5L9QQwwLxs5C_RQWWA-I82gWvUowtpyPjqm26fq2PVA1VaOg

Course Outcomes:

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

1. **Analyze** the Computer architecture and different processor architectures
2. **Explore** and analyze the architectures
3. **Illustrate** organization and operation of current generation parallel computer systems, including multiprocessor and multi-core systems
4. **Understand** patterns descriptions and solving problems and use of creational and structural patterns.
5. **Apply** design patterns, behavioral patterns and World Wide Web to case studies.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3		2	3	2	2
CO2	2		2	3	2	2
CO3	3		2	3	2	2
CO4	3	1	3	3	3	2
CO5	3	1	3	3	2	3

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. I Semester		
Code: C0H08	RESEARCH METHODOLOGY AND IPR	L	T	P
Credits: 2		2	-	-

PREREQUISITES: Nil

Course Objectives: The objective of the course is to make students familiar with the basics of research methodology and various types of Intellectual Properties, IPR legislations and policies.

Module I: Research Problem [6 Periods]
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Module II: Technical Writing and Research Proposal [7 Periods]
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Module III: Intellectual Property Rights [6 Periods]
A: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.
B: International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Module IV: Patent Rights [6 Periods]
Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Module V: Case Studies [7 Periods]
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCE BOOKS

1. Prabhuddha Ganguli: 'Intellectual Property Rights" Tata Mc-Graw –Hill, New Delhi
2. M.Ashok Kumar and Mohd.Iqbal Ali: "Intellectual Property Right" Serials Pub.
3. Carlos M.Correa- ''Intellectual property rights , The WTO and Developing countries"-Zed books
4. Law relating to patents, trademarks, copyright designs, Wadehra, B.L. & 2 ed. Universal Law Publishing 2000.
5. C.R.Kothari, "Research Methodology" New Age International Publishers, Fourth edition, 2018.
6. Donald Cooper & Pamela Schindler, "Business Research Methods", TMGH, 9th edition.

7. Alan Bryman & Emma Bell, “Business Research Methods”, Oxford University Press.

E-RESOURCES:

1. https://www.wto.org/english/tratop_e/trips_e/trips_e.htm
2. https://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm7_e.htm
3. http://nptel.ac.in/courses/110999906/
4. http://nptel.ac.in/courses/109105112/

Course Outcomes:

After completion of the course, students will be able to:

1. Comprehend the concepts of research methodology and its concepts.
2. Realize the concepts of literature review and developing a research proposal.
3. Understand the basic concepts of Intellectual property rights.
4. Understand the types of patents and their procedures.
5. Recognize the recent developments in IPR administration.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2	3	3	3	2	3	3
CO3	3	3	2		2	
CO4	3	2	3		2	
CO5	3		1		2	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: C5109	ADVANCED DATA STRUCTURES LAB	L	T	P
Credits: 2		-	-	4

Prerequisites: Computer Programming
Software Requirement: JDK

Course Objectives:
This objective of the course is to provide the students to implement the applications using Linear Data Structures, Non-linear Data Structures, Searching and Sorting techniques, and deploy the shortest path algorithms.

List of experiments:

1. Write Java programs to implement the following (using arrays and linked lists):
   a) List ADT, b) Stack ADT, c) Queue ADT
2. Write a Java program to read an infix expression and convert into postfix using stacks ADT.
3. Write a Java program to implement circular queue ADT using an array
4. Write a Java program using stack and queue to test the given string is a palindrome or not.
5. Write Java programs to implement the following using a singly linked list.
   a) Stack ADT, b) Queue ADT, c) priority queue ADT
6. Write Java programs to implement the deque (double ended queue) ADT using
   a) Array, b) Singly linked list, c) Doubly linked list.
7. Write a Java program to perform the following operations in binary search tree: a) Creation, b) Insert a key, c) Search for a key, c) Delete an element.
8. Write a Java program to implement all the functions of a dictionary (ADT) using Hashing.
9. Write a Java program to implement the following:
   a) Dijkstra's algorithm for Single source shortest path problem.
   b) Kruskal's algorithm to generate minimum cost spanning tree.
   c) KMP algorithm for Pattern matching.
10. Write Java programs for the implementation of BFS and DFS for a given graph.
11. Write Java programs for implementing the following sorting methods:
    a) Bubble, b) Insertion, c) Quick, d) Merge, e) Heap, f) Radix, g) Binary Tree
12. Write a Java program to perform the following operations in B-tree: a) Insertion b) Searching.

REFERENCE BOOKS

1. S.Sahni, "**Data Structures Algorithms and Applications in Java**", Universities Press.
2. Clifford Shaffer, "**Data structures and Algorithm analysis in Java**", 3rd Edition, Courier Corporation.

Course Outcomes:
At the end of the course, students will be able to:
1. **Design** and analyze the implementation of linear data structures and applications.
2. **Apply** the concepts related to different searching techniques.
3. **Implement** thesorting techniques.

4. **Learn** and implement the concept of nonlinear data structures and applications.
5. **Study** and deploy the shortest path algorithms.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
Cos	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3					
CO2					3	1
CO3			2	1		
CO4	3	2				
CO5		3				

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: C5110	BIG DATA ANALYTICS LAB	L	T	P
Credits: 2	(Professional Elective –I lab)	-	-	4

Prerequisites: Computer programming, Linux

Software Requirements: Hadoop, Linux, VMware

Course Objectives:

This objective of the course is to provide the students to study and understand the execute the experiments related to Big data using Hadoop.

List of Programs:

1. Installation of Hadoop
2. File Management tasks in Hadoop
3. Word Count Map Reduce program to understand Map Reduce Paradigm
4. Weather Report POC-Map Reduce Program to analyze time-temperature statistics and generate report with max/min temperature.
5. Implementing Matrix Multiplication with Hadoop Map Reduce
6. Pig Latin scripts to sort,group, join,project, and filter your data.
7. Hive Databases,Tables,Views,Functions and Indexe**s**

BOOKS

1. Dr. M.S.Vijaya Dr. N.Radha V. Pream Sudha on Big Data Analytics Lab Manual: Step by Step Guide to Hadoop, Pig, Hive and MongoDB
2. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
3. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.

REFERENCE BOOKS:

1. Bill Franks, Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2012.
2. Glenn J. Myatt, Making Sense of Data, John Wiley & sons, 2007 Pete Warden, Big Data Glossary, O'Reilly, 2011

Course Outcomes:

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

1. **Understand** the big data in Hadoop
2. **Explore** and analyze Files, Mapreduce programs.
2. **Implement** applications using Hadoop programs, POC Map Reduce, Matrix Multiplication
3. **Apply** the Pig Latin scripts using hadoop.
4. **Implement** and **explore** Hive Databases, tables, views, functions and indexes.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1		2	2	2
CO2	1					1
CO3	1			2	2	2
CO4				1		1
CO5	1	2		1		1

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: C5111	DATA SCIENCE LAB	L	T	P
Credits: 2	(Professional Elective-I Lab)	-	-	4

Prerequisites: Computer Programming

Software Requirement: R

Course Objectives:
To make students understand learn about a Data science – R Programming, way of solving problems and to teachstudents to write programs and solve problems.

List of experiments:

What is R and RStudio? R is a statistical software program. It has extremely useful tools for data exploration, data analysis, and data visualization. It is flexible and also allows for advanced programming. RStudio is a user interface for R, which provides a nice environment for working with R.

Introduction to R Programming:

1. Write an R program to evaluate the following expression ax+b/ax-b.
2. Write an R program to read input from keyboard (hint: readLine()).
3. Write an R program to find the sum of n natural numbers: 1+2+3+4+….n
4. Write an R program to read n numbers.
   (i) Sum of all even numbers (ii) Total number of even numbers.
5. Write an R program to read n numbers.
   (i) Total number of odd numbers (ii) Sum of all odd numbers
6. Write an R program to obtain
   (i)sum of two matrices A and B (ii) subtraction of two matrices A and B
   (iii) Product of two matrices.
7. Write an R program for "declaring and defining functions "
8. Write an R program that uses functions to add n numbers reading from keyboard
9. Write an R program uses functions to swap two integers.
10. Write an R program that use both recursive and non-recursive functions for implementing theFactorial of a given number, n.
11. Write an R program to reverse the digits of the given number {example 1234 to be written as 4321}
12. Write an R program to implement
    (i)Linear search (ii) Binary Search.
13. Write an R program to implement
    (i)Bubble sort (ii) selection sort.
14. Write a R program to implement the data structures
    (i) Vectors (ii) Array (iii) Matrix (iv) Data Frame (v) Factors
15. Write a R program to implement scan(), merge(), read.csv() and read.table() commands.
16. Write an R program to implement "Executing Scripts" written on the note pad, bycalling to the R console.
17. Write a R program, Reading data from files and working with datasets

(i)Reading data from csv files, inspection of data.
(ii)Reading data from Excel files.

18. Write a R program to implement Graphs
    (i) Basic high-level plots (ii)Modifications of scatter plots
    (iii)Modifications of histograms, parallel box plots.

REFERENCE BOOKS

1. Big data – Black Book: 2015 edition: dreamtech press. Pg. (490- 642)
2. Introducing to programming and problem solving by scala, mark c. lewis, lisal.lacher. CRC press, second edition.

Suggested Links:

1. https://www.tutorialspoint.com/scala/
2. https://www.tutorialspoint.com/r/

Course Outcomes:

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

1. **Design** and analyze the implementation of R programs.
2. **Apply** the data science and R concepts related to different problems using R studio.
3. **Implement** the searching techniques.
4. **Learn** and implement the concept of sorting, data structures, commands and applications.
5. **Study** and deploy the data sets and graphs

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
Cos	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3		2			2
CO2	2	3	2		2	1
CO3	2	2	2	3		
CO4					3	1
CO5	1		2	3	1	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: C5112	MACHINE LEARNING LAB	L	T	P
Credits: 2	(Professional Elective-I Lab)	-	-	4

Prerequisites: Computer Programming, Python

Software Requirement: Python

Course Objectives:
This objective of the course is to provide the students to implement the various supervised and unsupervised learning techniques along with the clustering and classification methods.

List of experiments:
1. Implement simple linear regression.
2. Implement the multivariate linear regression.
3. Implement simple logistic regression and multivariate logistic regression.
4. Implement decision trees.
5. Implement a classification algorithm.
6. Implement random forests algorithm
7. Implement K-means with example
8. Implement KNN algorithms with example.
9. Implement SVM on any applicable datasets.
10. Implement neural networks
11. Implement PCA.
12. Implement anomaly detection and recommendation.

REFERENCE BOOKS
1. Willi Richert, Luis Pedro Coelho, "Building Machine Learning with Python", Packt Publishing, 2013.

Course Outcomes:
At the end of the course, students will be able to:
1. **Study** of various statistical methods.
2. **Deploy** classification techniques for a real time data set.
3. **Implement** clustering algorithms for any data set.
4. **Explore** the dimensionality reduction procedures.
5. **Examine** the anomaly detection methods.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
Cos	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	3		3
CO2	3	2	3	3		3
CO3	3		3	3	1	3
CO4	3		3	3		3
CO5	3		3	3		3

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Sem		
Code: C0A04	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P
Credits: Nil		2	-	-

Prerequisites: Nil

Course Objectives: The objective of the course is to provide the knowledge on structuring paragraphs, paraphrasing and preparation of research documents related to abstract, literature review, methods and results.

Module I **[6 Periods]**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Module II **[7 Periods]**

Clarifying Who Did What, Highlighting Your Findings, Hedging and criticizing, paraphrasing and plagiarism, sections of a paper, abstracts. Introduction.

Module III **[6 Periods]**

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

Module IV **[6 Periods]**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Module V **[7 Periods]**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

REFERENCE BOOKS

1. Goldbort R (2006) Writing for Science, Yale University Press.
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Course Outcomes:

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

1. **Structure** the sentences and paragraphs.
2. **Elaborate** the various sections of research papers.
3. **Explore** the check list in research documents.
4. **Apply** the key skills to coin the title, abstract, introduction and literature review.
5. **Inspect** the skills required for preparing experimental results and discussions.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	2			1	2
CO2		2	3	1		
CO3	2	2				2
CO4		2		2	1	
CO5		2	1		1	1

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5113	ADVANCED ALGORITHMS	L	T	P
Credits: 3		3	-	-

Pre-Requisites: UG level course in Algorithm Design and Analysis

Course Objectives:

1. Introduce students to the advanced methods of designing and analyzing algorithms.
2. The student should be able to choose appropriate algorithms and use it for a specific problem.
3. To familiarize students with basic paradigms and data structures used to solve advancedalgorithmic problems.
4. Students should be able to understand different classes of problems concerning their computation difficulties.
5. To introduce the students to recent developments in the area of algorithmic design.

MODULE – I **[10 Periods]**

Sorting: Review of various sorting algorithms, topological sorting

Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkstra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

MODULE – II **[9 Periods]**

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.

Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

MODULE – III **[10 Periods]**

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.

Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP- decomposition.

MODULE – IV **[10 Periods]**

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm.

MODULE – V **[9 Periods]**

Linear Programming: Geometry of the feasibility region and Simplex algorithm

NP-completeness: Examples, proof of NP-hardness and NP-completeness.

Recent Trends in problem solving paradigms using recent searching and sorting techniques by applyingrecently proposed data structures.

Course Outcomes: After completion of course, students would be able to:

1. Analyze the complexity/performance of different algorithms.
2. Determine the appropriate data structure for solving a particular set of problems.
3. Categorize the different problems in various classes according to their complexity.

REFERENCES:

1. Cormen, Leiserson, Rivest, Stein, "Introduction to Algorithms".
2. Aho, Hopcroft, Ullman "The Design and Analysis of Computer Algorithms".
3. Kleinberg and Tardos."Algorithm Design".

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2	3	3	3	2	3	3
CO3			2		2	
CO4	3	2	3	1		
CO5	3		1		2	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5114	ADVANCED COMPUTER ARCHITECTURE	L	T	P
Credits: 3		3	-	-

Prerequisites: Computer Organization

Course Objectives:

1. To impart the concepts and principles of parallel and advanced computer architectures.
2. To develop the design techniques of Scalable and multithreaded Architectures.
3. To Apply the concepts and techniques of parallel and advanced computer architectures todesign modern computer systems

MODULE – I **[10 Periods]**

Theory of Parallelism, Parallel computer models, The State of Computing, Multiprocessors and Multicomputers, Multivector and SIMD Computers, PRAM and VLSI models, Architectural development tracks, Program and network properties, Conditions of parallelism, Program partitioning and Scheduling, Program flow Mechanisms, System interconnect Architectures.

MODULE – II **[10 Periods]**

Principles of Scalable performance, Performance metrics and measures, Parallel Processing applications, Speed up performance laws, Scalability Analysis and Approaches, Hardware Technologies, Processes and Memory Hierarchy, Advanced Processor Technology, Superscalar and Vector Processors

MODULE – III **[9 Periods]**

Shared-Memory Organizations, Sequential and weak consistency models, Pipelining and superscalar techniques, Linear Pipeline Processors, Non-Linear Pipeline Processors, Instruction Pipeline design, Arithmetic pipeline design, superscalar pipeline design.

MODULE – IV **[10 Periods]**

Parallel and Scalable Architectures, Multiprocessors and Multicomputers, Multiprocessor system interconnects, cache coherence and synchronization mechanism, Three Generations of Multicomputers, Message-passing Mechanisms, Multivetor and SIMD computers.

MODULE – V **[9 Periods]**

Vector Processing Principles, Multivector Multiprocessors, Compound Vector processing, SIMD computer Organizations, The connection machine CM-5.

Course Outcomes: Gain knowledge of

1. Computational models and Computer Architectures.
2. Concepts of parallel computer models.
3. Scalable Architectures, Pipelining, Superscalar processors

TEXT BOOK:

1. Advanced Computer Architecture, Kai Hwang, 2nd Edition, Tata McGraw Hill Publishers.

REFERENCES:

1. Computer Architecture, J.L. Hennessy and D.A. Patterson, 4th Edition, ELSEVIER.
2. Advanced Computer Architectures, S.G.Shiva, Special Indian edition, CRC, Taylor &Francis.
3. Introduction to High Performance Computing for Scientists and Engineers, G. Hager and G.Wellein, CRC Press, Taylor & Francis Group.
4. Advanced Computer Architecture, D. Sima, T. Fountain, P. Kacsuk, Pearson education.
5. Computer Architecture, B. Parhami, Oxford Univ. Press.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2	3	3	3	2	3	3
CO3			2		2	1
CO4		1	3			1
CO5		1	1			

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5115	DATABASE PROGRAMMING WITH PL/SQL	L	T	P
Credits: 3		3	-	-

Prerequisites: Nil

Course Objectives:

1. Knowledge on significance of SQL fundamentals.
2. Evaluate functions and triggers of PL/SQL
3. Knowledge on control structures, packages in PL/SQL and its applications

MODULE – I **[9 Periods]**

PL/SQL Basics: Block Structure, Behavior of Variables in Blocks, Basic Scalar and Composite Data Types, Control Structures, Exceptions, Bulk Operations, Functions, Procedures, and Packages, Transaction Scope.

MODULE – II **[9 Periods]**

Language Fundamentals & Control Structures: Lexical Modules, Variables and Data Types, Conditional Statements, Iterative Statements, Cursor Structures, Bulk Statements, Introduction to Collections, Object Types: Varray and Table Collections, Associative Arrays, Oracle Collection API.

MODULE – III **[10 Periods]**

Functions and Procedures: Function and Procedure Architecture, Transaction Scope, Calling Subroutines, Positional Notation, Named Notation, Mixed Notation, Exclusionary Notation, SQL Call Notation, Functions, Function Model Choices, Creation Options, Pass-by-Value Functions, Pass-by- Reference Functions, Procedures, Pass-by-Value Procedures, Pass-by-Reference Procedures, Supporting Scripts.

MODULE – IV **[10 Periods]**

Packages: Package Architecture, Package Specification, Prototype Features, Serially Reusable Precompiler Directive, Variables, Types, Components: Functions and Procedures, Package Body, Prototype Features, Variables, Types, Components: Functions and Procedures, Definer vs. Invoker Rights Mechanics, Managing Packages in the Database Catalog, Finding, Validating, and Describing Packages, Checking Dependencies, Comparing Validation Methods: Timestamp vs. Signature.

MODULE – V **[10 Periods]**

Triggers: Introduction to Triggers, Database Trigger Architecture, Data Definition Language Triggers, Event Attribute Functions, Building DDL Triggers, Data Manipulation Language Triggers, Statement- Level Triggers, Row-Level Triggers, Compound Triggers, INSTEAD OF Triggers, System and Database Event Triggers, Trigger Restrictions,

Maximum Trigger Size, SQL Statements, LONG and LONG RAWData Types.

Course Outcomes:

1. Understand importance of PL/SQL basics
2. Implement functions and procedures using PL/SQL
3. Understand the importance of triggers in database

TEXT BOOKS:

1. Oracle Database 12c PL/SQL Programming Michael McLaughlin, McGrawHill Education

REFERENCES:

1. Benjamin Rosenzweig, Elena Silvestrova Rakhimov, Oracle PL/SQL by example Fifth Edition
2. Dr. P. S. Deshpande, SQL & PL / SQL for Oracle 11g Black Book

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2	3	3	3	2	3	3
CO3	3	1	1		2	2
CO4	1				2	
CO5	1				2	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5116	DEEP LEARNING	L	T	P
Credits: 3	(Professional Elective – III)	3	-	-

Prerequisites: Nil

Course Objectives: students will be able

1. To understand complexity of Deep Learning algorithms and their limitations
2. To be capable of performing experiments in Deep Learning using real-world data.

MODULE – I **[10 Periods]**

Introduction: Feed forward Neural networks, Gradient descent and the back propagation algorithm, Module saturation, the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima, Heuristics for faster training, Nestors accelerated gradient descent, Regularization, Dropout

MODULE – II **[10 Periods]**

Convolutional Neural Networks: Architectures, convolution/pooling layers, Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures. Deep Unsupervised Learning: Auto encoders, Variational Auto-encoders, Adversarial Generative Networks, Auto-encoder and DBM Attention and memory models, Dynamic Memory Models

MODULE – III **[10 Periods]**

Applications of Deep Learning to Computer Vision: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text withLSTM models, Attention Models for computer vision tasks

MODULE – IV **[10 Periods]**

Applications of Deep Learning to NLP: Introduction to NLP and Vector Space Model of Semantics, Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of-Wordsmodel (CBOW), Glove, Evaluations and Applications in word similarity

MODULE – V **[10 Periods]**

Analogy reasoning: Named Entity Recognition, Opinion Mining using Recurrent Neural Networks: Parsing and Sentiment Analysis using Recursive Neural Networks: Sentence Classification using Convolutional Neural Networks, Dialogue Generation with LSTMs

Course Outcomes:

1. Implement deep learning algorithms, understand neural networks and traverse the layers ofdata
2. Learn topics such as convolutional neural networks, recurrent neural networks, training deepnetworks and high-level interfaces

3. Understand applications of Deep Learning to Computer Vision
4. Understand and analyze Applications of Deep Learning to NLP

TEXT BOOKS:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
2. The Elements of Statistical Learning by T. Hastie, R. Tibshirani, and J. Friedman, Springer.
3. Probabilistic Graphical Models. Koller, and N. Friedman, MIT Press.

REFERENCES:

1. Bishop, C, M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G.,H., and Van Loan, C.,F., Matrix Computations, JHU Press,2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2			3	2	3	3
CO3	3	3	2		2	1
CO4	3	2	3	1	2	1
CO5	3		1		2	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5117	ADVANCED COMPUTER NETWORKS	L	T	P
Credits: 3	(Professional Elective – III)	3	-	-

Prerequisites: Data Communication, Basic Networking Principles, Computer Networks

Course Objective: This course aims to provide advanced background on relevant computer networking topics to have a comprehensive and deep knowledge in computer networks.

MODULE – I **[10 Periods]**

Data-link protocols: Ethernet, Token Ring and Wireless (802.11). Wireless Networks and Mobile IP: Infrastructure of Wireless Networks, Wireless LAN Technologies, IEEE 802.11 Wireless Standard, Cellular Networks, Mobile IP, Wireless Mesh Networks (WMNs), Multiple access schemes Routing and Internetworking: Network–Layer Routing, Least-Cost-Path algorithms, Non-Least-Cost-Path algorithms, Intra-domain Routing Protocols, Inter-domain Routing Protocols, Congestion Control at Network Layer.

MODULE – II **[10 Periods]**

Transport and Application Layer Protocols: Client-Server and Peer-To-Peer Application Communication, Protocols on the transport layer, reliable communication. Routing packets through a LAN and WAN. Transport Layer, Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Mobile Transport Protocols, TCP Congestion Control. Principles of Network Applications,

MODULE- III **[10 Periods]**

The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, Domain Name System (DNS), P2P File Sharing, Socket Programming with TCP and UDP, building a Simple Web Server Creating simulated networks and passing packets through them using different routing techniques. Installing andusing network monitoring tools.

MODULE – IV **[10 Periods]**

Wireless and Mobile Networks: Introduction, Wireless links and Network Characteristics - CDMA, Wifi: 802.11 Wireless LANS, Cellular internet access, Mobility management: Principles

MODULE – V **[10 Periods]**

Multimedia networking: Multimedia networking applications, streaming stored video, Voice-over-IP, Protocols for real-time conversational applications.

Course Outcomes:

1. Understanding of holistic approach to computer networking

2. Ability to understand the computer network protocols and their applications
3. Ability to design simulation concepts related to packet forwarding in networks.

TEXT BOOKS:

1. Computer Networking: A Top-Down Approach, James F. Kuros and Keith W. Ross, Pearson,6th Edition, 2012.
2. Computer Networks and Internets, Duglas E. Comer, 6th Edition, Pearson.

REFERENCES:

1. A Practical Guide to Advanced Networking, Jeffrey S. Beasley and Piyasat Nilkaew, Pearson,3rd Edition, 2012
2. Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Prentice Hall.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	1
CO2	3	3	3	2	3	3
CO3	3	3	2	1	2	
CO4		2	1	1	2	
CO5			1		2	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5118	NATURAL LANGUAGE PROCESSING	L	T	P
Credits: 3	(Professional Elective – III)	3	-	-

Prerequisites:

1. Data structures, finite automata and probability theory.

Course Objectives:

1. Introduction to some of the problems and solutions of NLP and their relation to linguistics andstatistics.

MODULE – I **[10 Periods]**

Finding the Structure of Words: Words and Their Components, Issues and Challenges, Morphological Models. **Finding the Structure of Documents:** Introduction, Methods, Complexity of the Approaches, Performances of the Approaches

MODULE – II **[10 Periods]**

Syntax Analysis: Parsing Natural Language, Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms, Models for Ambiguity Resolution in Parsing,Multilingual Issues.

MODULE – III **[10 Periods]**

Semantic Parsing: Introduction, Semantic Interpretation, System Paradigms, Word Sense Systems, Software.

MODULE – IV **[10 Periods]**

Predicate-Argument Structure, Meaning Representation Systems, Software.

MODULE – V **[10 Periods]**

Discourse Processing: Cohesion, Reference Resolution, Discourse Cohesion and Structure Language Modeling: Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems, Multilingual and Cross Lingual Language Modeling.

Course Outcomes:

1. Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
2. Understand and carry out proper experimental methodology for training and evaluating empirical NLP systems
3. Able to manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.
4. Able to design, implement, and analyze NLP algorithms Able to design different

languagemodeling Techniques.

5. Able to design different language modeling Techniques.

TEXT BOOKS:

1. Multilingual natural Language Processing Applications: From Theory to Practice – Daniel M.Bikel and Imed Zitouni, Pearson Publication
2. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary

REFERENCE:

1. Speech and Natural Language Processing - Daniel Jurafsky & James H Martin, PearsonPublications

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2	3	3	3	2	3	3
CO3	1	3	2		2	1
CO4	2	2	3			1
CO5	1		1			

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5119	BIOINFORMATICS	L	T	P
Credits: 3	(Professional Elective – IV)	3	-	-

Prerequisites: Nil

Course Objectives: Knowledge on concepts of bioinformatics and biological motivations of sequenceanalysis

MODULE -I: **[10 Periods]**

The Central Dogma & XML (Bio XML) for Bioinformatics: Watson's definition, information flow, from data to knowledge, Convergence, the organization of DNA, the organization of Proteins, Introduction, Differences between HTML and XML, fundamentals of XML, fundamentals of XML namespaces. Introduction to DTDs, Document type Declarations, Declaring elements, declaring attributes, working with entities XML Schemas, Essential Concepts, working with simple types, working with complex types, Basic namespaces issues.

MODULE -II: **[10 Periods]**

Perl (Bioperl) for Bioinformatics: Representing sequence data, program to store a DNA sequence, concatenating DNA fragments, Transcription, Calculating the reverse complement in Perl, Proteins, files, reading proteins in files, Arrays, Flow control, finding motifs, counting Nucleotides, exploding strings into arrays, operating on strings, writing to files, subroutines and bugs.

MODULE -III: **[10 Periods]**

Databases: Flat file, Relational, object-oriented databases, object Relational and Hypertext, Data life cycle, Database Technology, Database Architecture, Database Management Systems and Interfaces.

MODULE -IV: **[10 Periods]**

Sequence Alignment Algorithms: Biological motivations of sequence analysis, the models forsequence analysis and their biological motivation, global alignment, local alignment, End free-space alignment and gap penalty, Sequence Analysis tools and techniques.

MODULE -V: **[10 Periods]**

Phylogenetic Analysis: Introduction, methods of Phylogenetic analysis, distance methods, the neighbor- Joining (NJ) method, The Fitch/ Margoliash method, character-based methods, Othermethods, Tree evaluation and problems in phylogenetic analysis, Clustering, Protein structure visualization and Protein structure prediction.

Course Outcomes:

1. Understand the Central Dogma & XML (Bio XML) for Bioinformatics
2. Analyze Perl (Bioperl) for Bioinformatics
3. Illustrate Databases technology, architecture and its interfaces
4. Understand Sequence Alignment Algorithms, Phylogenetic Analysis

TEXT BOOKS:

1. S.C. Rastogi, N. Mendiratta, "Bioinformatics Methods and Applications", CBS publications,2004
2. James D. Tisdall, "Beginning Perl for Bioinformatics" O'Reilly media, 1st Edition, 2001

REFERENCE BOOKS:

1. D.R. Westhead, J.H. Parish, "Bioinformatics" Viva books private limited, New Delhi (2003)
2. Att Wood, "Bioinformatics" Pearson Education, 2004
3. Bryan Bergeron, M.D, "Bioinformatics Computing" Pearson Education, 2003

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	1
CO2	3	3	3	2	3	3
CO3	2	1	2		2	1
CO4	2	2	1		1	
CO5	2		1		1	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5120	Nature Inspired Computing	L	T	P
Credits: 3	(Professional Elective – IV)	3	-	-

Prerequisites: Nil

Course Objectives: Knowledge on significance of intelligence, genetic algorithms Ant Colonyalgorithms

MODULE - I: **[10 Periods]**

Models of Life and Intelligence - Fundamentals of bio-inspired models and bio-inspired computing. Evolutionary models and techniques, Swarm models and its self-organization, swarm and evolutionary algorithms. Optimisation problems – single and multi-objective optimisation, heuristic, meta-heuristic and hyper heuristic functions.

MODULE - II: **[10 Periods]**

Genetic algorithms - Mathematical foundation, Genetic problem solving, crossover and mutation. genetic algorithms and Markov process, applications of genetic algorithms

MODULE - III: **[10 Periods]**

Ant Colony Algorithms - Ant colony basics, hybrid ant system, ACO in combinatorial optimisation, variations of ACO, case studies.

MODULE - IV: **[10 Periods]**

Particle Swarm algorithms - particles moves, particle swarm optimisation, variable length PSO, applications of PSO, case studies. Artificial Bee Colony algorithms - ABC basics, ABC in optimisation,multi-dimensional bee colony algorithms, applications of bee algorithms, case studies.

MODULE - V: **[10 Periods]**

Selected nature inspired techniques - Hill climbing, simulated annealing, Gaussian adaptation, Cuckoo search, Firey algorithm, SDA algorithm, bat algorithm, case studies. Other nature inspired techniques - Social spider algorithm, Cultural algorithms, Harmony search algorithm, Intelligent water drops algorithm, Artificial immune system, Flower pollination algorithm, case studies.

Course Outcomes:

1. Familiar with Genetic algorithm and its applications.
2. Compare different Ant Colony Optimization algorithmic models.
3. Compare different Artificial Bee Colony Optimization algorithmic models.
4. Illustrate Particle swam optimization algorithm with an example.

TEXT BOOKS:

1. Albert Y.Zomaya - "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006
2. Floreano, D. and C. Mattiussi -"Bio-Inspired Artificial Intelligence: Theories, methods, andTechnologies" IT Press, 2008

REFERENCES:

1. Leandro Nunes de Castro - " Fundamentals of Natural Computing, Basic Concepts, Algorithmsand Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
2. Marco Dorrigo, Thomas Stutzle -" Ant Colony Optimization", Prentice Hall of India, New Delhi,2005
3. Vinod Chandra S S, Anand H S - "Machine Learning: A Practitioner's Approach", Prentice Hallof India, New Delhi, 2020

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2	2	3	3	2	3	2
CO3	2	1	2		2	1
CO4	2	2	3			1
CO5			1			

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5121	ROBOTIC PROCESS AUTOMATION	L	T	P
Credits: 3	(Professional Elective – IV)	3	-	-

Prerequisites: Nil

Course Objectives: Aim of the course is to make learners familiar with the concepts of RoboticProcess Automation.

MODULE – I **[10 Periods]**

Introduction to Robotic Process Automation & Bot Creation Introduction to RPA and Use cases –Automation Anywhere Enterprise Platform – Advanced features and capabilities – Ways to create Bots

MODULE – II **[10 Periods]**

Web Control Room and Client Introduction - Features Panel - Dashboard (Home, Bots, Devices, Audit,Workload, Insights) - Features Panel – Activity (View Tasks in Progress and Scheduled Tasks) - Bots (View Bots Uploaded and Credentials)

MODULE – III **[10 Periods]**

Devices (View Development and Runtime Clients and Device Pools) - Workload (Queues and SLA Calculator) - Audit Log (View Activities Logged which are associated with Web CR) - Administration (Configure Settings, Users, Roles, License and Migration) - Demo of Exposed API's – Conclusion – Client introduction and Conclusion.

MODULE – IV **[10 Periods]**

Bot Creator Introduction – Recorders – Smart Recorders – Web Recorders – Screen Recorders - Task Editor – Variables - Command Library – Loop Command – Excel Command – Database Command String Operation Command - XML Command

MODULE – V **[10 Periods]**

Terminal Emulator Command - PDF Integration Command - FTP Command - PGP Command - Object Cloning Command - Error Handling Command - Manage Windows Control Command - Workflow Designer - Report Designer

Course Outcomes:

1. Describe RPA, where it can be applied and how it's implemented.
2. Identify and understand Web Control Room and Client Introduction
3. Understand how to handle various devices and the workload
4. Understand Bot creators, Web recorders and task editors

TEXT BOOKS:

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath: Create Software robots. with the leading RPAtool – UiPath Kindle Edition.

REFERENCES:

1. Robotic Process Automation A Complete Guide - 2020 Edition Kindle Edition.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2	3	3	3	2	3	2
CO3	1	2	2		1	
CO4	1				2	
CO5	1					

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)			M.Tech II Sem
Code: C5122	ADVANCED ALGORITHMS LAB	L	T	P
Credits: 2		-	-	4

Prerequisites: Algorithms

Course Objective: The student can able to attain knowledge in advanced algorithms.

List of Experiments

1. Implement assignment problem using Brute Force method
2. Perform multiplication of long integers using divide and conquer method.
3. Implement a solution for the knapsack problem using the Greedy method.
4. Implement Gaussian elimination method.
5. Implement LU decomposition
6. Implement Warshall algorithm
7. Implement the Rabin Karp algorithm.
8. Implement the KMP algorithm.
9. Implement Harspool algorithm
10. Implement max-flow problem.

Course Outcomes: The student can able to analyze the performance of algorithms

TEXT BOOK:

1. Design and Analysis of Algorithms, S.Sridhar, OXFORD University Press

REFERENCES:

1. Introduction to Algorithms, second edition, T.H. Cormen, C.E. Leiserson, R.L. Rivest and C.Stein, PHI Pvt. Ltd./ Pearson Education.
2. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajasekharam,Universities Press.
3. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3		1	
CO2	3	2	3	2	3	3
CO3	1	3	2		2	1
CO4	2	2	3		2	
CO5	1		1		2	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5123	DEEP LEARNING LAB	L	T	P
Credits: 2	(Professional Elective-III Lab)	-	-	4

Prerequisites: Nil

Course Objectives:

1. To Build The Foundation Of Deep Learning.
2. To Understand How To Build The Neural Network.
3. To enable students to develop successful machine learning concepts.

LIST OF EXPERIMENTS:

1. Setting up the Spyder IDE Environment and Executing a Python Program
2. Installing Keras, Tensorflow and Pytorch libraries and making use of them
3. Applying the Convolution Neural Network on computer vision problems
4. Image classification on MNIST dataset (CNN model with Fully connected layer)
5. Applying the Deep Learning Models in the field of Natural Language Processing
6. Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU notes
7. Applying the Autoencoder algorithms for encoding the real-world data
8. Applying Generative Adversial Networks for image generation and unsupervised tasks.

Course Outcomes:

1. Upon the Successful Completion of the Course, the Students would be able to:
2. Learn The Fundamental Principles Of Deep Learning.
3. Identify The Deep Learning Algorithms For Various Types of Learning Tasks in variousdomains.
4. Implement Deep Learning Algorithms And Solve Real-world problems.

TEXT BOOKS:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
2. The Elements of Statistical Learning by T. Hastie, R. Tibshirani, and J. Friedman, Springer.
3. Probabilistic Graphical Models. Koller, and N. Friedman, MIT Press.

REFERENCES:

1. Bishop, C, M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G.H., and Van Loan C.F., Matrix Computations, JHU Press, 2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Extensive Reading:

- http://www.deeplearning.net
- https://www.deeplearningbook.org/
- https://developers.google.com/machine-learning/crash-course/ml-intro
- www.cs.toronto.edu/~fritz/absps/imagenet.pdf
- http://neuralnetworksanddeeplearning.com/

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2	3	2	3	2	3	3
CO3	1	3	2		2	
CO4	1	2				1
CO5	1					

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5124	ADVANCED COMPUTER NETWORKS LAB	L	T	P
Credits: 2	(Professional Elective-III Lab)	-	-	4

Prerequisites: Data communication, Basic networking principles, Computer Networks

Course Objectives:

1. Understand and analyze the existing protocols
2. Understand the use of network packet capturing tools

List of Experiments:

1. Implement the IP fragmentation and reassembly algorithm.
2. Implement the IP forwarding algorithm.
3. Implement the simplest sliding window protocol of TCP.
4. Connect two systems using a switch and configure private IP addresses to the systems and ping them from each other. Using Wireshark, capture packets and analyze all the header information in the packets captured.
5. Install Telnet on one of the systems connected by a switch and telnet to it from the other system. Using Wireshark, capture the packets and analyze the TCP 3-way Handshake for connection establishment and tear down.
6. Start packet capture in wireshark application and then open your web browser and type in an URL of the website of your choice. How long did it take from when the HTTP GET message was sent until the HTTP OK reply was received for the web page you visited in your web browser.

Course Outcomes: Ability of acquiring the practical exposure to existing protocols

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3		2	1
CO2	3	3	3	2	2	3
CO3	2	1	2		2	
CO4	3	2	3		2	
CO5	1		1		2	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5125	NATURAL LANGUAGE PROCESSING LAB	L	T	P
Credits: 2	(Professional Elective-III Lab)	-	-	4

Prerequisites: Data structures, finite automata and probability theory

Course Objectives:

1. To Develop and explore the problems and solutions of NLP.

List of Experiments

Implement the following using Python

1. Tokenization
2. Stemming
3. Stop word removal (a, the, are)
4. Word Analysis
5. Word Generation
6. Pos tagging
7. Morphology
8. chunking
9. N-Grams
10. N-Grams Smoothing

Course Outcomes:

1. Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
2. Able to manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.
3. Able to design, implement, and analyze NLP algorithms

TEXT BOOKS:

1. Multilingual natural Language Processing Applications: From Theory to Practice – Daniel M.Bikel and Imed Zitouni, Pearson Publication.
2. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary.

REFERENCES:

1. Speech and Natural Language Processing - Daniel Jurafsky & James H Martin, PearsonPublications.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3		2	
CO2	3	3	3	2	3	2
CO3	3	3	2		2	1
CO4		2	1		2	
CO5			1			

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C00A5	AUDIT COURSE- II	L	T	P
Credits: Nil		2	-	-

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5126	DIGITAL FORENSICS	L	T	P
Credits: 3	(Professional Elective – V)	3	-	-

Pre-Requisites: Computer Networks

Course Objectives:

1. provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
2. Combines both the technical expertise and the knowledge required to investigate, detect andprevent digital crimes.
3. Knowledge on digital forensics legislations, digital crime, forensics processes and procedures,data acquisition and validation, e-discovery tools
4. E-evidence collection and preservation, investigating operating systems and file systems,network forensics, art of steganography and mobile device forensics

MODULE – I **[10 Periods]**

Digital Forensics Science: Forensics science, computer forensics, and digital forensics.
Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber criminalisticsarea, holistic approach to cyber-forensics

MODULE – II **[10 Periods]**

Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

MODULE – III **[10 Periods]**

Evidence Management & Presentation: Create and manage shared folders using operating system,importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define andapply probable cause.

MODULE – IV **[10 Periods]**

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case,
Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

MODULE – V **[10 Periods]**

Mobile Forensics: mobile forensics techniques, mobile forensics tools.
Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.

Recent trends in mobile forensic technique and methods to search and seizure electronic evidence

Course Outcomes: On completion of the course the student should be able to

1. Understand relevant legislation and codes of ethics.
2. Computer forensics and digital detective and various processes, policies and procedures.
3. E-discovery, guidelines and standards, E-evidence, tools and environment.
4. Email and web forensics and network forensics.

TEXT BOOKS:

1. John Sammons, The Basics of Digital Forensics, Elsevier
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		1	
CO2	3	2	3	2	3	3
CO3	2	3	2		2	
CO4	2	2	2			
CO5	3		1			

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5127	HIGH PERFORMANCE COMPUTING	L	T	P
Credits: 3	(Professional Elective – V)	3	-	-

Prerequisites:

1. Computer Organization & Architecture
2. Operating System Programming

Course Objectives:

1. To Improve the system performance
2. To learn various distributed and parallel computing architecture
3. To learn different computing technologies

MODULE – I **[10 Periods]**

Grid Computing: Data & Computational Grids, Grid Architectures And Its Relations To Various Distributed Technologies. Autonomic Computing, Examples Of The Grid Computing Efforts (IBM).

MODULE – II **[10 Periods]**

Cluster Computing at a Glance: Introduction, A Cluster Computer and its Architecture, Cluster Classifications, Commodity Components for clusters, Network Services/Communication SW, Cluster Middleware and SSI, RMS, Programming Environments and Tools, Cluster Applications.

Lightweight Messaging Systems: Introduction, Latency Bandwidth Evaluation of Communication performance, Traditional Communication Mechanisms for clusters, Lightweight Communication Mechanisms.

MODULE – III **[10 Periods]**

Job and Resource Management Systems: Need of Job management, Components and Architecture. Scheduling Parallel Jobs on Clusters: Introduction, Rigid Jobs with process migration, Malleable Jobs with Dynamic Parallelism, Communication-Based Coscheduling, Batch Scheduling.

Cluster Operating Systems: COMPaS.

MODULE – IV **[10 Periods]**

Pervasive Computing Concepts & Scenarios: Hardware & Software; Human – Machine Interface.

Device Connectivity: Java For Pervasive Devices; Application Examples.

MODULE – V **[10 Periods]**

Classical Vs Quantum Logic Gates: One, Two & Three Qubit Quantum Gates; Fredkin & Toffoli Gates; Quantum Circuits; Quantum Algorithms.

Course Outcomes: On completion of the course the student should be able to

1. Understand relevant legislation and codes of ethics.
2. Computer forensics and digital detective and various processes, policies and procedures.
3. E-discovery, guidelines and standards, E-evidence, tools and environment.
4. Email and web forensics and network forensics.

TEXT BOOKS:

1. Grid Computing, J. Joseph & C. Fellenstien, Pearson Education
2. High Performance Cluster Computing, Raj kumar Buyya, pearson Education.
3. Pervasive Computing, J. Burkhardt et.al, Pearson Education
4. Approaching Quantum Computing Marivesar, Pearson Education.

REFERENCES:

1. The Grid 2: Blue Print for a New Computing Infrastructure, Ian Foster and Carl Kesselman, 2nd Edition, The Elsevier Series.
2. Quantum computing and Quantum Information, Neilsen & Chung L, Cambridge UniversityPress.
3. A networking approach to Grid Computing, Minoli, Wiley

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2	2	2	3	2	1	3
CO3	3	3	2		2	1
CO4	2	2	2		1	
CO5	3		1		2	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5128	QUANTUM COMPUTING	L	T	P
Credits: 3	(Professional Elective – V)	3	-	-

Prerequisites: Nil

Course Objectives:

1. To introduce the fundamentals of quantum computing
2. The problem-solving approach using finite dimensional mathematics

MODULE – I **[10 Periods]**

Introduction to Essential Linear Algebra: Some Basic Algebra, Matrix Math, Vectors and Vector Spaces, Set Theory.

Complex Numbers: Definition of Complex Numbers, Algebra of Complex Numbers, Complex NumbersGraphically, Vector Representations of Complex Numbers, Pauli Matrice, Transcendental Numbers.

MODULE – II **[10 Periods]**

Basic Physics for Quantum Computing: The Journey to Quantum, Quantum Physics Essentials, Basic Atomic Structure, Hilbert Spaces, Uncertainty, Quantum States, Entanglement

Basic Quantum Theory: Further with Quantum Mechanics, Quantum Decoherence, Quantum Electrodynamics, Quantum Chromodynamics, Feynman Diagram Quantum Entanglement and QKD, Quantum Entanglement, Interpretation, QKE.

MODULE – III **[10 Periods]**

Quantum Architecture: Further with Qubits, Quantum Gates, More with Gates, Quantum Circuits, TheD-Wave Quantum Architecture.

Quantum Hardware: Qubits, How Many Qubits Are Needed? Addressing Decoherence, Topological Quantum Computing, Quantum Essentials.

MODULE – IV **[10 Periods]**

Quantum Algorithms: What Is an Algorithm? Deutsch's Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazirani Algorithm, Simon's Algorithm, Shor's Algorithm, Grover's Algorithm.

MODULE – V **[10 Periods]**

Current Asymmetric Algorithms: RSA, Diffie-Hellman, Elliptic Curve

The Impact of Quantum Computing on Cryptography: Asymmetric Cryptography, Specific Algorithms, Specific Applications

Course Outcomes:

1. Understand basics of quantum computing
2. Understand physical implementation of Qubit
3. Understand Quantum algorithms and their implementation
4. Understand The Impact of Quantum Computing on Cryptography

TEXT BOOKS:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press
2. Dr. Chuck Easttom, Quantum Computing Fundamentals, Pearson

REFERENCES:

1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol.Basic Concepts, Vol
3. Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to QuantumComputing Algorithms

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3		3	1
CO2	3	3	3	2	3	3
CO3	3	3	2		1	
CO4	2	2			2	
CO5	2				2	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5129	IPR	L	T	P
Credits: 3	(OPEN ELECTIVE)	3	-	-

Prerequisites: Nil

Course Objectives:

1. To explain the art of interpretation and documentation of research work
2. To explain various forms of intellectual property rights
3. To discuss leading International regulations regarding Intellectual Property Rights

MODULE- I **[10 Periods]**

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

MODULE – II **[10 Periods]**

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter,selecting, and evaluating trade mark, trade mark registration processes.

MODULE – III **[10 Periods]**

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

MODULE – IV **[10 Periods]**

Trade Secrets: Trade secret law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

MODULE – V **[10 Periods]**

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

Course Outcomes: Upon the Successful Completion of the Course, the Students would be able to:

1. Understand types of Intellectual Property
2. Analyze trademarks and its functionality
3. Illustrate law of copy rights and law of patents

TEXT BOOKS & REFERENCES:

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, TataMcGraw Hill Publishing company ltd.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	3		3	1
CO2	2	2	2	2	3	3
CO3	2	3	2			
CO4	3	2	3			
CO5	3		1			

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5130	FAULT TOLERANCE SYSTEMS (OPEN ELECTIVE)	L	T	P
Credits: 3		3	-	-

Prerequisites: Nil

Course Objectives:

1. To know the different advantages and limits of fault avoidance and fault tolerance techniques.
2. To impart the knowledge about different types of redundancy and its application for the design of computer system being able to function correctly even under presence of faults and data errors.
3. To understand the relevant factors in evaluating alternative system designs for a specific set of requirements.
4. To understand the subtle failure modes of "fault-tolerant" distributed systems.

MODULE – I **[10 Periods]**

Introduction to Fault Tolerant Computing: Basic concepts and overview of the course; Faults and their manifestations, Fault/error modeling, Reliability, availability and maintainability analysis, System evaluation, performance reliability tradeoffs.

MODULE – II **[10 Periods]**

System level fault diagnosis: Hardware and software redundancy techniques. Fault tolerant system design methods, Mobile computing and Mobile communication environment, Fault injection methods.

MODULE – III **[10 Periods]**

Software fault tolerance: Design and test of defect free integrated circuits, fault modeling, built in self-test, data compression, error correcting codes, simulation software/hardware, fault tolerant system design, CAD tools for design for testability.

MODULE – IV **[10 Periods]**

Information Redundancy and Error Correcting Codes: Software Problem. Software Reliability Models and Robust Coding Techniques, Reliability in Computer Networks Time redundancy. Re execution in SMT, CMP Architectures, Fault Tolerant Distributed Systems, Data replication.

MODULE – V **[10 Periods]**

Case Studies in FTC: ROC, HP Non-Stop Server. Case studies of fault tolerant systems and current research issues.

Course Outcomes: Upon the Successful Completion of the Course, the Students would be able to:

1. Become familiar with general and state of the art techniques used in design and analysis offault tolerant digital systems.
2. Be familiar with making system fault tolerant, modeling and testing, and benchmarking toevaluate and compare systems.

TEXT BOOK:

1. Fault Tolerant Computer System Design by D. K. Pradhan, Prentice Hall.

REFERENCES:

1. Fault Tolerant Systems by I. Koren, Morgan Kauffman.
2. Software Fault Tolerance Techniques and Implementation by L. L. Pullum, Artech HouseComputer Security Series.
3. Reliability of Computer Systems and Networks: Fault Tolerance Analysis and Design by M. L.Shooman, Wiley.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	1		3	
CO2	2	3	3	2	3	2
CO3	2	3	2		2	
CO4	3	2	3			
CO5	3		1			

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5131	INTRUSION DETECTION SYSTEMS (OPEN ELECTIVE)	L	T	P
Credits: 3		3	-	-

Prerequisites: Computer Networks, Computer Programming

Course Objectives:

1. Compare alternative tools and approaches for Intrusion Detection through quantitative analysisto determine the best tool or approach to reduce risk from intrusion.
2. Identify and describe the parts of all intrusion detection systems and characterize new and emerging IDS technologies according to the basic capabilities all intrusion detection systems share.

MODULE – I **[10 Periods]**

The state of threats against computers, and networked systems-Overview of computer security solutions and why they fail-Vulnerability assessment, firewalls, VPN's -Overview of Intrusion Detectionand Intrusion Prevention, Network and Host-based IDS

MODULE – II **[10 Periods]**

Classes of attacks - Network layer: scans, denial of service, penetration Application layer: software exploits, code injection-Human layer: identity theft, root access-Classes of attackers-Kids/hackers/sopHesitated groups-Automated: Drones, Worms, Viruses

MODULE – III **[10 Periods]**

A General IDS model and taxonomy, Signature-based Solutions, Snort, Snort rules, Evaluation of IDS,Cost sensitive IDS

MODULE – IV **[10 Periods]**

Anomaly Detection Systems and Algorithms-Network Behavior Based Anomaly Detectors (rate based)- Host-based Anomaly Detectors-Software Vulnerabilities-State transition, Immunology, Payload Anomaly Detection

MODULE – V **[10 Periods]**

Attack trees and Correlation of alerts- Autopsy of Worms and Botnets-Malware detection - Obfuscation,polymorphism- Document vectors.

Email/IM security issues-Viruses/Spam-From signatures to thumbprints to zero-day detection-Insider Threat issues-Taxonomy-Masquerade and Impersonation Traitors, Decoys and Deception-Future: Collaborative Security

Course Outcomes: After completion of the course, students will be able to:

1. Possess a fundamental knowledge of Cyber Security.
2. Understand what vulnerability is and how to address most common vulnerabilities.

3. Know basic and fundamental risk management principles as it relates to Cyber Security andMobile Computing.
4. Have the knowledge needed to practice safer computing and safeguard your information usingDigital Forensics.
5. Understand basic technical controls in use today, such as firewalls and Intrusion Detectionsystems.
6. Understand legal perspectives of Cyber Crimes and Cyber Security.

TEXT BOOKS:

1. Peter Szor, The Art of Computer Virus Research and Defense, Symantec Press ISBN 0-321-30545-3.
2. Markus Jakobsson and Zulfikar Ramzan, Crimeware, Understanding New Attacks and Defenses.

REFERENCE BOOKS:

1. Saiful Hasan, Intrusion Detection System, Kindle Edition.
2. Ankit Fadia, Intrusion Alert: An Ethical Hacking Guide to Intrusion Detection.

Online Websites/Materials:

1. https://www.intechopen.com/books/intrusion-detection-systems/

Online Courses:

1. https://www.sans.org/course/intrusion-detection-in-depth
2. https://www.cybrary.it/skill-certification-course/ids-ips-certification-training-course

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	2		3	1
CO2	2	1	3	2	3	3
CO3	2	3	2			
CO4	2	2	3			
CO5	3		1		2	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5132	DIGITAL FORENSICS	L	T	P
Credits: 3	(OPEN ELECTIVE)	3	-	-

Pre-Requisites: Cybercrime and Information Warfare, Computer Networks

Course Objectives:

1. provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
2. Combines both the technical expertise and the knowledge required to investigate, detect andprevent digital crimes.
3. Knowledge on digital forensics legislations, digital crime, forensics processes and procedures,data acquisition and validation, e-discovery tools
4. E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics

MODULE – I **[10 Periods]**

Digital Forensics Science: Forensics science, computer forensics, and digital forensics.

Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber criminalisticsarea, holistic approach to cyber-forensics

MODULE – II **[10 Periods]**

Cyber Crime Scene Analysis:

Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

MODULE – III **[10 Periods]**

Evidence Management & Presentation:

Create and manage shared folders using operating system, importance of the forensic mindset, definethe workload of law enforcement, Explain what the normal case would look like, Define who should benotified of a crime, parts of gathering evidence, Define and apply probable cause.

MODULE – IV **[10 Periods]**

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case, **Network Forensics:** open-source security tools for network forensic analysis, requirements forpreservation of network data.

MODULE – V **[10 Periods]**

Mobile Forensics: mobile forensics techniques, mobile forensics tools.

Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.
Recent trends in mobile forensic technique and methods to search and seizure electronic evidence

Course Outcomes: On completion of the course the student should be able to

1. Understand relevant legislation and codes of ethics.
2. Computer forensics and digital detective and various processes, policies and procedures.
3. E-discovery, guidelines and standards, E-evidence, tools and environment.
4. Email and web forensics and network forensics.

TEXT BOOKS:

1. John Sammons, The Basics of Digital Forensics, Elsevier
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

REFERENCES:

1. William Oettinger, Learn Computer Forensics: A beginner's guide to searching, analyzing, and securing digital evidence, Packt Publishing; 1st edition (30 April 2020), ISBN: 1838648178.
2. Thomas J. Holt, Adam M. Bossler, Kathryn C. Seigfried-Spellar, Cybercrime and DigitalForensics: An Introduction, Routledge.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2	2	3	3	2	3	3
CO3	2	3	2		2	
CO4	2	2	1			1
CO5	2					

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5133	OPTIMIZATION TECHNIQUES	L	T	P
Credits: 3	(OPEN ELECTIVE)	3	-	-

Prerequisite: Mathematics –I, Mathematics –II

Course Objectives:

1. To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming
2. Constrained and unconstrained optimization techniques for solving and optimizing electrical and electronic engineering circuits design problems in real world situations.
3. To explain the concept of Dynamic programming and its applications to project implementation.

MODULE – I **[10 Periods]**

Introduction and Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surface classification of Optimization problems.

Linear Programming: Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

MODULE – II **[10 Periods]**

Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.Degeneracy.

Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

MODULE – III **[10 Periods]**

Classical Optimization Techniques: Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints: Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints: Kuhn – Tucker conditions.

Single Variable Nonlinear Unconstrained Optimization: Elimination methods: Uni Model function-its importance, Fibonacci method & Golden section method.

MODULE – IV **[10 Periods]**

Multi variable nonlinear unconstrained optimization: Direct search methods – Univariant method, Pattern search methods – Powell's, Hooke - Jeeves, Rosenbrock's search methods. Gradient methods:Gradient of function & its importance, Steepest descent method, Conjugate

direction methods: Fletcher-Reeves method & variable metric method.

MODULE - V

Dynamic Programming: Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

Course Outcomes: After completion of this course, the student will be able to:

1. explain the need of optimization of engineering systems.
2. understand optimization of electrical and electronics engineering problems.
3. apply classical optimization techniques, linear programming, simplex algorithm, transportationproblem.
4. apply unconstrained optimization and constrained non-linear programming and dynamicprogramming.
5. Formulate optimization problems.

TEXT BOOKS:

1. Optimization Techniques & Applications by S.S.Rao, New Age International.
2. Optimization for Engineering Design by Kalyanmoy Deb, PHI

REFERENCES:

1. George Bernard Dantzig, Mukund Narain Thapa, "Linear programming", Springer series inOperations Research 3rd edition, 2003.
2. H. A. Taha, "Operations Research: An Introduction", 8th Edition, Pearson/Prentice Hall, 2007.
3. Optimization Techniques by Belegundu & Chandrupatla, Pearson Asia.
4. Optimization Techniques Theory and Practice by M.C. Joshi, K.M. Moudgalya, Narosa Publications

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2	2	3	3	2	3	2
CO3	2	3	2			
CO4	3	2	1		2	
CO5	2				2	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5134	CYBER PHYSICAL SYSTEMS (OPEN ELECTIVE)	L	T	P
Credits: 3		3	-	-

Prerequisites: Nil

Course Objective: To learn about design of cyber-physical systems

MODULE – I **[10 Periods]**

Symbolic Synthesis for Cyber-Physical Systems

Introduction and Motivation, Basic Techniques - Preliminaries, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques: Construction of SymbolicModels, Continuous-Time Controllers, Software Tools

MODULE – II **[10 Periods]**

Security of Cyber-Physical Systems

Introduction and Motivation, Basic Techniques - Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques: System Theoretic Approaches

MODULE – III **[10 Periods]**

Synchronization in Distributed Cyber-Physical Systems: Challenges in Cyber-Physical Systems, A Complexity-Reducing Technique for Synchronization, Formal Software Engineering, Distributed Consensus Algorithms, Synchronous Lockstep Executions, Time-Triggered Architecture, Related Technology, Advanced Techniques

MODULE – IV **[10 Periods]**

Real-Time Scheduling for Cyber-Physical Systems

Introduction and Motivation, Basic Techniques - Scheduling with Fixed Timing Parameters, Memory Effects, Multiprocessor/Multicore Scheduling, Accommodating Variability and Uncertainty

MODULE – V **[10 Periods]**

Model Integration in Cyber-Physical Systems

Introduction and Motivation, Causality, Semantic Domains for Time, Interaction Models for Computational Processes, Semantics of CPS DSMLs, Advanced Techniques, ForSpec, The Syntax ofCyPhyML, Formalization of Semantics, Formalization of Language Integration.

Course Outcomes: Upon the Successful Completion of the Course, the Students would be able to:

1. Understand the core principles behind CPS
2. Identify Security mechanisms of Cyber physical systems
3. Understand Synchronization in Distributed Cyber-Physical Systems

TEXT BOOKS:

1. Raj Rajkumar, Dionisio De Niz, and Mark Klein, Cyber-Physical Systems, Addison-WesleyProfessional.
2. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	
CO2	3	3	3	2	1	1
CO3	3	1	2		2	
CO4	2	2	1		2	
CO5	2				1	

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C5135	GRAPH ANALYTICS	L	T	P
Credits: 3	(OPEN ELECTIVE)	3	-	-

Prerequisites: Nil

Course Objectives:

1. To explore the concept of Graphs and related algorithms.
2. To learn new ways to model, store, retrieve and analyze graph-structured data.
3. To be aware of advanced concepts in graph analytic techniques and its applications.

MODULE – I **[10 Periods]**

Introduction and Application of Large-scale Graph: Characteristics, Complex Data Sources - Social Networks, Simulations, Bioinformatics; Categories- Social, Endorsement, Location, Co-occurrence graphs; Graph Data structures, Parallel, Multicore and Graph Algorithms

MODULE - II Algorithms: Search and Paths **[10 Periods]**

A Work-Efficient Parallel Breadth-First Search Algorithm (or How To Cope With the Nondeterminism ofReducers), Multi-Objective Shortest Paths

MODULE - III Algorithms: Structure **[10 Periods]**

Multicore Algorithms for Graph Connectivity Problems, Distributed Memory Parallel Algorithms for Massive Graphs, Massive-Scale Distributed Triangle Computation and Applications

MODULE - IV Models **[10 Periods]**

Recent Advances in Scalable Network Generation, Computational Models for Cascades in Massive Graphs, Executing Dynamic Data-Graph Computations Deterministically Using Chromatic Scheduling.

MODULE - V Frameworks and Software **[10 Periods]**

Graph Data Science Using Neo4j, A Cloud-Based Approach to Big Graphs, Interactive Graph Analyticsat Scale in Arkouda

Course Outcomes: Upon the Successful Completion of the Course, the Students would be able to:

1. Understand Large-scale Graph and its Characteristics
2. Analyze Breadth-First Search Algorithm
3. Illustrate Recent Advances in Scalable Network Generation

TEXT BOOKS:

1. David A. Bader, Massive Graph Analytics, CRC Press

REFERENCES:

1. Stanley Wasserman, Katherine Faust, "Social Network Analysis: Methods and Applications",(Structural Analysis in the Social Sciences), Cambridge University Press, 1995.
2. Matthew O. Jackson, "Social and Economic Networks", Princeton University Press, 2010.
3. Tanja Falkowski, "CommModuley Analysis in Dynamic Social Networks", (Dissertation), UniversityMagdeburg, 2009.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3		3	1
CO2	3	1	3	2	1	2
CO3	3	1	2		2	
CO4	3	2	1		2	
CO5	3		1			

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C51P1	TECHNICAL SEMINAR	L	T	P
Credits: 2		-	-	4

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C51P2	PROJECT /DISSERTATION PHASE - I	L	T	P
Credits: 8		-	-	16

2022-23 Onwards (MR-22)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech II Sem		
Code: C51P3	PROJECT /DISSERTATION PHASE - II	L	T	P
Credits: 16		-	-	32