TKR COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)
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M. Tech. COMPUTER SCIENCE AND ENGINEERING
ACADEMIC YEAR 2022 - 23
R22 COURSE STRUCTURE

I YEAR I – SEMESTER

Course Code	Course Title	L	T	P	Credits
D581PC1	Mathematical Foundations of Computer Science	3	0	0	3
D581PC2	Advanced Data Structures	3	0	0	3
D581PE1	1. Database Programming with PL/SQL 2. Deep Learning 3. Natural Language Processing	3	0	0	3
D581PC2	1. Applied Cryptography 2. Software Quality Engineering 3. Mining Massive Datasets	3	0	0	3
D581PCL1	Advanced Data Structures Lab	0	0	4	2
D581PEL1	Professional Elective - I Lab	0	0	4	2
	Research Methodology & IPR	2	0	0	2
D581PC1	Audit Course- I	2	0	0	0
	Total	**16**	**0**	**8**	**18**

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

I YEAR II – SEMESTER

Course Code	Course Title	L	T	P	Credits
D582PC3	Advanced Algorithms	3	0	0	3
D582PC4	Advanced Computer Architecture	3	0	0	3
D582PE3	1. Enterprise Cloud Concepts 2. Advanced Computer Networks 3. Edge Analytics	3	0	0	3
D582PE4	1. Bioinformatics 2. Nature Inspired Computing 3. Robotic Process Automation	3	0	0	3
D582PCL2	Advanced Algorithms Lab	0	0	4	2
D582PEL2	Professional Elective - III Lab	0	0	4	2
D582PW1	Mini Project with Seminar	0	0	4	2
D582PC2	Audit Course- II	2	0	0	0
	Total	**14**	**0**	**12**	**18**

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

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
ACADEMIC YEAR 2022 - 23
R22 COURSE STRUCTURE

II YEAR III – SEMESTER

Course Code	Course Title	L	T	P	Credits
D583PE5	1. Digital Forensics 2. High Performance Computing 3. Quantum Computing	3	0	0	3
D583OE1	Open Elective	3	0	0	3
D583PW2	Dissertation Work Review - II	0	0	12	6
	Total	**6**	**0**	**12**	**12**

II YEAR II - SEMESTER

Course Code	Course Title	L	T	P	Credits
D584PW3	Dissertation Work Review - III	0	0	12	6
D584PW4	Dissertation Viva-Voce	0	0	28	14
	Total	**0**	**0**	**40**	**20**

Note: For Dissertation Work Review - I, Please refer 7.10 in R19 Academic Regulations.

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

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE (PC-I)

M.Tech CSE I Year I Sem.   **L   T   P   C**
                                                                          3   0   0   3

Pre-requisites: An understanding of Math in general is sufficient.
Course Objectives: To learn
   1. Introduces the elementary discrete mathematics for computer science and engineering.
   2. Topics include formal logic notation, methods of proof, induction, sets, relations, graph theory, permutations and combinations, counting principles; recurrence relations and generatingfunctions.

Course Outcomes: After learning the contents of this paper the student must be able to
   1. Ability to understand and construct precise mathematical proofs.
   2. Ability to use logic and set theory to formulate precise statements.
   3. Ability to analyze and solve counting problems on finite and discrete structures.
   4. Ability to describe and manipulate sequences.
   5. Ability to apply graph theory in solving computing problems.

UNIT-I:
The Foundations Logic and Proofs: Propositional Logic, Applications of Propositional Logic, Propositional Equivalence, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy.

UNIT-II:
Basic Structures, Sets, Functions, Sequences, Sums, Matrices and Relations: Sets, Functions, Sequences & Summations, Cardinality of Sets and Matrices Relations, Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Partial Orderings.

UNIT-III:
Algorithms, Induction and Recursion: Algorithms, The Growth of Functions, Complexity of Algorithms. Induction and Recursion: Mathematical Induction, Strong Induction and Well-Ordering, RecursiveDefinitions and Structural Induction, Recursive Algorithms, Program Correctness.

UNIT-IV:
Discrete Probability and Advanced Counting Techniques:
An Introduction to Discrete Probability. Probability Theory, Bayes' Theorem, Expected Value and Variance. Advanced Counting Techniques:
Recurrence Relations, Solving Linear Recurrence Relations, Divide-and-Conquer Algorithms and Recurrence Relations, Generating Functions, Inclusion-Exclusion, Applications of Inclusion-Exclusion.

UNIT-V:
Graphs: Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring.
Trees: Introduction to Trees, Applications of Trees, Tree Traversal, Spanning Trees, Minimum Spanning Trees.

TEXT BOOKS:

1. Discrete Mathematical Structures with Applications to Computer Science: J.P. Tremblay, R. Manohar, McGraw-Hill, 1st ed.

2. Discrete Mathematics for Computer Scientists & Mathematicians: Joe l. Mott, Abraham Kandel,Teodore P. Baker, Prentis Hall of India, 2nd ed.

REFERENCES:

1. Discrete and Combinatorial Mathematics - an applied introduction: Ralph.P. Grimald, Pearsoneducation, 5th edition.
2. Discrete Mathematical Structures: Thomas Kosy, Tata McGraw Hill publishing co.

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
ADVANCED DATA STRUCTURES (PC-II)

M.Tech CSE I Year I Sem.	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Prerequisites: A course on "Data Structures"

Course Objectives
1. Introduces the heap data structures such as leftist trees, binomial heaps, Fibonacci and min-max heaps
2. Introduces a variety of data structures such as disjoint sets, hash tables, search structures and digital search structures

Course Outcomes
1. Ability to select the data structures that efficiently model the information in a problem
2. Ability to understand how the choice of data structures impact the performance of programs
3. Design programs using a variety of data structures, including hash tables, search structures and digital search structures

UNIT - I
Heap Structures
Introduction, Min-Max Heaps, Leftist trees, Binomial Heaps, Fibonacci heaps.

UNIT - II
Hashing and Collisions
Introduction, Hash Tables, Hash Functions, different Hash Functions: Division Method, Multiplication Method, Mid-Square Method, Folding Method, Collisions

UNIT - III
Search Structures: OBST, AVL trees, Red-Black trees, Splay trees,
Multiway Search Trees: B-trees, 2-3 trees

UNIT - IV
Digital Search Structures
Digital Search trees, Binary tries and Patricia, Multiway Tries, Suffix trees, Standard Tries, Compressed Tries

UNIT - V
Pattern matching
Introduction, Brute force, the Boyer –Moore algorithm, Knuth-Morris-Pratt algorithm, Naïve String,Harspool, Rabin Karp

TEXT BOOKS:
1. Fundamentals of data structures in C++ Sahni, Horowitz, Mehatha, Universities Press.
2. Introduction to Algorithms, TH Cormen, PHI

REFERENCES:
1. Design methods and analysis of Algorithms, SK Basu, PHI.
2. Data Structures & Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education.
3. Fundamentals of Computer Algorithms, 2nd Edition, Ellis Horowitz, Sartaj Sahni, SanguthevarRajasekaran, Universities Press.

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
DATABASE PROGRAMMING WITH PL/SQL (Professional Elective - I)

M.Tech CSE I Year I Sem.	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

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

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

UNIT - I
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.

UNIT - II
Language Fundamentals & Control Structures: Lexical Units, 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.

UNIT - III
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.

UNIT - IV
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.

UNIT - V
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.

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

M. Tech. COMPUTER SCIENCE AND ENGINEERING
DEEP LEARNING (Professional Elective - I)

M.Tech CSE I Year I Sem.

L	T	P	C
3	0	0	3

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.

Course Outcomes:
1. Implement deep learning algorithms, understand neural networks and traverse the layers of data
2. Learn topics such as convolutional neural networks, recurrent neural networks, training deep networks and high-level interfaces
3. Understand applications of Deep Learning to Computer Vision
4. Understand and analyze Applications of Deep Learning to NLP

UNIT - I
Introduction: Feed forward Neural networks, Gradient descent and the back propagation algorithm, Unit 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

UNIT - II
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

UNIT - III
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

UNIT - IV
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

UNIT - V
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

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.

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
NATURAL LANGUAGE PROCESSING (Professional Elective - I)

M.Tech CSE I Year I Sem.

L	T	P	C
3	0	0	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 and statistics.

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.

UNIT - I
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

UNIT - II
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.

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

UNIT - IV
Predicate-Argument Structure, Meaning Representation Systems, Software.

UNIT - V
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.

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, Pearson Publications

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
APPLIED CRYPTOGRAPHY (Professional Elective - II)

M.Tech CSE I Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives: Knowledge on significance of cryptographic protocols and symmetric and publickey algorithms

Course Outcomes:
1. Understand the various cryptographic protocols
2. Analyze key length and algorithm types and modes
3. Illustrate different public key algorithms in cryptosystems
4. Understand special algorithms for protocols and usage in the real world.

UNIT - I
Foundations: Terminology, Steganography, Substitution Ciphers and Transposition Ciphers, Simple XOR, One-Time Pads, Computer Algorithms, Large Numbers,
Cryptographic Protocols: Protocol Building Blocks: Introduction to Protocols, Communications Using Symmetric Cryptography, One-Way Functions, One-Way Hash Functions, Communications Using Public-Key Cryptography, Digital Signatures, Digital Signatures with Encryption, Random and Pseudo-Random-Sequence Generation

UNIT - II
Cryptographic Techniques: Key length: Symmetric Key length, Public key length, comparing symmetric and public key length.
Algorithm types and modes: Electronic Codebook Mode, Block Replay, Cipher Block Chaining Mode, Stream Cipher, Self-Synchronizing Stream Ciphers, Cipher-Feedback Mode, Synchronous Stream Ciphers, Output-Feedback Mod, Counter Mode, Other Block-Cipher Modes.

UNIT - III
Public-Key Algorithms: Background, Knapsack Algorithms, RSA, Pohlig-Hellman, Rabin, ElGamal, McEliece, Elliptic Curve Cryptosystems, LUC, Finite Automaton Public-Key Cryptosystems
Public-Key Digital Signature Algorithms: Digital Signature Algorithm (DSA), DSA Variants, Gost Digital Signature Algorithm, Discrete Logarithm Signature Schemes, Ong-Schnorr-Shamir, ESIGN

UNIT - IV
Special Algorithms for Protocols: Multiple-Key Public-Key Cryptography, Secret-Sharing Algorithms, Subliminal Channel, Undeniable Digital Signatures, Designated Confirmer Signatures, Computing with Encrypted Data, Fair Coin Flips, One-Way Accumulators, All-or-Nothing Disclosure of Secrets, Fair andFailsafe Cryptosystems, Zero-Knowledge Proofs of Knowledge, Blind Signatures, Oblivious Transfer, Secure Multiparty Computation, Probabilistic Encryption, Quantum Cryptography

UNIT - V
Real World Approaches: IBM Secret key management protocol, ISDN, Kerberos, KryptoKnight, Privacy enhanced mail (PEM), Message security protocol (MSP), PGP, Public-Key Cryptography Standards (PKCS), Universal Electronic Payment System (UEPS).

TEXT BOOKS:

1. Bruce Schneier, Applied Cryptography, Second Edition: Protocols, Algorithms, and SourceCode in C (cloth)

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M. Tech. COMPUTER SCIENCE AND ENGINEERING

SOFTWARE QUALITY ENGINEERING (Professional Elective - II)

M.Tech CSE I Year I Sem.	L	T	P	C
	3	0	0	3

Course Objectives: Knowledge on significance of Quality, quality assurance, quality engineering.

Course Outcomes:
1. Understand software quality and its perspectives
2. Analyze defect prevention and defect reduction in software quality assurance
3. Illustrate software quality engineering activities and its process

UNIT - I
Software Quality: Quality: perspectives and expectations, Quality frameworks and ISO-9126, correctness and defects: Definitions, properties and Measurements, A historical perspective of quality, software quality.

UNIT - II
Quality Assurance: Classification: QA as dealing with defects, Defect prevention- Education and training, Formal method, Other defect prevention techniques, Defect Reduction - Inspection: Direct faultdetection and removal, Testing: Failure observation and fault removal, other techniques and risk identification, Defect Containment- software fault tolerance, safety assurance and failure containment

UNIT - III
Quality Engineering: Activities and process, Quality planning: Goal setting and Strategy formation, Quality assessment and Improvement, Quality engineering in software process.

UNIT - IV
Test Activities, Management and Automation: Test planning and preparation, Test execution, Result checking and measurement, Analysis and follow- up, Activities People and Management, Test Automation.

UNIT - V
Coverage and usage testing based on checklist and partitions: Checklist based testing and its limitations, Testing for partition Coverage, Usage based Statistical testing with Musa's operational profiles, Constructing operational profiles
Case Study: OP for the cartridge Support Software

TEXT BOOKS:
1. Jeff Tia`n, Software Quality Engineering, Testing, Quality Assurance, and Quantifiableimprovement
2. Richard N. Taylor, Software Architecture: Foundations, Theory, and Practice

M. Tech. COMPUTER SCIENCE AND ENGINEERING

MINING MASSIVE DATASETS (Professional Elective - II)

M.Tech CSE I Year I Sem.   **L T P C**
                                                                          3 0 0 3

Prerequisites:
1. Students should be familiar with Data mining, algorithms, basic probability theory and Discrete math.

Course Objectives:
1. This course will cover practical algorithms for solving key problems in mining of massive datasets.
2. This course focuses on parallel algorithmic techniques that are used for large datasets.
3. This course will cover stream processing algorithms for data streams that arrive constantly, page ranking algorithms for web search, and online advertisement systems that are studied in detail.

Course Outcomes:
1. Handle massive data using MapReduce.
2. Develop and implement algorithms for massive data sets and methodologies in the context of data mining.
3. Understand the algorithms for extracting models and information from large datasets
4. Develop recommendation systems.
5. Gain experience in matching various algorithms for particular classes of problems.

UNIT - I:
Data Mining-Introduction-Definition of Data Mining-Statistical Limits on Data Mining,
MapReduce and the New Software Stack-Distributed File Systems, MapReduce, Algorithms Using MapReduce.

UNIT - II:
Similarity Search: Finding Similar Items**-**Applications of Near-Neighbor Search, Shingling of Documents, Similarity-Preserving Summaries of Sets, Distance Measures.
Streaming Data: Mining Data Streams-The Stream Data Model , Sampling Data in a Stream, Filtering Streams.

UNIT - III:
Link Analysis-PageRank, Efficient Computation of PageRank, Link Spam
Frequent Itemsets-Handling Larger Datasets in Main Memory, Limited-Pass Algorithms, Counting Frequent Items in a Stream.
Clustering-The CURE Algorithm, Clustering in Non-Euclidean Spaces, Clustering for Streams and Parallelism.

UNIT - IV:
Advertising on the Web-Issues in On-Line Advertising, On-Line Algorithms, The Matching Problem, The Adwords Problem, Adwords Implementation.
Recommendation Systems-A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering, Dimensionality Reduction, The NetFlix Challenge.

UNIT - V:
Mining Social-Network Graphs-Social Networks as Graphs, Clustering of Social-Network Graphs, Partitioning of Graphs, Simrank, Counting Triangles.

TEXT BOOK:
1. Jure Leskovec, Anand Rajaraman, Jeff Ullman, Mining of Massive Datasets, 3rd Edition.

REFERENCES:
1. Jiawei Han & Micheline Kamber , Data Mining – Concepts and Techniques 3rd Edition Elsevier.
2. Margaret H Dunham, Data Mining Introductory and Advanced topics, PEA.
3. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques,Morgan Kaufmann.

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
ADVANCED DATA STRUCTURES LAB (Lab - I)

M.Tech CSE I Year I Sem.   **L   T   P   C**
                                                               0   0   4   2

Prerequisites:
1. A course on Computer Programming & Data Structures

Course Objectives:
1. Introduces the basic concepts of Abstract Data Types.
2. Reviews basic data structures such as stacks and queues.
3. Introduces a variety of data structures such as hash tables, search trees, tries, heaps, graphs, and B-trees.
4. Introduces sorting and pattern matching algorithms.

Course Outcomes:
1. Ability to select the data structures that efficiently model the information in a problem.
2. Ability to assess efficiency trade-offs among different data structure implementations or combinations.
3. Implement and know the application of algorithms for sorting and pattern matching.
4. Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and B-trees.

List of Programs
1. Write a program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.

2. Write a program for implementing the following sorting methods:
   a) Merge sort b) Heap sort c) Quick sort

3. Write a program to perform the following operations:
   a) Insert an element into a B- tree.
   b) Delete an element from a B- tree.
   c) Search for a key element in a B- tree.

4. Write a program to perform the following operations:
   a) Insert an element into a Min-Max heap
   b) Delete an element from a Min-Max heap
   c) Search for a key element in a Min-Max heap

5. Write a program to perform the following operations:
   a) Insert an element into a Lefiist tree
   b) Delete an element from a Leftist tree
   c) Search for a key element in a Leftist tree

6. Write a program to perform the following operations:
   a) Insert an element into a binomial heap
   b) Delete an element from a binomial heap.
   c) Search for a key element in a binomial heap

7. Write a program to perform the following operations:
   a) Insert an element into a AVL tree.
   b) Delete an element from a AVL search tree.
   c) Search for a key element in a AVL search tree.

8. Write a program to perform the following operations:
   a) Insert an element into a Red-Black tree.
   b) Delete an element from a Red-Black tree.
   c) Search for a key element in a Red-Black tree.

9. Write a program to implement all the functions of a dictionary using hashing.

10. Write a program for implementing Knuth-Morris-Pratt pattern matching algorithm.

11. Write a program for implementing Brute Force pattern matching algorithm.

12. Write a program for implementing Boyer pattern matching algorithm.

TEXT BOOKS:
   1. Fundamentals of Data structures in C, E. Horowitz, S. Sahni and Susan Anderson Freed, 2nd Edition, Universities Press
   2. Data Structures Using C – A.S. Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/Pearson education.
   3. Introduction to Data Structures in C, Ashok Kamthane, 1st Edition, Pearson.

REFERENCES:
   1. The C Programming Language, B.W. Kernighan, Dennis M. Ritchie, PHI/Pearson Education
   2. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press
   3. Data structures: A Pseudocode Approach with C, R.F. Gilberg And B.A. Forouzan, 2nd Edition,Cengage Learning

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M. Tech. COMPUTER SCIENCE AND ENGINEERING

DATABASE PROGRAMMING WITH PL/SQL LAB (Lab - II)

M.Tech CSE I Year I Sem.

L	T	P	C
0	0	4	2

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

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

List of Experiments:
1. Write a Pl/SQL program using FOR loop to insert ten rows into a database table.
2. Given the table EMPLOYEE (EmpNo, Name, Salary, Designation, DeptID), write a cursor toselect the five highest paid employees from the table.
3. Illustrate how you can embed PL/SQL in a high-level host language such as C/Java And demonstrates how a banking debit transaction might be done.
4. Given an integer i, write a PL/SQL procedure to insert the tuple (i, 'xxx') into a given relation.
5. Write a PL/SQL program to demonstrate Exceptions.
6. Write a PL/SQL program to demonstrate Cursors.
7. Write a PL/SQL program to demonstrate Functions.
8. Write a PL/SQL program to demonstrate Packages.
9. Write PL/SQL queries to create Procedures.
10. Write PL/SQL queries to create Triggers.

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M. Tech. COMPUTER SCIENCE AND ENGINEERING

DEEP LEARNING LAB (Lab - II)

M.Tech CSE I Year I Sem.

L	T	P	C
0	0	4	2

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.

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.

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.

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/

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
NATURAL LANGUAGE PROCESSING LAB (Lab - II)

M.Tech CSE I Year I Sem.   **L   T   P   C**

                                                                          0   0   4   2

Prerequisites: Data structures, finite automata and probability theory

Course Objectives:
1. To Develop and explore the problems and solutions of NLP.

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

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

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, Pearson Publications.

M. Tech. COMPUTER SCIENCE AND ENGINEERING
RESEARCH METHODOLOGY & IPR

M.Tech CSE I Year I Sem.   **L   T   P   C**
                                                                     2   0   0   2

Prerequisite: None

Course Objectives:
1. To understand the research problem
2. To know the literature studies, plagiarism and ethics
3. To get the knowledge about technical writing
4. To analyze the nature of intellectual property rights and new developments
5. To know the patent rights

Course Outcomes: At the end of this course, students will be able to
1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrowworld will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I:
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.

UNIT - II:
Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT - III:
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT - IV:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - V:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information
and databases. Geographical Indications. 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.

TEXT BOOKS:
1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science &engineering students"
2. C.R. Kothari, Research Methodology, methods & techniques, 2nd edition, New age International publishers

REFERENCES:
1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New TechnologicalAge", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
ADVANCED ALGORITHMS (PC - III)

M.Tech CSE I Year II Sem.

L	T	P	C
3	0	0	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 advanced algorithmic 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.

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.

UNIT – I
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.

UNIT – II
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.

UNIT - III
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, inverseof a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

UNIT - IV
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.

UNIT - V
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 applying recently proposed data structures.

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".

M. Tech. COMPUTER SCIENCE AND ENGINEERING

ADVANCED COMPUTER ARCHITECTURE (PC - III)

M.Tech CSE I Year II Sem.	**L**	**T**	**P**	**C**
	3	**0**	**0**	**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 to design modern computer systems

Course Outcomes: Gain knowledge of
1. Computational models and Computer Architectures.
2. Concepts of parallel computer models.
3. Scalable Architectures, Pipelining, Superscalar processors

UNIT - I

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

UNIT - II

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

UNIT - III

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.

UNIT - IV

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.

UNIT - V

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

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.

M. Tech. COMPUTER SCIENCE AND ENGINEERING

ENTERPRISE CLOUD CONCEPTS (Professional Elective - III)

M.Tech CSE I Year II Sem.	L	T	P	C
	3	0	0	3

Course Objectives: Knowledge on significance of cloud computing and its fundamental concepts and models.

Course Outcomes:
1. Understand importance of cloud architecture
2. Illustrating the fundamental concepts of cloud security
3. Analyze various cloud computing mechanisms
4. Understanding the architecture and working of cloud computing.

UNIT - I

Understanding Cloud Computing: Origins and influences, Basic Concepts and Terminology, Goals and Benefits, Risks and Challenges.

Fundamental Concepts and Models: Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models.

UNIT - II

Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology.

Cloud Computing Mechanisms:

Cloud Infrastructure Mechanisms: Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Resource Replication.

UNIT - III

Cloud Management Mechanisms: Remote Administration System, Resource Management System, SLA Management System, Billing Management System, Case Study Example

Cloud Computing Architecture

Fundamental Cloud Architectures: Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, RedundantStorage Architecture, Case Study Example

UNIT - IV

Cloud-Enabled Smart Enterprises: Introduction, Revisiting the Enterprise Journey, Service-OrientedEnterprises, Cloud Enterprises, Smart Enterprises, The Enabling Mechanisms of Smart Enterprises **Cloud-Inspired Enterprise Transformations:** Introduction, The Cloud Scheme for EnterpriseSuccess, Elucidating the Evolving Cloud Idea, Implications of the Cloud on Enterprise Strategy,Establishing a Cloud-Incorporated Business Strategy

UNIT - V

Transitioning to Cloud-Centric Enterprises: The Tuning Methodology, Contract Management in theCloud

Cloud-Instigated IT Transformations

Introduction, Explaining Cloud Infrastructures, A Briefing on Next-Generation Services, Service Infrastructures, Cloud Infrastructures, Cloud Infrastructure Solutions, Clouds for Business Continuity, The Relevance of Private Clouds, The Emergence of Enterprise Clouds

TEXT BOOKS:

1. Erl Thomas, Puttini Ricardo, Mahmood Zaigham, Cloud Computing: Concepts, Technology &Architecture 1st Edition,
2. Pethuru Raj, Cloud Enterprise Architecture, CRC Press

REFERENCES:

1. James Bond,The Enterprise Cloud, O'Reilly Media, Inc.

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M. Tech. COMPUTER SCIENCE AND ENGINEERING

ADVANCED COMPUTER NETWORKS (Professional Elective - III)

M.Tech CSE I Year II Sem.	L	T	P	C
	3	0	0	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.

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.

UNIT - I

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.

UNIT - II

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,

UNIT- III

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.

UNIT - IV

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

UNIT - V

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

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.

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M. Tech. COMPUTER SCIENCE AND ENGINEERING

EDGE ANALYTICS (Professional Elective - III)

M.Tech CSE I Year II Sem.	L	T	P	C
	3	0	0	3

Prerequisites
- A basic knowledge of "Python Programming"

Course Objectives
1. The aim of the course is to introduce the fundamentals of Edge Analytics.
2. The course gives an overview of – Architectures, Components, Communication Protocols and tools used for Edge Analytics.

Course Outcomes
1. Understand the concepts of Edge Analytics, both in theory and in practical application.
2. Demonstrate a comprehensive understanding of different tools used at edge analytics.
3. Formulate, Design and Implement the solutions for real world edge analytics .

UNIT - I
Introduction to Edge Analytics
What is edge analytics, Applying and comparing architectures, Key benefits of edge analytics, Edge analytics architectures, Using edge analytics in the real world.

UNIT - II
Basic edge analytics components, Connecting a sensor to the ESP-12F microcontroller, KOM-MICS smart factory platform, Communications protocols used in edge analytics, Wi-Fi communication for edge analytics, Bluetooth for edge analytics communication, Cellular technologies for edge analytics communication, Long-distance communication using LoRa and Signfox for edge analytics.

UNIT - III
Working with Microsoft Azure IoT Hub, Cloud Service providers, Microsoft Azure, Exploring the Azure portal, Azure ioT Hub, Using the Raspberry Pi with Azure IoT edge, Connecting our Raspberry Pi edgedevice, adding a simulated temperature sensor to our edge device.

UNIT - IV
Using Micropython for Edge Analytics, Understanding Micropython, Exploring the hardware that runs MicroPython, Using MicroPython for an edge analytics application, Using edge intelligence with microcontrollers, Azure Machine Learning designer, Azure IoT edge custom vision.

UNIT - V
Designing a Smart Doorbell with Visual Recognition setting up the environment, Writing the edge code, creating the Node-RED dashboard, Types of attacks against our edge analytics applications, Protectingour edge analytics applications

TEXT BOOK:
1. Hands-On Edge Analytics with Azure IoT: Design and develop IoT applications with edge analytical solutions including Azure IoT Edge by Colin Dow

REFERENCES:
1. Learn Edge Analytics - Fundamentals of Edge Analytics: Automated analytics at source using Microsoft Azure by Ashish Mahajan

M. Tech. COMPUTER SCIENCE AND ENGINEERING

BIOINFORMATICS (Professional Elective - IV)

M.Tech CSE I Year II Sem.   **L   T   P   C**
                                                                                                  3   0   0   3

Course Objectives: Knowledge on concepts of bioinformatics and biological motivations of sequence analysis

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

UNIT -I:
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.

UNIT -II:
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.

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

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

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

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

M. Tech. COMPUTER SCIENCE AND ENGINEERING
NATURE INSPIRED COMPUTING (Professional Elective - IV)

M.Tech CSE I Year II Sem.   L T P C
                                                                            3 0 0 3

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

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.

UNIT - I:
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.

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

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

UNIT - IV:
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.

UNIT - V:
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.

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, Algorithms and 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

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M. Tech. COMPUTER SCIENCE AND ENGINEERING

ROBOTIC PROCESS AUTOMATION (Professional Elective - IV)

M.Tech CSE I Year II Sem.

	L	T	P	C
	3	0	0	3

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

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

UNIT - I

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

UNIT - II

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)

UNIT - III

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.

UNIT - IV

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

UNIT - V

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

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.

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M. Tech. COMPUTER SCIENCE AND ENGINEERING

ADVANCED ALGORITHMS LAB (Lab - III)

M.Tech CSE I Year II Sem.	**L**	**T**	**P**	**C**
	0	**0**	**4**	**2**

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

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

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.

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M. Tech. COMPUTER SCIENCE AND ENGINEERING

ENTERPRISE CLOUD CONCEPTS LAB (Professional Elective - III Lab)

M.Tech CSE I Year II Sem.

L	T	P	C
0	0	4	2

Course Objectives: Knowledge on significance of cloud computing and its fundamental concepts and models.

Course Outcomes:
1. Understand importance of cloud architecture
2. Illustrating the fundamental concepts of cloud security
3. Analyze various cloud computing mechanisms
4. Understanding the architecture and working of cloud computing.

List of Experiments:
1. Install Virtualbox/VMware Workstation with different flavors of linux or windows OS on top ofwindows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute SimplePrograms
3. Install Google App Engine. Create a hello world app and other simple web applications usingpython/java..
4. Find a procedure to transfer the files from one virtual machine to another virtual machine.
5. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
6. Install Hadoop single node cluster and run simple applications like word count.

E-Resources:

1. https://www.iitk.ac.in/nt/faq/vbox.htm

2.https://www.google.com/urlsa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjqrNG0za73Ah

XZt1YBHZ21DWEQFnoECAMQAQ&url=http%3A%2F%2Fwww.cs.columbia.edu%2F~sedwards%2F classes%2F2015%2F1102-fall%2Flinuxvm.pdf&usg=AOvVaw3xZPuF5xVgk-AQnBRsTtHz

3. https://www.cloudsimtutorials.online/cloudsim/

4.https://edwardsamuel.wordpress.com/2014/10/25/tutorial-creating-openstack-instance-in-trystack/

5. https://www.edureka.co/blog/install-hadoop-single-node-hadoop-cluster

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M. Tech. COMPUTER SCIENCE AND ENGINEERING

ADVANCED COMPUTER NETWORKS LAB (Professional Elective - III Lab)

M.Tech CSE I Year II Sem.

L	T	P	C
0	0	4	2

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

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

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.

M. Tech. COMPUTER SCIENCE AND ENGINEERING

EDGE ANALYTICS LAB (Professional Elective - III Lab)

M.Tech CSE I Year II Sem.
          L   T   P C
          0   0   4 2

Course Objectives:
1. Understand the concept of edge computing
2. Understand the Edge computing Architecture
3. Implement the edge computing in IOT
4. Understand the concept of multi-access edge computing
5. Implement edge computing in MEC

Course Outcomes:
1. Identify the benefits of edge computing
2. Develop the microservices in iofog
3. Develop user defined services in the edge
4. Create use cases in IOT with edge computing
5. Develop services in MEC
6. Implement use cases in MEC

List of Experiments:

1. Set up the Arduino IDE for ESP8266-12 module and program it to blink a LED light.

2. Installation tools to create and manage ECN's

3. Deploy micro services and writing your own microservices

4. Setup the Communication Parameters

5. Implement any two Communications protocols

6. Deploy modules to a Windows IoT Edge device

7. Create an IoT hub.

8. Register an IoT Edge device to your IoT hub.

9. Install and start the IoT Edge for Linux on Windows runtime on your device.

10. Remotely deploy a module to an IoT Edge device and send telemetry.

11. Python based basic programs using Raspberry Pi.

12. Deploy a module Manage your Azure IoT Edge device from the cloud to deploy a module thatsends telemetry data to IoT Hub.

13. Publishing Data using HTTP.

14. Sensor Interfacing and Logging using MQTT.

15. File IO Example - # Example code to demonstrate writing and reading data to/from files

16. write code to turn on one of the LEDs on the board (Breadboard)

Additional Exercises on IOT Edge Analytics Applications

17. Temperature Logger

18. Home Automation

TEXT BOOKS:
1. Hands-On Edge Analytics with Azure IoT: Design and develop IoT applications with edgeanalytical solutions including Azure IoT Edge by Colin Dow
2. MicroPython for the Internet of Things A Beginner's Guide to Programming with Python onMicrocontroller, Charles Bell, A Press.

REFERENCE BOOKS:
1. Learn Edge Analytics - Fundamentals of Edge Analytics: Automated analytics at source using Microsoft Azure by Ashish Mahajan
2. Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications usingRaspberry Pi 3", First Edition, Packt Publishing, 2018
3. John C. Shovic, "Raspberry Pi IoT Projects: Prototyping Experiments for Makers", PacktPublishing, 2016
4. Python for Microcontrollers: Getting Started with MicroPython Paperback – 16 December 2016,by Donald Norris, McGraw-Hill Education TAB
5. Programming with MicroPython: Embedded Programming with Microcontrollers and Python, byNicholas H. Tollervey, OReilly
6. R. Buyya, S.N. Srirama (2019), Fog and Edge Computing: Principles and Paradigms, Wiley-Blackwell, 2019.

M. Tech. COMPUTER SCIENCE AND ENGINEERING

DIGITAL FORENSICS (Professional Elective - V)

M.Tech CSE II Year I Sem.	**L**	**T**	**P**	**C**
	3	**0**	**0**	**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 and prevent 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

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.

UNIT - I
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

UNIT - II
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.

UNIT - III
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.

UNIT - IV
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.

UNIT - V
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

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, andsecuring 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.

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
HIGH PERFORMANCE COMPUTING (Professional Elective - V)

M.Tech CSE II Year I Sem.

L	T	P	C
3	0	0	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

Course Outcomes:
1. Understanding the concepts in grid computing
2. Ability to set up cluster and run parallel applications
3. Ability to understand the cluster projects and cluster OS
4. Understanding the concepts of pervasive computing & quantum computing.

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

UNIT - II
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.

UNIT - III
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.

UNIT - IV
Pervasive Computing Concepts & Scenarios: Hardware & Software; Human – Machine Interface.
Device Connectivity: Java For Pervasive Devices; Application Examples.

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

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

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
QUANTUM COMPUTING (Professional Elective - V)

M.Tech CSE II Year I Sem.   **L   T   P   C**
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Course Objectives:
1. To introduce the fundamentals of quantum computing
2. The problem-solving approach using finite dimensional mathematics

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

UNIT - I
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 Numbers Graphically, Vector Representations of Complex Numbers, Pauli Matrice, Transcendental Numbers.

UNIT - II
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.

UNIT - III
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.

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

UNIT - V
Current Asymmetric Algorithms: RSA, Diffie-Hellman, Elliptic Curve
The Impact of Quantum Computing on Cryptography: Asymmetric Cryptography, Specific Algorithms, Specific Applications

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

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M. Tech. COMPUTER SCIENCE AND ENGINEERING

IPR (Open Elective)

M.Tech CSE II Year I Sem.	L	T	P	C
	3	0	0	3

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

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

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

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

UNIT - III
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

UNIT - IV
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.

UNIT - V
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.

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.

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
FAULT TOLERANCE SYSTEMS (Open Elective)

M.Tech CSE II Year I Sem.

L	T	P	C
3	0	0	3

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 designof 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.

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 of fault tolerant digital systems.
2. Be familiar with making system fault tolerant, modeling and testing, and benchmarking toevaluate and compare systems.

UNIT - I
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.

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

UNIT - III
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.

UNIT - IV
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.

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

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.

M. Tech. COMPUTER SCIENCE AND ENGINEERING
INTRUSION DETECTION SYSTEMS (Open Elective)

M.Tech CSE II Year I Sem.   **L   T   P   C**
                                                       3   0   0   3

Prerequisites: Computer Networks, Computer Programming

Course Objectives:
1. Compare alternative tools and approaches for Intrusion Detection through quantitative analysis to 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.

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 and Mobile Computing.
4. Have the knowledge needed to practice safer computing and safeguard your information using Digital Forensics.
5. Understand basic technical controls in use today, such as firewalls and Intrusion Detection systems.
6. Understand legal perspectives of Cyber Crimes and Cyber Security.

UNIT - I
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

UNIT - II
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/sop Hesitated groups-Automated: Drones, Worms, Viruses

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

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

UNIT - V
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

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

M. Tech. COMPUTER SCIENCE AND ENGINEERING
DIGITAL FORENSICS (Open Elective)

M.Tech CSE II Year I Sem.

L	T	P	C
3	0	0	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 and prevent 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

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.

UNIT - I
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

UNIT - II
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.

UNIT - III
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 benotified of a crime, parts of gathering evidence, Define and apply probable cause.

UNIT - IV
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.

UNIT - V
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

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, andsecuring 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.

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
OPTIMIZATION TECHNIQUES (Open Elective)

M.Tech CSE II Year I Sem.	L	T	P	C
	3	0	0	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 projectimplementation.

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 dynamic programming.
5. Formulate optimization problems.

UNIT - I
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.

UNIT - II
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.

UNIT - III
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.

UNIT - IV
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.

UNIT - 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.

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

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
CYBER PHYSICAL SYSTEMS (Open Elective)

M.Tech CSE II Year I Sem.

L	T	P	C
3	0	0	3

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

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

UNIT - I
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

UNIT - II
Security of Cyber-Physical Systems
Introduction and Motivation, Basic Techniques - Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques: System Theoretic Approaches

UNIT - III
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

UNIT - IV
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

UNIT - V
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 of CyPhyML, Formalization of Semantics, Formalization of Language Integration.

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

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M. Tech. COMPUTER SCIENCE AND ENGINEERING
GRAPH ANALYTICS (Open Elective)

M.Tech CSE II Year I Sem.	L	T	P	C
	3	0	0	3

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.

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

UNIT - I
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

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

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

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

UNIT - V Frameworks and Software
Graph Data Science Using Neo4j, A Cloud-Based Approach to Big Graphs, Interactive Graph Analyticsat Scale in Arkouda

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, "Community Analysis in Dynamic Social Networks", (Dissertation), UniversityMagdeburg, 2009.