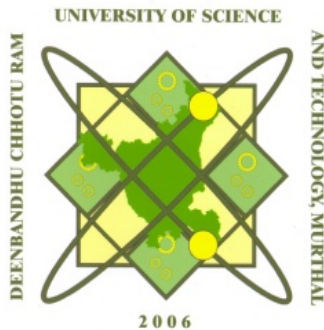# SCHEME OF STUDIES & EXAMINATION

AND

SYLLABUS

FOR

THE DEGREE

OF

MASTER OF TECHNOLOGY

(2 Years Post Graduate Programme)

IN

COMPUTER SCIENCE AND ENGINEERING

(w.e.f. Session 2018-19)

Faculty of Information Technology & Computer Science

Deenbandhu Chhotu Ram University of Science & Technology
Murthal (Sonepat)-131039, Haryana, India
June 2018

M. Tech. 1ˢᵗ semester to 4ᵗʰ semester CSE: Approved in 15ᵗʰ meeting of Academic Council held on 14.08.2020.
applicable to all students admitted in 2019-20 & onwards and trailing students.

1

Program Outcomes of CSE (M.Tech.) program:

The main outcomes of the CSE (M.Tech.) program are given here. At the end of the program a student is expected to have:

1. An understanding of the theoretical foundations and the limits of computing.
2. An ability to adapt existing models, techniques, algorithms, data structures, etc. for efficiently solving problems.
3. An ability to design, develop and evaluate new computer based systems for novel applications which meet the desired needs of industry and society.
4. Understanding and ability to use advanced computing techniques and tools.
5. An ability to undertake original research at the cutting edge of computer science & its related areas.
6. An ability to function effectively individually or as a part of a team to accomplish a stated goal.
7. An understanding of professional and ethical responsibility.
8. An ability to communicate effectively with a wide range of audience.
9. An ability to learn independently and engage in life-long learning.
10. An understanding of the impact of IT related solutions in an economic, social and environment context.

M. Tech. 1ˢᵗ semester to 4ᵗʰ semester CSE: Approved in 15ᵗʰ meeting of Academic Council held on 14.08.2020. applicable to all students admitted in 2019-20 & onwards and trailing students.

2

Deenbandhu Chhotu Ram University of Science & Technology, Murthal (Sonepat)
SCHEME OF STUDIES & EXAMINATIONS
M.TECH. 1ST Year 1st Semester (Computer Science & Engineering)
Choice Based Credit System Scheme w.e.f. 2018-19

S. No.	Course No.	Course Title	Teaching Schedule		Marks of Class Work	Examination Marks		Total	Credits	Exam Duration
			L	P		Theory	Practical			
1	MTCSE501C	Mathematical foundations of Computer Science	3	-	25	75	-	100	3	3
2	MTCSE503C	Advanced Data Structures	3	-	25	75	-	100	3	3
3		Program Elective I	3	-	25	75	-	100	3	3
4		Program Elective II	3	-	25	75	-	100	3	3
5	MTCSE505C	Research Methodology & IPR	2	-	25	75	-	100	2	3
6		Audit Course 1	2	-	25	75	-	100	0	3
7	MTCSE511C	Advanced Data Structures lab	-	4	25	-	75	100	2	3
8		Elective I Lab	-	4	25	-	75	100	2	3
		Total	16	8	200	450	150	800	18	

Elective I		Elective II	
MTCSE521C	Machine Learning	MTCSE541C	Data Science
MTCSE523C	Wireless Sensor Networks	MTCSE543C	Distributed Systems
MTCSE525C	Introduction to Intelligent Systems	MTCSE545C	Advanced Wireless and Mobile Networks
MTCSE527C	Digital Image Analysis	MTCSE547C	Emulation and Simulation Methodologies
MTCSE529C	Steganography and Digital Watermarking	MTCSE549C	Biometrics
Elective I Lab			
MTCSE561C	Machine Learning Lab	MTCSE563C	Wireless Sensor Networks Lab
MTCSE565C	Intelligent Systems Lab	MTCSE567C	Digital Image Analysis Lab
MTCSE569C	Steganography and Digital Watermarking Lab		
Audit Course 1			
AUD 531C	English for Research Paper Writing	AUD 539C	Constitution of India
AUD533C	Disaster Management	AUD 541C	Pedagogical Studies
AUD535C	Sanskrit for Technical Knowledge	AUD543C	Stress Management by Yoga
AUD537C	Value Education	AUD 545C	Personality Development through Life Enlightenment Skills

M. Tech. 1st semester to 4th semester CSE: Approved in 15th meeting of Academic Council held on 14.08.2020. applicable to all students admitted in 2019-20 & onwards and trailing students.

Deenbandhu Chhotu Ram University of Science & Technology, Murthal(Sonepat)
SCHEME OF STUDIES & EXAMINATIONS
M.TECH. 1ST Year 2nd Semester (Computer Science & Engineering)
Choice Based Credit System Scheme w.e.f. 2018-19

S. No.	Course No.	Course Title	Teaching Schedule		Marks of Class Work	Examination Marks		Total	Credits	Exam Duration
			L	P		Theory	Practical			
1	MTCSE502C	Advanced Algorithms	3	-	25	75	-	100	3	3
2	MTCSE504C	Soft Computing	3	-	25	75	-	100	3	3
3		Program Elective III	3	-	25	75	-	100	3	3
4		Program Elective IV	3	-	25	75	-	100	3	3
5		Audit Course 2	2	-	25	75	-	100	0	3
6	MTCSE512C	Soft Computing Lab	-	4	25	-	75	100	2	3
7		Elective III Lab	-	4	25	-	75	100	2	3
8	MTCSE514C	Mini Project	-	4	25	-	75	100	2	-
Total			14	12	200	375	225	800	18	

Elective III	
MTCSE522C	Data Preparation and Analysis
MTCSE524C	Secure Software Design & Enterprise Computing
MTCSE526C	Computer Vision
MTCSE528C	Sensor Networks and IoT
MTCSE530C	Cloud Computing

Elective IV	
MTCSE542C	GPU Computing
MTCSE544C	Human and Computer Interaction
MTCSE546C	Architecture of High Performance Computer Systems
MTCSE548C	Network Security

Elective III Lab			
MTCSE562C	Data Preparation and Analysis Lab	MTCSE564C	Secure Software Design & Enterprise Computing Lab
MTCSE566C	Computer Vision Lab	MTCSE568C	Sensor Networks and IoT Lab
MTCSE570C	Cloud Computing Lab		
Audit Course 2			
AUD 531C	English for Research Paper Writing	AUD 539C	Constitution of India
AUD533C	Disaster Management	AUD 541C	Pedagogical Studies
AUD535C	Sanskrit for Technical Knowledge	AUD543C	Stress Management by Yoga
AUD537C	Value Education	AUD 545C	Personality Development through Life Enlightenment Skills

M. Tech. 1st semester to 4th semester CSE: Approved in 15th meeting of Academic Council held on 14.08.2020. applicable to all students admitted in 2019-20 & onwards and trailing students.

Deenbandhu Chhotu Ram University of Science & Technology, Murthal(Sonepat)
SCHEME OF STUDIES & EXAMINATIONS
M.TECH. 2nd Year 3rd Semester (Computer Science & Engineering)
Choice Based Credit System Scheme w.e.f. 2019-20

S. No.	Course No.	Course Title	Teaching Schedule		Marks of Class Work	Examination Marks		Total	Credits	Exam Duration
			L	P		Theory	Practical			
1		Program Elective 5	3	-	25	75	-	100	3	3
2		Open Elective	3	-	25	75	-	100	3	3
3	MTCSE621C	Dissertation-I /Industrial Project	0	20	50	-	100	150	10	-
	Total		06	20	100	150	100	350	16	

Students going for Industrial Project/Thesis in III sem. will complete these courses through MOOCs.

Elective V	
MTCSE601C	Mobile Applications and Services
MTCSE603C	Compiler for HPC
MTCSE605C	Optimization Techniques
MTCSE607C	Digital Forensics

Open Electives		
Business Analytics		Cost Management of Engineering Projects
Industrial Safety		Composite Materials
Operations Research		Waste to Energy

Deenbandhu Chhotu Ram University of Science & Technology, Murthal(Sonepat)
SCHEME OF STUDIES & EXAMINATIONS
M.TECH. 2nd Year 4th Semester (Computer Science & Engineering)
Choice Based Credit System Scheme w.e.f. 2019-20

S. No.	Course No.	Course Title	Teaching Schedule		Marks of Class Work	Examination Marks		Total	Credits	Exam Duration
			L	P		Theory	Practical			
1	MTCSE602C	Dissertation-II	0	32	100	-	200	300	16	-
	Total		0	32	100	0	200	300	16	

M. Tech. 1st semester to 4th semester CSE: Approved in 15th meeting of Academic Council held on 14.08.2020. applicable to all students admitted in 2019-20 & onwards and trailing students.

Syllabus, course objective and course outcomes for M.Tech. (CSE)

MTCSE501C: MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE			
M.Tech. Semester-I (Computer Science and Engineering)			
Pre-Requisites	Discrete Mathematics	Class Work	25 Marks
Lectures	03	Examination	75 Marks
Practical	-	Total	100 Marks
Credits	03	Duration of Exam	03 Hrs.

COURSE OBJECTIVE

- To understand the mathematical fundamentals that are prerequisites for a variety of courses like Data mining, Computer Networks, Computer security etc.
- To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.
- To study various sampling and classification problems.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains	10
Unit 2 Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood,	9
Unit 3 Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment.	10
Unit 4 Graph Theory: Isomorphism, Planar Graphs, Graph colouring, Hamilton circuits and Euler cycles. Permutations and combinations with and without repetition.	11

COURSE OUTCOMES

After completion of course, students would be able to:

- To understand the basic notions of discrete and continuous probability.
- To understand the methods of statistical inference, and the role that sampling distributions play in those methods.
- To be able to perform correct and meaningful statistical analyses of simple to moderate complexity.

References:

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE503C: ADVANCED DATA STRUCTURES			
M.Tech. Semester-I (Computer Science and Engineering)			
Pre-Requisites	Data Structures (UG level)	Class Work	25 Marks
Lectures	03	Examination	75 Marks
Practical	-	Total	100 Marks
Credits	03	Duration of Exam	03 Hrs.

COURSE OBJECTIVE

- The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- Students should be able to understand the necessary mathematical abstraction to solve problems.
- To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
- Student should be able to come up with analysis of efficiency and proofs of correctness.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.	10
Unit 2 Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem	11
Unit 3 Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees	9
Unit 4 Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad-trees, k-D Trees.	10

COURSE OUTCOMES

After completion of course, students would be able to:

1. Understand the implementation of symbol table using hashing techniques.
2. Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
3. Develop algorithms for text processing applications.
4. Identify suitable data structures and develop algorithms for computational geometry problems.

References:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE521C: MACHINE LEARNING			
M.Tech. Semester-I (Computer Science and Engineering)			
Pre-Requisites	-	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
- To 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.
- To explore Deep learning technique and various feature extraction strategies.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 Supervised Learning: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes, Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	10
Unit 2 Unsupervised Learning: 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)	10
Unit 3 Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests), Introduction to scalable machine learning, Recent trends in various learning techniques of machine learning.	11
Unit 4 Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning	9

COURSE OUTCOMES

After completion of course, students would be able to:

- Extract features that can be used for a particular machine learning approach in various IOT applications.
- To 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.
- To mathematically analyse various machine learning approaches and paradigms.

References:

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.

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE523C: WIRELESS SENSOR NETWORKS			
M.Tech. Semester-I (Computer Science and Engineering)			
Pre-Requisites	Computer Networks	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- Architect sensor networks for various application setups.
- Devise appropriate data dissemination protocols and model links cost.
- Understanding of the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.
- Evaluate the performance of sensor networks and identify bottlenecks.

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Introduction to Wireless Sensor Networks: Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture, Hardware Platforms: Motes, Hardware parameters Recent development in WSN standards	11
Unit 2 Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled; Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis ; MAC Protocol Analysis: Asynchronous duty-cycled. X-MAC Analysis (Markov Chain)	11
Unit 3 **Security**: Possible attacks, countermeasures, SPINS, Static and dynamic key Distribution	8
Unit 4 Routing protocols: Introduction, MANET protocols; Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast Opportunistic Routing Analysis: Analysis of opportunistic routing (Markov Chain) Advanced topics in wireless sensor networks.	10

COURSE OUTCOMES

After completion of course, students would be able to:

- Describe and explain radio standards and communication protocols for wireless sensor networks.
- Explain the function of the node architecture and use of sensors for various applications.
- Be familiar with architectures, functions and performance of wireless sensor networks systems and platforms.

References:

1. W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks –Theory and Practice", Wiley 2010.
2. KazemSohraby, Daniel Minoli and TaiebZnati, "wireless sensor networks -Technology, Protocols, and Applications", Wiley Interscience 2007.
3. Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, "Wireless Sensor Network Technologies for the Information Explosion Era", springer 2010.

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE525C: INTRODUCTION TO INTELLIGENT SYSTEMS			
M.Tech. Semester-I (Computer Science and Engineering)			
Pre-Requisites	Data Structures and Data Management	Class Work	25 Marks
Lectures	03	Examination	75 Marks
Practical	-	Total	100 Marks
Credits	03	Duration of Exam	03 Hrs.

COURSE OBJECTIVE

- 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.

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Biological foundations to intelligent systems I: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks. Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks, Recent trends in Fuzzy logic	11
Unit 2 Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill-climbing search. Optimization and search such as stochastic annealing and genetic algorithm.	10
Unit 3 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, Knowledge Representation	10
Unit 4 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.	9

COURSE OUTCOMES

After completion of course, students would be:

- Able to demonstrate knowledge of the fundamental principles of intelligent systems and would be able to analyze and compare the relative merits of a variety of AI problem solving techniques.

References:

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.

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE527C: DIGITAL IMAGE ANALYSIS			
M.Tech. Semester-I (Computer Science and Engineering)			
Pre-Requisites	Basic Electronics	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To study the image enhancement techniques
- To study image restoration procedures.
- To study the image compression procedures.

LECTURE WITH BREAKUP	NO. OF LECT.
UNIT 1 Fundamentals of Image Analysis: Introduction – Steps in Image Processing Systems – Image Acquisition – Sampling and Quantization – Pixel Relationships – Colour Fundamentals and Models, File Formats, Image operations – Arithmetic, Geometric and Morphological.	10
UNIT 2 Image Enhancement: Spatial Domain Grey level Transformations Histogram Processing, Spatial Filtering: Smoothing and Sharpening. Filtering in Frequency Domain: DFT, FFT, DCT, Smoothing and Sharpening filters, Homomorphic Filtering.	9
UNIT 3 Image Segmentation And Feature Analysis: Detection of Discontinuities, Edge Operators, Edge Linking and Boundary Detection, Thresholding, Region Based Segmentation, Morphological Water Sheds, Motion Segmentation, Feature Analysis and Extraction. Multi Resolution Analysis: Image Pyramids, Multi resolution expansion, Wavelet Transforms. Image Compression: Fundamentals, Models, Elements of Information Theory, Error Free Compression, Lossy Compression, Compression Standards.	11
UNIT 4 Applications of Image Processing: Image Classification, Image Recognition, Image Understanding, Video Motion Analysis, Image Fusion, Steganography, Digital Composting, Mosaics, Colour Image Processing.	10

COURSE OUTCOMES

After completion of course, students would be:

- Able to review the fundamental concepts of a digital image processing system.
- Analyze images in the frequency domain using various transforms and evaluate the techniques for image enhancement and image restoration.
- Categorize various compression techniques, interpret Image compression standards.
- Interpret image segmentation and representation techniques.

References

1. Rafael C. Gonzalez and Richard E.Woods, "Digital Image Processing" Second Edition, Pearson Education, 2003.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", Second Edition, Thomson Learning, 2001

3. Anil K. Jain, "Fundamentals of Digital Image Processing", Person Education, 2003.

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

M. Tech. 1st semester to 4th semester CSE: Approved in 15th meeting of Academic Council held on 14.08.2020. applicable to all students admitted in 2019-20 & onwards and trailing students.

MTCSE529C: STEGANOGRAPHY AND DIGITAL WATERMARKING			
M.Tech. Semester-I (Computer Science and Engineering)			
Pre-Requisites	Image and Video Processing, Linear Algebra	Class Work	25 Marks
Lectures	03	Examination	75 Marks
Practical	-	Total	100 Marks
Credits	03	Duration of Exam	03 Hrs.

COURSE OBJECTIVE
- The objective of course is to provide a insight to steganography techniques. Watermarking techniques along with attacks on data hiding and integrity of data is included in this course.

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Cryptography, Introduction, Plain Text and Cypher Text, Cryptographic Techniques, Symmetric and Asymmetric keys, DSA	9
Unit 2 Steganography: Overview, History, Methods for hiding, Issues: Security, Capacity and Imperceptibility, Frameworks for secret communication (pure Steganography, secret key, public key steganography), Steganography techniques: Substitution systems, Spatial Domain, Transform domain techniques	11
Unit 3 LSB Embedding, Steganography algorithms, Algorithm of 6th and 7th bit, Digital logic technique algorithm	8
Unit 4 **Digital Watermarking**: Introduction, Difference between Watermarking and Steganography, History, Classification (Characteristics and Applications), Types and techniques (Spatial-domain, Frequency-domain), Recent trends in Steganography and digital watermarking techniques.	12

COURSE OUTCOMES
After completion of course, students would:
• Learn the concept of information hiding.
• Survey of current techniques of steganography and learn how to detect and extract hidden information.
• Learn watermarking techniques and through examples understand the concept.
References:

1. Peter Wayner, "Disappearing Cryptography–Information Hiding: Steganography & Watermarking", Morgan Kaufmann Publishers, New York, 2002.
2. Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, TonKalker, "Digital Watermarking and Steganography", Margan Kaufmann Publishers, New York, 2008.
3. Information Hiding: Steganography and Watermarking-Attacks and Countermeasures by Neil F. Johnson, Zoran Duric, Sushil Jajodia
4. Information Hiding Techniques for Steganography and Digital Watermarking by Stefan Katzenbeisser, Fabien A. P. Petitcolas

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

M. Tech. 1st semester to 4th semester CSE: Approved in 15th meeting of Academic Council held on 14.08.2020. applicable to all students admitted in 2019-20 & onwards and trailing students.

MTCSE541C: DATA SCIENCE		
M.Tech. Semester-I (Computer Science and Engineering)		
Pre-Requisites	-	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- 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;
- Produce Python code to statistically analyze a dataset;
- Critically evaluate data visualizations based on their design and use for communicating stories from data;

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.	8
Unit 2 Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources	9
Unit 3 Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.	11
Unit 4 Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.	12

COURSE OUTCOMES
On completion of the course the student should be able to

- Explain how data is collected, managed and stored for data science;
- Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists;

References:

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

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE543C: DISTRIBUTED SYSTEMS			
M.Tech. Semester-I (Computer Science and Engineering)			
Pre-Requisites	Database Management Systems	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts Distributed Database Management System Architecture: Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues	9
Unit 2 Distributed Database Design: Alternative design strategies; Distributed design issues; Fragmentation; Data allocation, Semantics Data Control: View management; Data security; Semantic Integrity Control, Query Processing Issues: Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data	11
Unit 3 Distributed Query Optimization: Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms; Transaction Management: The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models; Concurrency Control: Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management	11
Unit 4 Reliability: Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols, Mobile Databases, Distributed Object Management, Multi-databases	9

COURSE OUTCOMES
After completion of course, students would be:

- Design trends in distributed systems.
- Apply network virtualization.
- Apply remote method invocation and objects.

References:

1. Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE545C: ADVANCED WIRELESS AND MOBILE NETWORKS			
M.Tech. Semester-I (Computer Science and Engineering)			
Pre-Requisites	Computer Networks	Class Work	25 Marks
Lectures	03	Examination	75 Marks
Practical	-	Total	100 Marks
Credits	03	Duration of Exam	03 Hrs.

COURSE OBJECTIVE
- The students should get familiar with the wireless/mobile market and the future needs and challenges.
- To get familiar with key concepts of wireless networks, standards, technologies and their basic operations
- To learn how to design and analyse various medium access
- To learn how to evaluate MAC and network protocols using network simulation software tools.
- The students should get familiar with the wireless/mobile market and the future needs and challenges.

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Introduction: Wireless Networking Trends, Key Wireless Physical Layer Concepts, Multiple, Access Technologies -CDMA, FDMA, TDMA, Spread Spectrum technologies, Frequency reuse, Challenges in Mobile Computing IEEE 802.11 standards, Infrastructure vs. Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues, VANETs	11
Unit 2 Wireless cellular networks: 1G and 2G, 2.5G, 3G, and 4G, Mobile IPv4, Mobile IPv6, TCP variants for Wireless Networks, Cellular architecture, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, Spread spectrum Technologies.	10
Unit 3 WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE 802.22 Wireless Sensor Networks: Introduction, Application, Physical, MAC layer and Network Layer, Power Management.	9
Unit 4 Bluetooth AND Zigbee, Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in Wireless Communication, EAPTLS, EAP-TTLS, EAP-Peap	10

COURSE OUTCOMES
After completion of course, students would be:
- Demonstrate advanced knowledge of networking and wireless networking and understand various types of wireless networks, standards, operations and use cases.
- Be able to design WLAN, WPAN, WWAN, Cellular based upon underlying propagation and performance analysis.
- Demonstrate knowledge of protocols used in wireless networks and learn simulating wireless networks.
- Design wireless networks exploring trade-offs between wire line and wireless links.

- Develop mobile applications to solve some of the real world problems.

References:

1. Schiller J., Mobile Communications, Addison Wesley 2000
2. Stallings W., Wireless Communications and Networks, Pearson Education 2005
3. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc 2002
4. Yi Bing Lin and Imrich Chlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc 2000
5. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI 200

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE547C: EMULATION AND SIMULATION METHODOLOGIES			
M.Tech. Semester-I (Computer Science and Engineering)			
Pre-Requisites	Probability Theory, Computer Networks	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- This module teaches the fundamentals of simulation and emulation methodologies providing guidance on how to design a performance evaluation campaign,
- Set up a test scenario, select the appropriate models, level of granularity
- Metrics for statistical correctness, and discuss the differences between simulation and emulation platforms and how to use them for accurate performance evaluation of communications.

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Fundamentals of Discrete Event Simulations (DES)	8
Unit 2 Model-based representation for DES, from communication and networking, to mobility and data traffic.	10
Unit 3 Application-based Granularity Requirements: from bit-level, packet-level, to system-level evaluation, and their appropriate selection as a function of the application requirements.	10
Unit 4 Fundamentals on Random Numbers, Fundamentals on Statistical Tools for Performance Evaluation, Simulation vs. Emulations, Recent trends in simulation and emulation for IOT	12

COURSE OUTCOMES

On completion of the course the student should be able to

- Key concepts, tools and approaches for pattern recognition on complex data sets
- Kernel methods for handling high dimensional and non-linear patterns
- State-of-the-art algorithms such as Support Vector Machines and Bayesian networks
- Theoretical concepts and the motivations behind different learning frameworks
- Be able to solve real-world machine learning tasks: from data to inference

References:
1. Jack L. Burbank, An Introduction to Network Simulator 3, Wiley

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE549C: BIOMETRICS			
M.Tech. Semester-I (Computer Science and Engineering)			
Pre-Requisites	Image Processing	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- The objective of this course is to introduce Bio-metric and traditional authentication methods. Application of bio-metric systems in government sector and various face recognition and finger print recognition methods are included.

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Introduction and Definitions of bio-metrics, Traditional authenticated methods and technologies. DNA Matching	9
Unit 2 Bio-metric technologies: Fingerprint, Face, Iris, Hand Geometry, Gait Recognition, Ear, Voice, Palm print, On-Line Signature Verification, 3D Face Recognition, Dental Identification and DNA.	12
Unit 3 The Law and the use of multi bio-metrics systems, Recent trends in Bio-metric technologies and applications in various domains. Bio-metric System Vulnerabilities.	10
Unit 4 Statistical measurement of Bio-metric. Bio-metrics in Government Sector and Commercial Sector.	9

COURSE OUTCOMES

After completion of course, students would be:

- Perform R&D on bio-metrics methods and systems.
- A good understanding of the various modules constituting a bio-metric system.
- Familiarity with different bio-metric traits and to appreciate their relative significance.
- A good knowledge of the feature sets used to represent some of the popular bio-metric traits.
- Evaluate and design security systems incorporating bio-metrics.
- Recognize the challenges and limitations associated with bio-metrics.

References:

1. Biometrics for network security, Paul Reid, Hand book of Pearson
2. D. Maltoni, D. Maio, A. K. Jain, and S. Prabhakar, Handbook of Fingerprint Recognition, Springer Verlag, 2003.
3. A. K. Jain, R. Bolle, S. Pankanti (Eds.), BIOMETRICS: Personal Identification in Networked Society, Kluwer Academic Publishers, 1999.
4. J. Wayman, A.K. Jain, D. Maltoni, and D. Maio (Eds.), Biometric Systems: Technology, Design and Performance Evaluation, Springer, 2004.
5. Anil Jain, Arun A. Ross, Karthik Nanda kumar, Introduction to biometric, Springer, 2011.
6. Biometric Systems: Technology, Design and Performance Evaluation, J. Wayman, A.K. Jain, D. Maltoni, and D. Maio
Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE505C: RESEARCH METHODOLOGY AND IPR			
M.Tech. Semester-I (Computer Science and Engineering)			
Pre-Requisites	-	**Class Work**	25 Marks
Lectures	02	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	02	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- The objective of this course is to introduce the overall process of designing research study from its inception to its report. Further, it is to make students aware of their rights for the protection of their invention done in their project work.

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 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	9
Unit 2 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	10
Unit 3 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.	10
Unit 4 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.	11

Course Outcomes:

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

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- 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.

- 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.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE561C: MACHINE LEARNING LAB			
M.Tech. Semester-II (Computer Science and Engineering)			
Lectures	-	Class Work	25 Marks
Practical	04	Examination	75 Marks
Credits	02	Total	100 Marks

The students will be required to carry out 10 to 12 experiments covering the respective theory course

MTCSE563C: WIRELESS SENSOR NETWORKS LAB			
M.Tech. Semester-II (Computer Science and Engineering)			
Lectures	-	Class Work	25 Marks
Practical	04	Examination	75 Marks
Credits	02	Total	100 Marks

The students will be required to carry out 10 to 12 experiments covering the respective theory course

MTCSE565C: INTELLIGENT SYSTEMS LAB			
M.Tech. Semester-II (Computer Science and Engineering)			
Lectures	-	Class Work	25 Marks
Practical	04	Examination	75 Marks
Credits	02	Total	100 Marks

The students will be required to carry out 10 to 12 experiments covering the respective theory course

MTCSE567C: DIGITAL IMAGE ANALYSIS LAB			
M.Tech. Semester-II (Computer Science and Engineering)			
Lectures	-	Class Work	25 Marks
Practical	04	Examination	75 Marks
Credits	02	Total	100 Marks

The students will be required to carry out 10 to 12 experiments covering the respective theory course

MTCSE569C: STEGANOGRAPHY AND DIGITAL WATERMARKING LAB			
M.Tech. Semester-II (Computer Science and Engineering)			
Lectures	-	Class Work	25 Marks
Practical	04	Examination	75 Marks
Credits	02	Total	100 Marks

The students will be required to carry out 10 to 12 experiments covering the respective theory course

MTCSE502C: ADVANCED ALGORITHMS		
M.Tech. Semester-II (Computer Science and Engineering)		
Pre-Requisites	UG level course in Algorithm Design and Analysis	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

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

LECTURE WITH BREAKUP	NO. OF LECT.
Unit1 Sorting: Review of various sorting algorithms, topological sorting Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra'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. Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	11
Unit 2 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.	9
Unit 3 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.	9
Unit 4 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	11

COURSE OUTCOMES

After completion of course, students would be able to:

- Analyze the complexity/performance of different algorithms.
- Determine the appropriate data structure for solving a particular set of problems.
- Categorize the different problems in various classes according to their complexity.
- Students should have an insight of recent activities in the field of the advanced data structure.

References:

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

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE504C: SOFT COMPUTING			
M.Tech. Semester-II (Computer Science and Engineering)			
Pre-Requisites	Basic knowledge of mathematics	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
- To implement soft computing based solutions for real-world problems.
- To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
- To provide student an hand-on experience on MATLAB to implement various strategies.

LECTURE WITH BREAKUP	**NO. OF LECT.**
Unit 1 Introduction to Soft Computing and Neural Networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics, Introduction to Deep Learning	11
Unit 2 Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.	9
Unit 3 Neural Networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks	11
Unit 4 Genetic Algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.	9

COURSE OUTCOMES

After completion of course, students would be able to:

- Identify and describe soft computing techniques and their roles in building intelligent machines
- Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
- Apply genetic algorithms to combinatorial optimization problems.
- Evaluate and compare solutions by various soft computing approaches for a given problem.

References:
1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing , Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications , Prentice Hall, 1995.
3. MATLAB Toolkit Manual

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE522C: DATA PREPARATION AND ANALYSIS			
M.Tech. Semester-II (Computer Science and Engineering)			
Pre-Requisites	DBMS	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- To prepare the data for analysis and develop meaningful Data Visualizations

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit1 Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real-time issues	9
Unit2 Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation	10
Unit3 Exploratory Analysis: Descriptive and comparative statistics, Clustering and association, Hypothesis generation	10
Unit4 Visualization: Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity	11

COURSE OUTCOMES
After completion of course, students would be:
- Able to extract the data for performing the Analysis.

References:

1. Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE524C: SECURE SOFTWARE DESIGN AND ENTERPRISE COMPUTING			
M.Tech. Semester-II (Computer Science and Engineering)			
Pre-Requisites	Computer Programming, Software	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- To fix software flaws and bugs in various software.
- To make students aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic
- Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
- Methodologies and tools to design and develop secure software containing minimum vulnerabilities

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 Secure Software Design: Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts,	9
Unit 2 Enterprise Application Development: Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Research technologies available for the presentation, business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.	11
Unit 3 Enterprise Systems Administration: Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).	9
Unit 4 Software containing minimum vulnerabilities and flaws, Perform security testing and quality assurance Managing software quality in an organization, software configuration management, software measurement and metrics,	11

COURSE OUTCOMES
After completion of course, students would be able to:

- Differentiate between various software vulnerabilities.
- Software process vulnerabilities for an organization.

- Monitor resources consumption in a software.
- Interrelate security and software development process.

References:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.
3. Nina S. Godbole, Software Quality Assurance: Principles and Practices, Narosa Publication.

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE526C: COMPUTER VISION			
M.Tech. Semester-II (Computer Science and Engineering)			
Pre-Requisites	Linear algebra, vector calculus, Data structures and Programming	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE
- Be familiar with both the theoretical and practical aspects of computing with images.
- Have described the foundation of image formation, measurement, and analysis.
- Understand the geometric relationships between 2D images and the 3D world.
- Grasp the principles of state-of-the-art deep neural networks.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis	10
Unit 2 Edge detection, Edge detection performance, Hough transform, corner detection Segmentation, Morphological filtering, Fourier transform	10
Unit 3 Feature extraction, shape, histogram, color, spectral, texture, Feature analysis, feature vectors, distance /similarity measures, data pre- processing	9
Unit 4 Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised Classifiers: Bayes, KNN, ANN models	11

COURSE OUTCOMES
After completion of course, students would be able to:
- Developed the practical skills necessary to build computer vision applications.
- To have gained exposure to object and scene recognition and categorization from images.

References:
1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Deep Learning, by Goodfellow, Bengio, and Courville.
3. Dictionary of Computer Vision and Image Processing, by Fisher et al.

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE528C: SENSOR NETWORKS AND INTERNET OF THINGS			
M.Tech. Semester-II (Computer Science and Engineering)			
Pre-Requisites	Wireless Networks	Class Work	25 Marks
Lectures	03	Examination	75 Marks
Practical	-	Total	100 Marks
Credits	03	Duration of Exam	03 Hrs.

COURSE OBJECTIVE

- The course gives an overview of various topics related to wireless sensor networks, which are expected to be the basis for the emerging internet-of-things.
- The course covers topics with relation to various sub-disciplines of computer science such as hardware, operating systems, distributed systems, networking, security and databases.
- Able to understand wireless sensor network (WSN) specific issues such as localization, time synchronization, and topology control are addressed as well.

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Introduction and Applications: smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. Examples of research areas include for instance: Self-Adaptive Systems, Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security	8
Unit 2 IoT Reference Architecture: Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints: Introduction, Technical Design constraints: hardware, Data representation and visualization, Interaction and remote control.	10
Unit 3 Industrial Automation: Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device Board, Linux on Raspberry , Interface and Programming & IOT Device	12
Unit 4: Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases	10

COURSE OUTCOMES

 On completion of the course the student should be able to

- identify requirements from emerging   WSN applications on   WSN platforms, communication systems, protocols and middleware
- understand, compare and evaluate communication and network protocols used in WSNs
- discuss and evaluate mechanisms and algorithms for time synchronization and localization in WSNs
- understand and discuss requirements for the design of security mechanisms

and middleware systems to be used in WSNs

References:

1. Mandler, B., Barja, J., Mitre Campista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publishing

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

M. Tech. 1ˢᵗ semester to 4ᵗʰ semester CSE: Approved in 15ᵗʰ meeting of Academic Council held on 14.08.2020. applicable to all students admitted in 2019-20 & onwards and trailing students.

MTCSE530C: CLOUD COMPUTING			
M.Tech. Semester-II (Computer Science and Engineering)			
Pre-Requisites	-	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- The student will also learn how to apply trust-based security model to real-world security problems.
- An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
- Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Introduction to Cloud Computing: Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing, Services provided by the cloud, Introduction to Hybrid cloud	8
Unit 2 Cloud Computing Architecture: Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model, Cloudlets	12
Unit 3 Security Issues in Cloud Computing: Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and its Security	9
Unit 4 Security Management in the Cloud: Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS Privacy Issues: Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations	11

COURSE OUTCOMES

 After completion of course, students would be able to:

- Identify security aspects of each cloud model
- Develop a risk-management strategy for moving to the Cloud
- Implement a public cloud instance using a public cloud service provider
- Apply trust-based security model to different layer

References:

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2, 2009
2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance
   (Theory in Practice), Tim Mather, ISBN-10: 0596802765,O'Reilly Media, September 2009

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE542C: GPU COMPUTING			
M.Tech. Semester-II (Computer Science and Engineering)			
Pre-Requisites	OS, COA	Class Work	25 Marks
Lectures	03	Examination	75 Marks
Practical	-	Total	100 Marks
Credits	03	Duration of Exam	03 Hrs.

COURSE OBJECTIVE

- To learn parallel programming with Graphics Processing Units (GPUs).

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs	12
Unit 2 Memory: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories	8
Unit 3 Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects	11
Unit 4: Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing	9

COURSE OUTCOMES

After completion of course, students would be:

- Students would learn concepts in parallel programming, implementation of programs on GPUs, debugging and profiling parallel programs.

References:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-mei Hwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)

2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE544C: HUMAN AND COMPUTER INTERECTION			
M.Tech. Semester-II (Computer Science and Engineering)			
Pre-Requisites	OS, COA	Class Work	25 Marks
Lectures	03	Examination	75 Marks
Practical	-	Total	100 Marks
Credits	03	Duration of Exam	03 Hrs.

COURSE OBJECTIVE
- Learn the foundations of Human Computer Interaction
- Be familiar with the design technologies for individuals and persons with disabilities
- Be aware of mobile Human Computer interaction.
- Learn the guidelines for user interface.

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Human: I/O channels, Memory, Reasoning and problem solving; The computer: Devices, Memory, processing and networks; Interaction: Models, frameworks, Ergonomics, styles, elements, interactivity, Paradigms.	10
Unit 2 Interactive Design basics, process, scenarios, navigation, screen design, Iteration and prototyping. HCI in software process, software life cycle, usability engineering, Prototyping in practice, design rationale. Design rules, principles, standards, guidelines, rules. Evaluation Techniques, Universal Design.	12
Unit 3 Web Interfaces – Drag & Drop, Direct Selection, Communication and collaboration models-Hypertext, Multimedia and WWW.	8
Unit 4 Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture,	10

COURSE OUTCOMES
After completion of course, students would be:
- Understand the structure of models and theories of human computer interaction and vision.\
- Design an interactive web interface on the basis of models studied.

References:
1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004 (UNIT I , II & III)
2. Brian Fling, "Mobile Design and Development", First Edition , O Reilly Media Inc., 2009 (UNIT – IV)
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, OReilly, 2009.(UNIT-V)

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE546C: ARCHITECTURE OF HIGH PERFORMANCE COMPUTER SYSTEMS			
M.Tech. Semester-II (Computer Science and Engineering)			
Pre-Requisites	COA	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE
- To provide students with a broad understanding of current and emerging trends in computer architecture
- To study architecture exploiting instruction level parallelism and muti processors and multi computers
- To inculcate knowledge about the latest commercial processors

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Introduction: review of basic computer architecture, quantitative techniques in computer design, measuring and reporting performance. CISC and RISC processors.	9
Unit 2 Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards, and structural hazards, techniques for handling hazards. Exception handling. Pipeline optimization techniques. Compiler techniques for improving performance.	10
Unit 3 Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies. Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super-pipelined and VLIW processor architectures. Array and vector processors.	11
Unit 4 Multiprocessor architecture: taxonomy of parallel architectures. Centralized shared-memory architecture: synchronization, memory consistency, interconnection networks. Distributed shared-memory architecture. Cluster computers. Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures.	10

COURSE OUTCOMES
  After completion of course, students would be able to:
- Demonstrate the advanced concepts of computer architecture
- Investigate modern design structures of Pipelined and Multiprocessor Systems
- Understand the interaction amongst architecture, applications and technology

References:
1. John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.

2. John Paul Shen and Mikko H. Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, Tata McGraw-Hill.
3. M. J. Flynn, Computer Architecture: Pipelined and Parallel Processor Design, Narosa Publishing House.
4. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill.

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE548C: NETWORK SECURITY			
M.Tech. Semester-II (Computer Science and Engineering)			
Pre-Requisites	Computer Networks, Web Programming	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- To learn the basics of security and various types of security issues.
- To study different cryptography techniques available and various security attacks.
- Explore network security and how they are implemented in real world.
- To get an insight of various issues of Web security and biometric authentication.

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Data security: Review of cryptography, Public key vs. Private key. Examples RSA, DES, AES, Diffie Hellman	10
Unit 2 Authentication, Authentication basics, Authentication Tokens, Passwords, Certificate based Authentication	10
Unit 3 Network security: Firewalls, Proxy-Servers, Network intrusion detection, IDS, IPS	10
Unit 4 Access Control, Biometric authentication, Secure E-Commerce (ex. SET), Smart Cards, Recent trends in Security	10

COURSE OUTCOMES

After completion of course, students would be able to:

- To have an understanding of basics of security and issues related to it.
- Understanding of biometric techniques available and how they are used in today's world.
- Security issues in web and how to tackle them.
- Learn mechanisms for transport and network security

References:
1. W. R. Cheswick and S. M. Bellovin. Firewalls and Internet Security. Addison Wesley, 1994.
2. W. Stallings. Cryptography and Network Security. Prentice Hall, 1999.
3. B. Schneier. Applied Cryptography. Wiley, 1999.

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE562C: DATA PREPARATION AND ANALYSIS LAB			
M.Tech. Semester-II (Computer Science and Engineering)			
Lectures	-	Class Work	25 Marks
Practical	04	Examination	75 Marks
Credits	02	Total	100 Marks

The students will be required to carry out 10 to 12 experiments covering the respective theory course

MTCSE564C: SECURE SOFTWARE DESIGN & ENTERPRISE COMPUTING LAB			
M.Tech. Semester-II (Computer Science and Engineering)			
Lectures	-	Class Work	25 Marks
Practical	04	Examination	75 Marks
Credits	02	Total	100 Marks

The students will be required to carry out 10 to 12 experiments covering the respective theory course

MTCSE566C: COMPUTER VISION LAB			
M.Tech. Semester-II (Computer Science and Engineering)			
Lectures	-	Class Work	25 Marks
Practical	04	Examination	75 Marks
Credits	02	Total	100 Marks

The students will be required to carry out 10 to 12 experiments covering the respective theory course

MTCSE568C: SENSOR NETWORKS AND IOT LAB			
M.Tech. Semester-II (Computer Science and Engineering)			
Lectures	-	Class Work	25 Marks
Practical	04	Examination	75 Marks
Credits	02	Total	100 Marks

The students will be required to carry out 10 to 12 experiments covering the respective theory course

MTCSE569C: CLOUD COMPUTING LAB			
M.Tech. Semester-II (Computer Science and Engineering)			
Lectures	-	Class Work	25 Marks
Practical	04	Examination	75 Marks
Credits	02	Total	100 Marks

The students will be required to carry out 10 to 12 experiments covering the respective theory course

MTCSE569C: STEGANOGRAPHY AND DIGITAL WATERMARKING LAB			
M.Tech. Semester-II (Computer Science and Engineering)			
Lectures	-	Class Work	25 Marks
Practical	04	Examination	75 Marks
Credits	02	Total	100 Marks

The students will be required to carry out 10 to 12 experiments covering the respective theory course

MTCSE601C: MOBILE APPLICATIONS AND SERVICES			
M.Tech. Semester-III (Computer Science and Engineering)			
Pre-Requisites	Wireless Communication and Mobile Computing	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- This course presents the three main mobile platforms and their ecosystems, namely Android, iOS, and PhoneGap/WebOS.
- It explores emerging technologies and tools used to design and implement feature-rich mobile applications for smartphones and tablets
- It also take into account both the technical constraints relative to storage capacity, processing capacity, display screen, communication interfaces, and the user interface, context and profile

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 Introduction: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User	9
Unit 2 More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis. Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Android Storing and Retrieving Data	9
Unit 3 Communications via Network and the Web: State Machine, Android Networking and Web, Wireless Connectivity and Mobile Apps, Android Telephony Notifications and Alarms: Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance	11
Unit 4 Putting It All Together : Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android, Mobile App Testing Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia	11

COURSE OUTCOMES
On completion of the course the student should be able to

- Identify the target platform and users and be able to define and sketch a mobile application
- Understand the fundamentals, frameworks, and development lifecycle of mobile application platforms including iOS, Android, and PhoneGap
- Design and develop a mobile application prototype in one of the platform (challenge project)

References:
1. Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE603C: COMPILER FOR HPC		
M.Tech. Semester-III (Computer Science and Engineering)		
Pre-Requisites	Data Structure, Compiler Design, Theory of Computation	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- The objective of this course is to introduce structure of compilers and high performance compiler design for students. Concepts of cache coherence and parallel loops in compilers are included.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 High Performance Systems: Structure of a Compiler, Programming Language Features, Parallel Programming Languages for High Performance. Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Global Cache Coherence, Local Cache, Coherence.	10
Unit 2 Data Dependence: Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph. Scalar Analysis with Factored Use-Def Chains: Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, Data Dependence for Scalars. Data Dependence Analysis for Arrays.	10
Unit 3 Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis. Loop Restructuring: Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations. Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.	10
Unit 4 Concurrency Analysis: Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers. Parallel Algorithms: Reduction, Broadcast, Prefix Sums	10

COURSE OUTCOMES
 After completion of course, students would be:

- Familiar with the structure of compiler.
- Parallel loops, data dependency and exception handling and debugging in compiler.

References:

1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson
2. Michael J. Quinn, Parallel Computing: Theory and Practice, TMH

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE605C: OPTIMIZATION TECHNIQUES			
M.Tech. Semester-III (Computer Science and Engineering)			
Pre-Requisites	Linear Algebra and Numerical Methods	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

- The objective of this course is to provide insight to the mathematical formulation of real world problems.
- To optimize these mathematical problems using nature based algorithms. And the solution is useful specially for NP-Hard problems.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 Formulation of design problems as mathematical programming problems. General Structure of Optimization Algorithms, Constraints, The Feasible Region.	10
Unit 2 Branches of Mathematical Programming: Optimization using calculus, Linear, Programming, Quadratic Programming, Integer Programming,	10
Unit 3 Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.	11
Unit 4 Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications, Engineering application of Optimization	9

COURSE OUTCOMES

After completion of course, students would be:

- Formulate optimization problems.
- Understand and apply the concept of optimality criteria for various types of optimization problems.
- Solve various constrained and unconstrained problems in Single variable as well as multivariable.
- Apply the methods of optimization in real life situation.

References:

1. Laurence A. Wolsey (1998). Integer programming. Wiley. ISBN 978-0-471-28366-9.
2. Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.
3. An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.
4. Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers.

       Dynamic Ideas. ISBN 978-0-9759146-2-5.

5. John K. Karlof (2006). Integer programming: theory and practice.CRC Press. ISBN 978-0-8493-1914-3.
6. H. Paul Williams (2009). Logic and Integer Programming. Springer. ISBN 978-0-387-92279-9.

7. Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3-540-68274-5.
8. Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling and Solution. John Wiley and Sons. ISBN 978-0-470-37306-4.

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

MTCSE607C: DIGITAL FORENSICS			
M.Tech. Semester-II (Computer Science and Engineering)			
Pre-Requisites	Cybercrime and Information Warfare, Computer Networks	**Class Work**	25 Marks
Lectures	03	**Examination**	75 Marks
Practical	-	**Total**	100 Marks
Credits	03	**Duration of Exam**	03 Hrs.

COURSE OBJECTIVE

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

LECTURE WITH BREAKUP	NO. OF LECT.
Unit 1 Digital Forensics Science: Forensics science, digital forensics. Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics	9
Unit 2 Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, Discuss the importance of understanding what court documents would be required for a criminal investigation. Evidence Management & Presentation: Create and manage shared folders using operating system, Define who should be notified of a crime, parts of gathering evidence	11
Unit 3 Computer Forensics: Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.	11
Unit 4 Mobile Forensics: mobile forensics techniques, mobile forensics tools, Recent trends in mobile forensic technique Legal Aspects of Digital Forensics: Case study of IT Act 2000, amendment of IT Act 2008.	9

COURSE OUTCOMES
After completion of course, students would be able to:
- Understand relevant legislation and codes of ethics
- Computer forensics and digital detective and various processes, policies and

procedures
- E-discovery, guidelines and standards, E-evidence, tools and environment.
- Email and web forensics and network forensics

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

Note: In the semester examination, the examiner will set two questions from each unit (total 08 questions in all), covering the entire syllabus. The students will be required to attempt only 05 questions selecting at least one question from each unit.

M.Tech. Semester-II
Choice Based Credit System (effective from Session 2018-19)
MINI PROJECT
(MTCSE514C)

L T P		Class-work Marks	: 25
0 0 4		Exam. Marks	: 75
		Total Marks	: 100
		Credits	: 2

The objective of mini project is to develop in students the professional quality of synthesis employing technical knowledge obtained in the field of Engineering & Technology through a project work involving design / analysis augmented with creativity, innovation and ingenuity.

The student shall take up investigative study on a topic in the broad relevant field of engineering, involving hardware or software or both hardware & software, to be assigned by the department on an individual basis, under the guidance of a supervisor from the department. This is expected to provide a good initiation for the student(s) in R&D work.

The activities under mini project may normally include:
1. Literature survey on an assigned topic.
2. Working out a preliminary approach to the problem relating to the assigned topic.
3. Conducting preliminary analysis/modelling/simulation/experiment/design.
4. Compilation of the work and presenting it in two seminar talks in the semester, before a committee having M.Tech. coordinator and supervisor(s).
5. Submit a written spiral-bound report on the work undertaken to the M.Tech. Coordinator.

Internal evaluation of Mini Project will be done at the end of the semester through a seminar by the committee consisting of the following:
1. Chairperson/Head of Department/ Nominee : Chairperson
2. M.Tech. Coordinator : Member-Secretary
3. Respective Project Supervisor(s) : Member(s)

Final exam. will be conducted by the internal examiner (M.Tech. Coordinator / faculty nominated by Chairperson) and external examiner to be appointed by Controller of Examinations from a Panel of Examiners submitted by the Dept.

M.Tech. coordinator will be assigned a load of 1 hour per week excluding his/ her own guiding load. Project supervisor (guiding teacher) will be assigned a load of 1 hour per week per student subject to a maximum load of 2 hours.

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Choice Based Credit System (effective from Session 2019-20)
DISSERTATION (PHASE-I)
(MTCSE621C)

L	T	P		
0	0	20		

Class-work Marks : 50
Exam. Marks : 100
Total Marks : 150
Credits : 10

The objective of this course is to develop in students the capacity for analysis & judgment and the ability to carry out independent investigation in design/development through a dissertation work involving creativity, innovation and ingenuity. The work should start with comprehensive literature search and critical appreciation thereof so as to select a research problem and finalize the topic of dissertation.

Each student will carry out an independent dissertation under the supervision of a supervisor; in no case, more than two supervisors may be associated with one dissertation work. The first supervisor must be from the department, however, for interdisciplinary research work,the second supervisor may be from other department of the university/ outside university/industry. In the latter case, consent of the second supervisor with justification thereof needs to be submitted to the dissertation coordinator.

The Dissertation (Phase-I) involving literature survey and problem formulation along with data collection (if required) commences in 3rd semester &will be completed as Dissertation (Phase-II) in 4th semester. Each student will be required to present two seminar talks, first towards the beginning of the Dissertation (Phase-I) to present the scope of the work and to finalize the topic, and the second towards the end of the semester, presenting the progress report containing literature survey, partial results (if any) of the work carried out by him/her in the semester.The student will be required to submit one copy of spiral-bound progress report to the M.Tech. Coordinator.

Internal evaluation of Dissertation (Phase-I) will be done by following committee:
1. Chairperson / Head of Department / Nominee : Chairperson
2. M.Tech. Coordinator/Senior Faculty : Member-Secretary
3. Respective Dissertation Supervisor(s) : Member(s)

Final exam will be conducted by the internal examiner (M.Tech. Coordinator/ faculty nominated by Chairperson) &an external examiner to be appointed by Controller of Examinations from a panel of examiners submitted by the Dept.

For this course, M. Tech. coordinator will be assigned a load of 1 hour per week excluding his/ her own guiding load. Dissertation supervisor (guiding teacher) will be assigned a load of 1 hour per week for the first student and additional 1 hour per week (for their own department only) for the subsequent student(s) subject to a maximum load of 2 hours. Work load allocated for the joint supervision within the department will be treated as half for each supervisor.

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DISSERTATION (PHASE-II)
(MTCSE602C)

L T P		
0 0 32	Class-work Marks	: 100
	Exam. Marks	: 200
	Total Marks	: 300
	Credits	: 16

The Dissertation (Phase-II) shall be the extension of Dissertation (Phase-I) carried out in 3rd semester. Each student will be required to present three seminar talks, first at the beginning of the semester to present the progress made during the winter break; second in the middle of the semester involving partial results obtained and comparative analysis; and third towards the end of the semester, presenting the dissertation report of the work carried out. Each student will be required to submit two copies of dissertation report to M.Tech. coordinator. The committee constituted by the Chairperson of the department will screen all the presentations so as to award the sessional marks.

INTERNAL ASSESSMENT:

The internal assessment (Class-work evaluation) will be effected through presentation and discussion thereon by the following committee:

1. Chairperson/Head of Department / Nominee : Chairperson
2. M.Tech. Coordinator/Senior Faculty : Member-Secretary
3. Respective Dissertation Supervisor(s) : Member(s)

EXTERNAL ASSESSMENT:

Dissertation will be evaluated by the following committee:

1. Chairperson/Head of the Department / Nominee : Chairperson
2. Respective Dissertation Supervisor(s) : Member(s)
3. External Expert : To be appointed by the University.

For this course, supervisor(s) will be assigned a load of 2hours per week for the first student and additional 1 hour per week for the subsequent student(s) subject to a maximum load of 3 hours. Work load allocated for the joint supervision within the department will be treated as half for each supervisor.

NOTE: There is a desirable requirement of one publication in a UGC-listed journal / unpaid journal. The external expert must be from the respective area of the specialization. Chairperson &M.Tech. Coordinator in mutual consultation will divide the submitted dissertations into groups depending upon area of specialization and recommend the list of experts for each group separately to the Vice-Chancellor for selecting the examiners (*one examiner for not more than four students of a group*).