COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

DIT UNIVERSITY
DEHRADUN

DETAILED COURSE STRUCTURE & SYLLABUS

OF

M.TECH – CSE BATCH 2022-24

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

COURSE STRUCTURE

Year: 1st **Semester: I**

Course Code	Course Title	Contact Hours			Credits
		L	T	P	
CSF601	Data Structures and Algorithm Design	**3**	**0**	**2**	**4**
CSF602	Modelling and Simulation	**3**	**0**	**2**	**4**
	Specialized Core-1				**4**
	Specialized Core-2				**4**
	Total Credits				**16**

Specialized Core-Artificial Intelligence, Machine Learning and Robotics

Course Category	Course Code	Course Title	L	T	P	Credits
Specialized Core-1	CSF611	Artificial Intelligence and Knowledge Representation	3	0	2	4
Specialized Core-2	CSF612	Robotics Systems	3	0	2	4

Specialized Core-Internet of Things

Course Category	Course Code	Course Title	L	T	P	Credits
Specialized Core-1	CSF613	Data Communication Systems	3	1	0	4
Specialized Core-2	CSF614	Wireless and Mobile Computing	3	0	2	4

Specialized Core-Data Science and Engineering

Course Category	Course Code	Course Title	L	T	P	Credits
Specialized Core-1	CSF615	Introduction to Data Science	3	0	2	4
Specialized Core-2	CSF616	Data Mining	3	0	2	4

Specialized Core-Computer Vision and Biometrics

Course Category	Course Code	Course Title	L	T	P	Credits
Specialized Core-1	CSF617	Visual Computing	3	0	2	4
Specialized Core-2	CSF618	Advanced Image Processing	3	0	2	4

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Year: 1st **Semester: II**

Course Code	Course Name	Contact Hours			Credits
		L	T	P	
	Specialized Elective 1	**3**	**0**	**2**	**4**
	Specialized Elective 2	**3**	**0**	**2**	**4**
	Specialized Elective 3	**3**	**0**	**2**	**4**
CSF652	Seminar	**0**	**0**	**4**	**2**
	Total Credits				**14**

List of Specialized Elective Courses for 2nd Semester and 3rd Semester (3 courses to be chosen in2nd and 1 course in 3rd semester as per advising of specialization requirements):

Course Code	Course Title	L	T	P	Credits
CSF641	Internet of Things and Edge Computing	3	0	2	4
CSF642	Cloud Computing and Virtualization	3	0	2	4
CSF643	Programming for Data Science	3	0	2	4
CSF644	Applied Machine Learning and Deep Learning	3	0	2	4
CSF645	Data Analytics	3	0	2	4
CSF646	Image and Video Processing	3	0	2	4
CSF647	Natural Language Processing	3	0	2	4
CSF648	Research Ethics and Methods	3	0	2	4
CSF649	Fuzzy Neural Networks	3	0	2	4
CSF650	Evolutionary Computing Techniques	3	0	2	4
CSF651	Applied Cryptography	3	0	2	4

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Year: 2nd **Semester: III**

Course Code	Course Name	Contact Hours			Credits
		L	T	P	
	Specialized Elective 4	**3**	**0**	**2**	**4**
CSF701	Dissertation I				**14**
	Total Credits				**18**

Year: 2nd **Semester: IV**

Course Code	Course Name	Contact Hours			Credits
		L	T	P	
CSF702	Dissertation II				**20**
	Total Credits				**20**

SUMMARY OF THE CREDITS

Year	Semester	Credit
1	1	16
	2	14
2	3	18
	4	20
Total		**68**

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF601	Subject Title	DATA STRUCTURES AND ALGORITHMS DESIGN						
LTP	3 0 2	Credit	4	Subject Category	DC	Year	1st	Semester	I

OBJECTIVE

To understand and implement different types of data structures and their applications and learn different typesof algorithmic techniques and strategies.

COURSE CONTENTS

UNIT-1. **8L**

Analysis of Algorithms: Asymptotic Analysis, Asymptotic Notations, Running time calculation. Linear Data Structures: Arrays, Stacks, Queues, Lists, their operations, and implementations.

UNIT-2. **8L**

Searching and Sorting: Linear Search, Binary Search, Bubble Sort, Selection Sort, Insertion Sort, Shell Sort,Quick Sort, Heap Sort, Merge Sort, etc.

UNIT-3. **8L**

Algorithmic Strategies: Brute Force approach, Greedy approach, Divide and Conquer algorithms, Recursive Algorithms, Backtracking Algorithms, Dynamic Programming, etc. with appropriate examples.

UNIT-4. **8L**

Non-Linear Data Structures: Hash tables, Trees, Graphs, their operations, implementation with relevantexamples.

UNIT-5. **4L**

Miscellaneous Topics: P NP Problems, Randomized Algorithms, other miscellaneous algorithmic techniques.

COURSE OUTCOME

At the end of the course, the student will learn:

CO1: Analyze complexity of Algorithms.

CO2: Implement linear data structures and solve problems using fundamental algorithms.

CO3: Implement non-linear data structures and solve problems using fundamental algorithms.

CO4: Understand and Implement various algorithmic techniques to solve real world problems.

TEXT BOOKS

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, “Introduction to Algorithms”, PHI Learning Pvt.Ltd., 3rd Edition, 2012.
2. Anany Levitin, “Introduction to the Design and Analysis of Algorithm”, Pearson Education Asia, 3rdEdition, 2012.

REFERENCE BOOKS

1. M. T. Goodrich and R. Tomassia, “Algorithm Design: Foundations, Analysis and Internet Examples”, JohnWiley and sons
2. R. C. T. Lee, S. S. Tseng, R. C. Chang and T. Tsai, “Introduction to Design and Analysis of Algorithms Astrategic approach”, McGraw-Hill Education (Asia), 2005

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF602	Subject Title	MODELLING & SIMULATION						
LTP	3 0 2	Credit	4	Subject Category	DC	Year	1st	Semester	I

OBJECTIVE

Introduce computer simulation technologies and techniques, provides the foundations for the student to understand computer simulation needs, and to implement and test a variety of simulation and programs.

COURSE CONTENTS

UNIT-1. **8L**

Modelling: Concepts of a System, System Environment, Stochastic Activities, Continuous and Discrete System, Types of Models.

UNIT-2. **8L**

Discrete system simulation: Monte Carlo method, Random Number Generation: Congruence generators, long period generators, uniformity and independence testing. Random Variate Generation: Location, scale and shape parameters, discrete and continuous probability distributions; Inverse transformation method

UNIT-3. **8L**

Queuing Theory: Introduction, notation and assumption, Little's theorem, queuing model with poison input, exponential service and arbitrary service times, simulation of queuing system, simulation of single-server queue, Simulation of two server queuing system.

UNIT-4. **6L**

Simulation of Inventory Control: Elements of Inventory Theory, more complex inventory models, finite and infinite delivery rate model with and without back ordering, simulation of inventory systems.

UNIT-5. **6L**

Miscellaneous Topics: Simulation of PERT, CPM Computations, Verification and Validation of Simulation Models, Design of Simulation Experiment.

COURSE OUTCOME

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

CO1. Analyze simulation models of various types.

CO2. Identify and implement different types of models and simulations techniques for hypothesis testing.

CO3. Apply queuing theory and inventory control in various real-world applications.

CO4. Implement various algorithmic techniques use to link the physical world, the virtual world and the science of prediction.

TEXT BOOKS

1. Dingyü Xue and Yang Quan Chen, "System Simulation Techniques with MATLAB and Simulink," John Wiley & Sons, UK, 1st edition, 2013.
2. Deo Narsingh, "System Simulation with Digital Computer," Prentice-Hall of India Pvt. Ltd., 1st edition, 2009.

REFERENCE BOOKS

1. V. P. Singh, "System Modeling and Simulation," A New Age International Publisher, 2009
2. Gabriel A. Wainer, "Discrete-Event Modeling and Simulation: A Practitioners Approach," CRC Press, Boca Raton, FL, 2009.

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF611	Subject Title	ARTIFICIAL INTELLIGENCE AND KNOWLEDGE REPRESENTATION						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	I

OBJECTIVE
To provide the foundation for AI problem solving techniques and knowledge representation formalisms.

COURSE CONTENTS

UNIT-1. **6L**
Introduction to AI: Definitions, The Foundations AI, The History of AI, Intelligent Agents, Structure of Intelligent Agents, Environments

UNIT-2. **8L**
Problem-solving: Problem solving Agents, Problem Formulation, Search Strategies, Constraint Satisfaction Search, Informed Search Methods

UNIT-3. **8L**
Knowledge representation and reasoning: Agents that Reason Logically, Propositional Logic and Inference, First-Order Logic, Inference in First-Order Logic

UNIT-4. **8L**
Planning and Learning: Introduction to Planning, Types, Learning from observations, Forms of Learning, Inductive Learning, Learning decision trees, Reinforcement Learning

UNIT-5. **6L**
Uncertain knowledge and reasoning: Acting under Uncertainty, Basic Probability Notation, The Axioms of Probability, Bayes' Rule and Its Use, Probabilistic Reasoning System

COURSE OUTCOME
After the completion of the course, students will be able to:
CO1: Ability to compare different AI algorithms in terms of design issues, computational complexity, and assumptions.
CO2: Apply basic search techniques and AI algorithms for problem solving.
CO3: Able to explain how to represent knowledge required for problem solving.
CO4: Use the concepts of AI for real world problem solving.

TEXT BOOKS

1. Elaine Rich and Kevin Knight, “Artificial Intelligence”, McGraw-Hill
2. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Pearson Education

REFERENCE BOOKS

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann.
2. E Charniak and D McDermott, “Introduction to Artificial Intelligence”, Pearson

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF612	Subject Title	ROBOTICS SYSTEM						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	I

OBJECTIVE

To become familiar with different types of robotics components and their applications and learn different typesof techniques and strategies.

COURSE CONTENTS

UNIT-1. **8L**

Introduction to Robotics, History of robots, Classification of robots, Present status and future trends. Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission.

UNIT-2. **8L**

Drive system- hydraulic, pneumatic and electric systems Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors

UNIT-3. **8L**

Introduction to lego robotics kits, Introduction to robot manipulation. Forward and inverse kinematics of robotsand some case studies. Manipulator dynamics. Basics of robot control. Task planning with emphasis on computational geometry methods for robot path finding, robot arm reachability, grasp planning. Overview of robot vision and Parallel robots

UNIT-4. **6L**

Designing a Reactive Implementation, Overview, Behaviours as Objects in OOP Example: A primitive move- to-goal behavior Example: An abstract follow-corridor behavior.

UNIT-5. **6L**

steps in Designing a Reactive Behavioural System Case Study: Unmanned Ground Robotics Competition Assemblages of Behaviours Finite state automata Pick Up the Trash FSA Implementation Examples Abstract Behaviors Scripts.

COURSE OUTCOME:

At the end of the course the student will learn:

CO1. Understanding the concepts of Robotic system, its components and instrumentation and control related torobotics.

CO2. Creating the forward kinematics and inverse kinematics of serial and parallel robots.

CO3. Analyzing the Jacobian for serial and parallel robot.

CO4. Evaluating the path planning for a robotic system.

TEXT BOOKS

1. Nikku, S.B., Introduction to Robotics, Prentice Hall of India Private Limited (2002).
2. Schilling. R. J., Fundamentals of Robotics: Analysis and Control, Prentice Hall of India Private Limited(2006)

REFERENCE BOOKS

1. Criag, J., Fundamentals of Robotics: Analysis and Control, Prentice Hall of India Private Limited (2006)
2. Gonzalex, R. C. and Fu, K. S., Robotics Control Sensing, Vision and Intelligence, McGraw Hill (2004).Koren,Y., Robotics for Engineers, McGraw Hill (1985)

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF613	Subject Title	DATA COMMUNICATION SYSTEMS						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	1st	Semester	I

OBJECTIVE

This course aims to provide advanced background on relevant computer networking topics to have a comprehensive and deep knowledge in computer networks. Algorithms and protocols at the application, transport, network and medium access layers. The course explores emerging research challenges in the field of information and content centric networks, last mile network access from wireless and mobile devices and new networking paradigms.

COURSE CONTENTS

UNIT-1. **6L**

Network Layer: Design Issues, IPv4, IPv6, Shortest Path Routing, Distance Vector Routing, Flooding, Hierarchical Routing, Broadcast Routing, and Multicast Routing.

UNIT-2. **8L**

Wireless Networks: GSM Architecture, CDMA, Mobility in networks, Handoffs. Mobile IP- IP Packet Delivery, Agent Discovery, Registration, Tunneling and Encapsulation.

UNIT-3. **8L**

Mobile TCP: Traditional TCP (Congestion Control, Slow Start, Fast Retransmit/Fast Recovery), Indirect TCP,Snooping TCP, Mobile TCP, Selective Retransmission, Transaction Oriented TCP

UNIT-4. **8L**

Wireless LAN: Infrared Vs Radio Transmission, Infrastructure and Ad-hoc Network, IEEE 802.11-System Architecture, Protocol Architecture, Physical Layer, Bluetooth.

UNIT-5. **6L**

IP Security: Architecture, Authentication header, encapsulating security payloads, combining security associations, key management, SSL.

COURSE OUTCOME

At the end of the course the student will learn:

CO1. Understand the basics of data communication, networking, internet and their importance.
CO2. Analyze the services and features of various protocol layers in data networks.
CO3. Differentiate wired and wireless computer networks.
CO4. Understand contemporary networking technologies and security issues in networks.

TEXT BOOKS

1. Andrew S. Tanenbaum and David J. Wetherall, Computer Networks (5th Edition), Pearson Education.
2. Douglas E. Comer, Computer Networks and Internets (6th Edition), Cambridge, MA, USA: Pearson.

REFERENCE BOOKS

1. Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, Second Edition (TheMorgan Kaufmann Series in Networking), Elsevier.
2. Keith W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Pearson.

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF614	Subject Title	WIRELESS AND MOBILE SYSTEMS						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	I

OBJECTIVE

The objective of this course is to impart knowledge of various types of cellular, wireless and mobile systemsarchitectures and technologies.

COURSE CONTENTS

UNIT-1. **6L**

Introduction: Introduction, history and generations of Wireless and Mobile Systems.

UNIT-2. **8L**

Propagation Mechanisms: Free Space and Land Propagation, Path loss and fading, Doppler Effect, DelaySpread and Inter Symbol Interference.

UNIT-3. **8L**

Cellular Concepts: Cell, Clustering, Splitting and Sectoring, Interference, Multiple Division Techniques,Channel Allocation Techniques.

UNIT-4. **8L**

Mobile Communication Systems: Cellular System Infrastructure, Registration, Handoff and RoamingSupport, Multicasting, Security and Privacy.

UNIT-5. **6L**

Miscellaneous Topics: Wireless MANS, PANS, and LANS. Case studies of prominent systems.

COURSE OUTCOME

At the end of the course the student will learn:

CO1. Explain various radio propagation mechanisms.
CO2. Describe cellular concepts, multiple division techniques and channel allocation techniques.
CO3. Explain mobile communication system architecture.
CO4. Describe wireless MANS, LANS and PANS.

TEXT BOOKS

1. Introduction to Wireless and Mobile Systems, by D.P. Agrawal and Q. Zeng.

REFERENCE BOOKS

1. Wireless Communications: Principles and Practice, 2e, by T.S. Rappaport.

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF615	Subject Title	INTRODUCTION TO DATA SCIENCE						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	I

OBJECTIVE

Gain an in-depth understanding of Data Science processes, data wrangling, data exploration, data visualization, hypothesis building, and testing.

COURSE CONTENTS

UNIT-1. **6L**

Data Science Overview: Introduction to Data Science, Different Sectors Using Data Science, Purpose of Python.

UNIT-2. **8L**

Linear algebra: Algebraic view - vectors, matrices, product of matrix & vector, rank, null space. Geometric view - vectors, distance, projections, eigenvalue decomposition.

UNIT-3. **8L**

Statistical Analysis: Descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates

UNIT-4. **6L**

Optimization: Optimization, Typology of data science problems and a solution framework.

UNIT-5. **8L**

Regression: Simple linear regression and verifying assumptions used in linear regression, Multivariate linear regression, model assessment, assessing importance of different variables, subset selection

Classification: Classification using logistic regression, Classification using KNN and k-means clustering.

COURSE OUTCOME

At the end of the course the student will learn:

CO1. Identify and describe the methods and techniques commonly used in data science.

CO2. Understand and use various statistical methods to solve problems of data science.

CO3. Explain the overview of optimization techniques, concepts of objective functions.

CO4. Select real-world applications that needs machine learning based solutions and implementing the machine learning algorithms

TEXT BOOKS

1. Data Science Concepts and Practices, Vijay Kotu and Bala Deshpande, Morgan Kauffman Publishers, 2nd edition.
2. Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from The Frontline. O'Reilly, 2013.

REFERENCE BOOKS

1. Understanding Machine Learning: From Theory to Algorithms, Shai Shalev-Shwartz, Shai Ben-David, Cambridge University Press
2. Avrim Blum, John Hopcroft, and Ravindran Kannan, Foundations of Data Science, 2018.

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF616	Subject Title	DATA MINING						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	I

OBJECTIVE

This course will introduce the concepts of data warehousing and data mining, which describes the requirements, applications, architectures and design of data warehousing and examine the types of data to be mined through pre-processing of data and apply data mining algorithms to discover interesting patterns.

COURSE CONTENTS

UNIT-1. **6L**

Introduction to Data Warehousing: Data Warehouse Definition, Perspectives of DW, Applications of DW.

UNIT-2. **6L**

Dimensional Modelling and ETL: Multi-Dimensional Data Model, Data Cubes, Stars and Snowflakes schema, Fact Constellations, Mapping ER to DW Schema, Extraction, Transformation, and Loading.

UNIT-3. **8L**

OLAP: OLAP functions, OLAP vs. OLTP, ROLAP, MOLAP, HOLAP, MDX query language.

Data Pre-processing: Data Cleaning, Missing Values, Noisy Data, Binning, Clustering, Regression, Inconsistent Data, Data Integration and Transformation, Dimensionality reduction, Data Compression, Dimensionality reduction.

UNIT-4. **8L**

Introduction to Data Mining: Data warehousing to Mining, Motivation (for Data Mining), Data Mining-Definition & Functionalities.

Association Rule Mining: Apriority Algorithm, Mining Multilevel Association rules from Transaction Databases.

UNIT-5. **8L**

Classification and Prediction: Regression, Decision tree Classification, Bayesian Classification, Support Vector Machine, Classification by Backpropagation.

Cluster Analysis: Partitioning methods. Hierarchical Clustering- AGNES, DIANA CURE and Chameleon, Density-Based Methods-DBSCAN, OPTICS, Grid-Based Methods- STING, CLIQUE, Outlier Analysis.

COURSE OUTCOME

At the end of the course the student will learn:

CO1. Understand the architecture of data warehousing system and ETL operations.

CO2. Design data models for a data warehouse and perform business analysis with OLAP tools.

CO3. Apply suitable data-preprocessing techniques for data cleaning and transformation.

CO4. Implement data mining algorithms for frequent itemset mining, classification, prediction, and clustering.

TEXT BOOKS

1. Data Mining Concepts and Techniques, Jiawei Han and Micheline Kamber, Elsevier, Third Edition, 2012.
2. "Doing Data Science, Straight Talk from the Frontline", Cathy O'Neil and Rachel Schutt, O'Reilly. 2014.

REFERENCE BOOKS

1. Data-Mining. Introductory & Advanced Topicsǁ, Margaret H. Dunham, Pearson Education, India, 3rdedition, 2012.
2. Data Mining and Analysis: Fundamental Concepts and Algorithms", Mohammed J. Zaki and WagnerMiera Jr. Cambridge University Press. 2014.

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF617	Subject Title	VISUAL COMPUTING						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	I

OBJECTIVE

Computer Vision focuses on development of algorithms and techniques to analyse and interpret the visible world around us. This requires understanding of the fundamental concepts related to multi-dimensional signal processing, feature extraction, pattern analysis visual geometric modelling, stochastic optimization etc. Knowledge of these concepts is necessary in this field, to explore and contribute to research and further developments in the field of computer vision. Applications range from Biometrics, Medical diagnosis, document processing, mining of visual content, to surveillance, advanced rendering etc.

COURSE CONTENTS

UNIT-1. **8L**

Digital Image Formation and Low-Level Processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc. Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing**.**

UNIT-2. **6L**

Depth Estimation and Multi-Camera Views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

UNIT-3. **8L**

Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

UNIT-4. **8L**

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

UNIT-5. **6L**

Motion Analysis: Background Subtraction and Modelling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

COURSE OUTCOME

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

CO1: To recognize and identify specific faces, among others.

CO2: Learn how to install Open CV and explore basic image processing concepts.

CO3: To develop techniques to separate foreground and background in images, create stunning panoramas, calibrate the camera and automatically detect common objects like faces or people in images.

CO4: To build a 3D representation of a scene using stereoscopic images.

TEXT BOOKS

1. David A. Forsyth and Jean Ponce. Computer Vision: A Modern Approach. Second Edition Pearson 2015.
2. Robert Haralick and Linda Shapiro. Computer and Robot Vision. Vol-I/II, Addison Wesley, 1993.

REFERENCE BOOKS

1. Milan Sonka, Vaclav Hlavac, and Roger Boyle. Image Processing, Analysis, and Machine Vision. Fourth Edition. CENGAGE Learning.

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF618	Subject Title	ADVANCED IMAGE PROCESSING						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	I

OBJECTIVE

- To learn about the basic concepts of Digital Image Processing and various Image Transforms.
- To familiarize the student with the Image Enhancement Techniques.
- To expose the student to a broad range of Image Processing Techniques and their Applications.
- To appreciate the use of current technologies those are specific to Image Processing Systems.
- To expose the students to real-world applications of Image Processing.

COURSE CONTENTS

UNIT-1. **6L**

Fundamentals of Image Processing: Introduction–Applications of Image Processing – Steps in Image Processing Applications – Digital Imaging System – Sampling and Quantization – Pixel Connectivity – Distance Measures – Colour Fundamentals and Models – File Formats, Image Operations.

UNIT-2. **8L**

Image Enhancement: Image Transforms: Fast Fourier Transform and Discrete Fourier Transform – Image Enhancement in Spatial and Frequency Domain – Grey level Transformations–Histogram Processing – SpatialFiltering – Smoothing and Sharpening – Filtering in Frequency Domain.

UNIT-3. **6L**

Image Restoration and Multi-Resolution Analysis: Multiresolution Analysis: Image Pyramids – Multi Resolution Expansion – Wavelet Transforms–Image Restoration–Image Degradation Model–Noise Modelling
– Blur – Order Statistic Filters–Image restoration Algorithms.

UNIT-4. **8L**

Image Segmentation and Feature Extraction: Image Segmentation – Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region based Segmentation –Image Features and Extraction–Image Features– Types of Features–Feature Extraction–SIFT, SURF and Texture– Feature Reduction Algorithms.

UNIT-5. **8L**

Image Processing Applications: Image Classifiers – Supervised Learning – Support Vector Machines, Image Clustering – Unsupervised Learning – Hierarchical and Partition Based Clustering Algorithms – EM Algorithm
– Case Studies in Biometrics – Iris, Fingerprint and Face Recognition – Case Studies on Image Security – Steganography and Digital Watermarking – Case Studies on Medical Imaging and Remote Sensing.

COURSE OUTCOME

At the end of the course the student will learn:

CO1. Understand the basis of image processing.

CO2. The ability to apply principles and techniques of digital image processing in applications related to advancedtopics in digital imaging system design and analysis.

CO3. The ability to analyze and implement advanced image processing algorithms and the ability to modify them.

CO4. The ability to analyze and implement 3D Visualization."

TEXT BOOKS

1. Digital Image Processing (3rd Edition) Rafael C. Gonzalez, Richard E. Woods Prentice Hall, 2007
2. Image Processing, Analysis and Machine Vision (4th Edition), Milan Sonka, Vaclav Hlava and RogerBoyle, 2013

REFERENCE BOOKS

1. Robert J. Schalkoff, Digital Image Processing and Computer Vision, John Wiley and Sons, NY, 1stEdition, 1989.
2. Mark Nixon, Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press, 2008.

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF641	Subject Title	INTERNET OF THINGS AND EDGE COMPUTING						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	II

OBJECTIVE

The objective of this course is to impart fundamental and applied concepts of IoT systems, and understand various kinds of communication using system-on-chip devices so that students can develop end-to-end IoT prototypes.

COURSE CONTENTS

UNIT-1. **8L**

Introduction: IoT Architecture, Sensing, Communication and Actuation, Hardware and Software setup.

UNIT-1. **6L**

GPIO: Pin setup and interfacing using GPIO pins.

UNIT-1. **6L**

Communication and Protocols: Serial Communication in IoT, Serial Peripheral Interface (SPI) and Inter- Integrated Circuit (I2C) in IoT.

UNIT-1. **8L**

IoT Analytics: Data transmission in Cloud, IoT Analytics and Visualization.

UNIT-1. **8L**

Miscellaneous Topics: IoT Security, IoT Project execution and demonstration.

COURSE OUTCOME

At the end of the course the student will learn:

CO1. Understand fundamental concepts and building blocks of an IoT system.

CO2. Implement IoT prototypes using GPIO programming, sensors, and various communication protocols.CO3. Develop end-to-end systems by syncing with Cloud.

CO4. Understand security aspects of an IoT system.

TEXT BOOKS

1. No text book, teaching and learning materials will be provided by the instructor of the subject.

REFERENCES

1. No reference book, teaching and learning materials will be provided by the instructor of the subject.

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF642	Subject Title	CLOUD COMPUTING AND VIRTUALIZATION						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	II

OBJECTIVE

To become familiar with different cloud deployments and service models and learn various aspects of cloudsecurity.

COURSE CONTENTS

UNIT-1. **6L**

Definition of Cloud Computing: Define cloud computing, service models, deployment models, Differencebetween Cloud Computing and other computing paradigm.

UNIT-2. **8L**

Public Cloud: Concept of Public Cloud, Public cloud players, IaaS/PaaS/SaaS Vendors and their servicescomparisons (AWS, Microsoft, Google, IBM, Salesforce).

Private Cloud: Basics of Virtualization Technologies, Virtualization Types, Hypervisors Concepts and Its Types, Private Cloud Concept, Concept of Multitenancy and its Types. API and Billing Services.

UNIT-3. **8L**

Multi Cloud: Multi Cloud Concepts, Need and benefits of Multi Cloud, Challenges in managing heterogeneousclouds, Introduction of OpenStack, ESXi Server, Xen, KVM.

UNIT-4. **8L**

Cloud Security: Cloud Security Reference Model, Public cloud security breaches, Malicious insider, ServiceHijacking, Identity Management, Abuse and Nefarious Use of Cloud.

UNIT-5. **6L**

Miscellaneous Topics: Case study on: Private cloud, Multi-Cloud Management System (Right Scale CloudManagement System).

COURSE OUTCOME

At the end of the course the student will learn:

CO1: Define the cloud deployment and service model, and virtualization technology

CO2: Develop and analyze the public and private cloud architecture.

CO3: illustrate the Multi-Cloud concepts and their usages for service management using virtualization.

CO4: Elaborate the different security concerns of different cloud deployments.

TEXT BOOKS

1. R. Buyya, C. Vecchiola, S. T. Selvi, Matering Cloud Computing, Ed. Third reprint, 2013.
2. Carlin, Sean, and Kevin Curran. "Cloud computing security." Pervasive and Ubiquitous TechnologyInnovations for Ambient Intelligence Environments. IGI Global, 2013. 12-17.

REFERENCE BOOKS

1. M. Miller, Cloud Computing, Pearson education in South Asia, Ed. 9th 2014.
2. Buyya, Rajkumar, James Broberg, and Andrzej M. Goscinski, eds. Cloud computing: Principles andparadigms. John Wiley & Sons, 2010.

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF643	Subject Title	PROGRAMMING FOR DATA SCIENCE						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	II

OBJECTIVE

To become familiar with the basic concepts of R programming and its utilities to implement and analyse variousstatistical and machine learning approaches in data science.

COURSE CONTENTS

UNIT-1. **8L**

Introduction to Data Science and R: Definition: Big Data and Data Science Hype, why data science, Data Science Process: Overview, defining goals, retrieving data, Data preparation, Data exploration, Data modeling, Presentation, Introduction of R, Vectors and Data Frames, Data analysis with summary statistics and scatter plots, Summary tables, working with Script Files.

UNIT-2. **8L**

R Programming Basics: R data types and objects: Number and Text, Vector, Matrix, Factor, Array, List Data Frame, Manipulating Objects. Control structures, looping, scoping rules, Operations on Dates and Times, functions, debugging tools. R built-in packages and functions.

UNIT-3. **6L**

Data Visualization using R: Reading and loading data into R: Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. Working with Charts and Graphs using R: Histograms, Boxplots, Bar Charts, LineGraphs, Scatterplots, and Pie Charts.

UNIT-4. **6L**

Introduction to Statistical using R: Normal and Binomial distributions, Dispersion: variance, standard deviation, shape– skewness, kurtosis, percentiles, Central Tendency, Time Series Analysis, Linear and Multiple Regression, Logistic Regression.

UNIT-5. **8L**

Machine Learning using R: Introduction to machine learning, Application of Machine Learning, types of machine learning, supervised learning: Regression, Classification, Specifying and Validation of models, supervised learning packages. Unsupervised Learning: Dimensionality reduction, clustering, association rule.

COURSE OUTCOME

At the end of the course the student will learn:

CO1. An understanding of problems solvable with data science and an ability to attack them from a statisticalperspective.

CO2. An understanding of when to use supervised and unsupervised statistical learning methods on labeled andunlabeled data-rich problems.

CO3. The ability to create data analytical pipelines and applications in Python.

CO4. Familiarity with the Python data science ecosystem and the various tools needed to continue developing asa data scientist.

TEXT BOOKS

1. Cathy O 'Neil and Rachel Schutt, Doing Data Science, Straight Talk from the Frontline, O 'Reilly. 2014
2. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, Third Edition. ISBN0123814790, 2011

REFERENCE BOOKS

1. Mohammed J. Zaki and Wagner MieraJr., Data Mining and Analysis: Fundamental Concepts andAlgorithms. Cambridge University Press. 2014.
2. Douglas Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, 2014

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF644	Subject Title	APPLIED MACHINE LEARNING AND DEEP LEARNING						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	II

OBJECTIVE

To become familiar with different types of learning such as supervised and unsupervised learning and their applications and learn different types of techniques and strategies.

COURSE CONTENTS

UNIT-1. **8L**

Definition of learning systems, Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation. Types of Learning: Supervised learning and unsupervised learning. Overview of classification: setup, training, test, validation dataset, over fitting. Classification Families: linear discriminative, non-linear discriminative, decision trees, KNN.

UNIT-2. **6L**

Logistic regression, Perceptron, Exponential family, Generative learning algorithms, Gaussian discriminant analysis, Naive Bayes, Support vector machines: Optimal hyper plane, Kernels. Model selection and feature selection. Combining classifiers: Bagging, boosting (The Ada boost algorithm), Evaluating and debugging learning algorithms, Classification errors.

UNIT-3. **6L**

Unsupervised learning: Clustering. K-means. EM Algorithm. Mixture of Gaussians. Factor analysis. PCA (Principal components analysis).

UNIT-4. **8L**

Introduction to Convolutional Neural Networks: Introduction to CNNs, Introduction to RNNs Kernel filter, Principles behind CNNs, Multiple Filters, CNN applications Introduction to Recurrent Neural Networks: Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, RNN applications

UNIT-5. **8L**

Deep Learning applications: Image Processing, Natural Language Processing, Speech Recognition, VideoAnalytic

COURSE OUTCOME

At the end of the course the student will learn:

CO1. Discuss about the use of various machine learning algorithms and implementation.
CO2. Understanding the application of Deep Learning Methods.
CO3. Will understand the concepts of various learning.

TEXT BOOKS

1. Deep Learningǁ, Ian Good fellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.
2. Ethem Alpaydin, Introduction to Machine Learning, PHI, 3rd edition, 2015.

REFERENCE BOOKS

1. Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press, 2nd edition, 2014.
2. “Neural Networks: A Systematic Introduction”, Raúl Rojas, 1996 2. Pattern Recognition and MachineLearning, Christopher Bishop, 2007.

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF645	Subject Title	DATA ANALYTICS						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	II

OBJECTIVE
To become familiar with various data analytics approaches to solve many real life problems.

COURSE CONTENTS

UNIT-1. **6L**
Data Definitions and Analysis Techniques: Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing, Introduction to statistical learning.

UNIT-2. **8L**
Descriptive Statistics: Introduction to graphical approaches, Measures of central tendency, Measures of locationof dispersions.
Data Quality and Pre-processing: Data Quality, Missing values, redundant data, inconsistent data, noisy data, outliers, Data transformation, Dimensionality reduction, Attribute aggregation.

UNIT-3. **8L**
Probability distributions and Inferential statistics: Random Variables and Probability distributions, inferential statistics: Motivation, Single Sample test, Two sample tests, Type1 and Type 2 Errors, Confidence intervals, ANOVA and Test of Independence, Basics of Regression.

UNIT-4. **6L**
Basic analysis techniques: Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test.

UNIT-5. **8L**
Data analysis techniques: Regression analysis, Classification techniques, Clustering, Association rules analysis. Introduction to Big Data Analytics: Big Data, V's definition of Big Data, Scalable and parallel computing for data intensive and computation intensive applications.

COURSE OUTCOME
At the end of the course the student can:
CO1. Describe the life cycle phases of Data Analytics through discovery, planning and building.
CO2. Learn various Data Analysis Techniques.
CO3. Implement various Data streams.
CO4. Understand item sets, Clustering, frame works & Visualizations for developing real time applications.

TEXT BOOKS

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press.

REFERENCE BOOKS

1. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big Data Analytics", EMC Education Series, John Wiley
2. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF646	Subject Title	IMAGE AND VIDEO PROCESSING						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	II

OBJECTIVE

- To provide the basic understanding of the digital image formation and visualization.
- To provide the visualization of relationships between spatial and frequency.
- To provide the understanding of mapping the signal processing techniques to the digital image.
- To provide an idea of multimedia data (image, video).
- To provide an exposure to various image and video compression standards.

COURSE CONTENTS

UNIT-1. **8L**

Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms

UNIT-2. **8L**

Image Processing Techniques: Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial Filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation Image Compression

UNIT-3. **6L**

Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models: Lossy and Lossless, Huffman coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding, wavelet coding, JPEG standards

UNIT-4. **6L**

Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models: 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations

UNIT-5. **8L**

2-D Motion Estimation: Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, block based transform coding, predictive coding, Application of motion estimation in video coding.

COURSE OUTCOME

At the end of the course the student can:

CO1. Understand theory and models in Image and Video Processing.

CO2. Explain the need of spatial and frequency domain techniques for image compression.

CO3. Comprehend different methods, models for video processing and motion estimation.

CO4. Illustrate quantitative models of image and video segmentation and apply the process of image enhancement for optimal use of resources

TEXT BOOKS

1. Gonzaleze and Woods, “Digital Image Processing”, 3rd edition, Pearson
2. Yao wang, Joem Ostarmann and Ya – quin Zhang, “Video processing and communication” ,1st edition,PHI

REFERENCE BOOKS

1. M. Tekalp, “Digital video Processing”, Prentice Hall International
2. Chris Solomon, Toby Breckon, “Fundamentals of Digital Image Processing a Practical Approach withExamples in Matlab”, John Wiley & Sons

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF647	Subject Title	NATURAL LANGUAGE PROCESSING						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	II

OBJECTIVE

To gain a foundational understanding of natural language processing methods, strategies and how computational methods be used for language phenomena and develop skills for finding solutions of real-world problems and building applications using natural language processing techniques.

COURSE CONTENTS

UNIT-1. **8L**

Introduction: NLP tasks in syntax, semantics, and pragmatics, Applications such as information extraction, question answering, and machine translation, problem of ambiguity, role of machine learning in NLP.

Regular expressions: Chomsky hierarchy, regular languages and their limitations, Finite-state automata, Regular Expressions, Text Normalization, and Edit Distance, Morphology & Finite-state Transducers.

UNIT-2. **6L**

Introduction to probability theory: Probabilistic models, Events, and counting, Joint and conditional probability, marginals, independence, Bayes rule, combining evidence, examples of applications in natural language.

UNIT-3. **8L**

N-gram language models: The role of language models, Simple N-gram models, estimating parameters and smoothing. Evaluating language models.

Part of Speech tagging and sequence labeling: Lexical syntax, Hidden Markov Models, Viterbi and A* decoding, Word classes and POS tagging.

UNIT-4. **8L**

Syntactic parsing: Efficient parsing for context-free grammars, Statistical parsing and probabilistic CFGs, CFG for English and Parsing.

Semantics: Introduction & Distributional semantics, Lexical semantics, and word-sense disambiguation. Compositional semantics, Semantic Role Labeling and Semantic Parsing.

UNIT-5. **6L**

Advance topics: Text classification, Text Summarization, Sentiment analysis, Stylometry analysis, Web mining.

COURSE OUTCOME

At the end of the course the student will be able to:

CO1. Describe the concepts of NLP tasks applications and Relate NLP with Regular expressions & machine learning

CO2. Evaluate, analyze and apply different NLP models such as HMM, n-gram and Wordnet etc.

CO3. Discover various linguistic and statistical features and Develop systems for various NLP problems with moderate complexity.

CO4. Analyze real-world datasets generated from a range of real-world applications and Build models in solving real-world problems

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

TEXT BOOKS

1. Jurafsky Daniel and Martin James H. “Speech and Language Processing”, Prentice Hall, 3rd Edition,2018.
2. Roland R. Hausser, Foundations of Computational Linguistics: Human Computer Communication inNatural Language, Paperback, 3rd ed. 2014, Springer

REFERENCE BOOKS

1. Machine Learning for Text by Charu C. Aggarwal, Springer, 2018 edition
2. Steven Bird, Ewan Klein and Edward Loper Natural Language Processing with Python, O’Reilly Media;1 edition, 2009.

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF648	Subject Title	RESEARCH ETHICS AND METHODS						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	1st	Semester	II

OBJECTIVE

To become familiar with research, methodologies, and comprehend different techniques for the data collection and analysis.

COURSE CONTENTS

UNIT-1. **8L**

Introduction to Research: Meaning and importance of Research, Types of Research, Research Design and Stages, Selection and Formulation of Research Problem, Objective(s) and Hypothesis, Developing Research Plan – Exploration, Description, Diagnosis, Experimentation, Determining Experimental and Sample Design.

UNIT-2. **8L**

Data Collection: Sources of Data, Primary and Secondary, Types of Data – Categorical (nominal and ordinal), Numerical (discrete, continuous, ratio and interval), Methods of Data Collection: Survey, Interviews (in-depth or Key Informant interviews), Focus Group Discussion (FGD), Observation, Records or Experimental Observations.

UNIT-3. **6L**

Data Processing and Analysis: Statistical Graphics – Histograms, Frequency Polygon, Ogive, Dot plots, Stem plots, Bar Graphs, Pareto Charts, Pie Charts, Scatterplots, Boxplots, Descriptive Analysis – Frequency Distributions, Measures of Central Tendency, Measures of Variation/Dispersion, Skewness and Kurtosis, Measures of Relative Standing, ANOVA, Multivariate Analysis, SPSS

UNIT-4. **8L**

Scientific Writing: Structure and Components of Scientific Reports – Types of Report – Technical Reports and Thesis – Significance – Different steps in the preparation – Layout, Structure and Language of Typical Reports

– Illustrations and Tables – Bibliography, Referencing and Foot Notes. Preparation of the Project Proposal – Title, Abstract, Introduction – Rationale, Objectives, Methodology – Time frame and Work Plan – Budget and Justification – References.

UNIT-5. **6L**

Ethical Issues: Ethical Committees, Commercialization, copy right, royalty, Intellectual Property rights and patent law, Track Related aspects of intellectual property Rights, Reproduction of published material, Plagiarism, Citation and Acknowledgement, Reproducibility and accountability.

COURSE OUTCOME

At the end of the course the student can:

CO1. Formulate the research problem statement and plan.

CO2. Collection of data using various techniques.

CO3. Statistically analyse the data.

CO4. Understand the importance of research ethics for scientific writing.

TEXT BOOKS

1. Yadav Santosh. Research and Publication Ethics, 2020.

REFERENCE BOOKS

1. Research Ethics Handbook: Philosophy, History and Theory, Brunel University London. 2015

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CS649	Subject Title	FUZZY NEURAL NETWORK						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	2nd	Semester	III

OBJECTIVE

To provide knowledge of fuzzy logic and neural network with its different approaches and methods that can beapplied to solve real life problems.

COURSE CONTENTS

UNIT-1. **8L**

Introduction to Fuzzy Sets: Basic Concepts of Crisp sets vs. Fuzzy Sets, Comparison with classical Logic, Elements of Fuzzy Logic, Fuzzification, Membership Function, Fuzzy Set operations, Relation Matrix, Min- Max Theorem, De-fuzzification, MOM and COG method.

UNIT-2. **6L**

Fuzzy Logic: Fuzzy Inference System Rules, Propositional logic and predicate logic, Approximate Reasoning, Mamdani Fuzzy inference system, Fuzzy Modeling, Fuzzy Decision Making, Fuzzy Control Systems.

UNIT-3. **8L**

Introduction to Neural Networks: Basic concepts of Neural Networks, Biological Neural System, Artificial Intelligent Systems, Modeling human performance. Uncertain & incomplete knowledge, Expert Systems Vs Neural Networks, Multilayer feed forward networks and recurrent networks.

UNIT-4. **6L**

Artificial Neural Networks: ANN Architecture, Activation functions, Characteristics of Neural Networks, Single layer perception, Multilayer Perception, Supervised and Unsupervised learning, Reinforcement learning, Backpropagation networks, Competitive Learning Neural Networks, Hopfield network - energy; stability; capacity.

UNIT-5. **8L**

Application of Fuzzy Logic and Neural Network: Hybrid Systems, Design of Fuzzy systems, Use of Fuzzy Approach in Neural Networks, Neuro-Fuzzy Systems: Types of Fuzzy Neural Nets, Neural components in a Fuzzy System, Fuzzy-ANN Controller, Application in pattern recognition, Image processing and computer vision, Application in control: Fuzzy controllers, neuro controllers and fuzzy neuro controllers, applications in expert systems and decision-making systems, application in real world computing.

COURSE OUTCOME

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

CO1: Understand the concept and theories of Fuzzy Logic and Neural Network.

CO2: Identify and analyse the different approaches and methods of Fuzzy logic and Neural Network.

CO3: Apply Fuzzy logic for control system design.

CO4: Apply design and Develop Fuzzy based Neural Network systems.

CO5: Implement Neural Network and evaluate different solutions of various real-life problems.

TEXT BOOKS

1. Timothy J Ross, Fuzzy Logic with Engineering Applications, John Willey and Sons, West Sussex, England, 4th edition, 2016
2. Simon Haykin, Neural Networks: A Comprehensive Foundation, Prentice Hall, 2nd edition, 2002.
3. Kosko, B, Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence, Prentice Hall, New Delhi, 2009.

REFERENCE BOOKS

1. Jack M. Zurada, "Introduction to Artificial Neural Systems", PWS Publishing Co., Boston, 2002.
2. John Yen and Reza Langan, "Fuzzy Logic: Intelligence, Control and Information", Pearson Education, 2004.

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF650	Subject Title	EVOLUTIONARY COMPUTING TECHNIQUES						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	2nd	Semester	III

OBJECTIVE

The main goal of this course is to help students learn evolution method for computer solvable problems using Darwinian laws. Students shall be able to get familiar with advanced concepts of mutation and the implementation of the biological concepts through methods such as neural networks and statistical methods.

COURSE CONTENTS

UNIT-1. **8L**

Evolutionary Computing: The Origins, The Main Evolutionary Computing Metaphor, Brief History, TheInspiration from Biology: Darwinian Evolution, Genetics, Taboo Search.

UNIT-2. **8L**

Evolutionary Algorithm: What Is an Evolutionary Algorithm, Components of Evolutionary Algorithms: Representation, Evaluation Function, Parent Selection, Variation Operators (Mutation and Recombination), Survivor Selection Mechanism (Replacement), Termination Condition.

UNIT-3. **8L**

Representation, Mutation, and Recombination: Representation and the Roles of Variation Operators, Binary Representation, Integer Representation, Real-Valued or Floating-Point Representation, Permutation Representation, Tree Representation.

UNIT-4. **8L**

Fitness, Selection, and Population Management: Population Management Models, Parent Selection Survivor Selection**,** Selection Pressure**,** Multimodal Problems, Selection, and the Need for Diversity

UNIT-5. **8L**

Application: Genetic Algorithms, Genetic Programming, Global and local optimization, Particle Swarm Optimization Ant System (AS).

COURSE OUTCOME

At the end of the course the student can:

CO1. Understand the fundamental of evolution-based learning algorithms, advanced searching andoptimization techniques.

CO2. Understand and implement the concepts of genetic algorithms and genetic programming

CO3. Ability to solve problems using swarm intelligence, Ant Colony Optimization

CO4. Understand multimodal problems and their solution and understand the concept of Spatial Distribution

TEXT BOOKS

1. K. Deb, Multi-objective Optimization using Evolutionary Algorithms, Wiley, 2001.
2. Carlos Coello Coello, Gary B. Lamont, David A. van Veldhuizen, Evolutionary Algorithms for SolvingMulti-Objective Problems, Springer, 2007

REFERENCE BOOKS

1. A.E. Eiben J.E. Smith, Introduction to Evolutionary Computing, Springer, 2015
2. Ashish M. Gujarathi, B. V. Babu, Evolutionary Computation Techniques and Applications, Apple Academic Press, 2016

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code	CSF651	Subject Title	APPLIED CRYPTOGRAPHY						
LTP	3 0 2	Credit	4	Subject Category	DE	Year	2nd	Semester	III

OBJECTIVE

Gain an in-depth knowledge of Encryption and Decryption, Cryptanalysis, Intrusion Detection System, Non-conventional Encryption and Decryption, Botnet.

COURSE CONTENTS

UNIT-1. **6L**

Basic Cryptography Concepts: Purpose of Cryptography, Need for security, Encryption Techniques and Classical methods.

UNIT-2. **6L**

Number Theory: Finite fields, Modular arithmetic, Efficient algorithms for modular arithmetic, Fermat's little theorem, Euler's criteria, Euler's function, Primality testing, prime factorization.

UNIT-3. **8L**

Modern ciphers and Public Key Cryptography: Block ciphers and their applications, Structure of a block cipher, Data Encryption Standard (DES), AES, Diffie-Hellman method, RSA and related methods.

UNIT-4. **8L**

Cryptanalysis: Linear cryptanalysis, Differential cryptanalysis.
Intrusion Detection System: Basic of Intrusion Detection and Prevention System, Host-based and Network based IDS.

UNIT-5. **8L**

Non-conventional Methods: Genetic Algorithm, Fuzzy Logic, Neural Network and Chaos based Encryption techniques.

COURSE OUTCOME

At the end of the course the student can:

CO1. Solve the encryption and decryption of modern ciphers like AES.
CO2. Solve the public key cryptography.
CO3. Identify the strength of cryptosystems by using various cryptanalysis techniques.
CO4. Solve Non-conventional encryption techniques.

TEXT BOOKS

1. Cryptography and Network Security: Principals and Practice, William Stallings, Pearson Education, 7th Edition,2017"
2. Cryptography and Network Security, Forouzan Behrouz, TMH, 2nd edition, 2011

REFERENCES

1. Network Security and Cryptography, Bernard Menezes, Cengage Learning,3rd edition,2015
2. Applied Cryptography: Protocols, Algorithms and Source Code in C, Bruce Schneier, Wiley, 2015

COURSE STRUCTURE & SYLLABUS OF M. TECH – COMPUTER SCIENCE & ENGINEERING
APPLICABLE FOR BATCH: 2022-2024

Subject Code		Subject Title	DESSERTATION I & DESSERTATION II						
LTP		Credit	14 & 20	Subject Category		Year	2nd	Semester	III & IV

M. Tech. Dissertation
M. Tech. program students are required to take up the project in two phases in last two semesters of theirrespective programs.

Allotment –Topic for M. Tech. thesis/dissertation as guide to be assigned by the Head of the Department inconsonance with the area of research and the area of expertise of the guide.

Monitoring of Progress – Day to day monitoring has to be done by the guide as per the time slot decided bythe concerned faculty member guiding the project.

Evaluation – Thesis/project report will be conducted in two parts. Dissertation I & Dissertation II in Pre final& final semester respectively and will be evaluated out of 100 marks as shown in the table given below.

Table. 1. Evaluation Scheme

Sr. No.	Evaluation	Marks
1.	Day to day evaluation by the guide	20
2.	First Presentation, between 3rd and 4th week	20
3.	Midterm evaluation (after midterm examinations)	20
4.	End term evaluation (after end term examinations)	40
Total		**100**

Project is to be done by a panel of examiners comprising of –

A. Internal Exam: (In 3rd semester)
1. Head of the Department - Chairperson
2. Thesis Guide – Faculty member from the concerned department assigned by the HoD.
3. Two faculty members from the department nominated by HoD and marks allotment.
4. Dissertation-II 3rd Presentation has one External Examiner.

Dissertation I.
1st Presentation – Topic and guide selection, literature review.
2nd Presentation – Detailed presentation on literature review, collection of references and discussion on the workselected i.e. synopsis of proposed research work.
3rd Presentation – Complete documentation of the experimentation and data collection, road map for DissertationII.

Dissertation II.
Completion of experimentation and data collection, result analysis 1st Presentation – Detailed report of data collection.
2nd Presentation – Completion of result analysis and thesis write up.
3rd Presentation – Submission of complete presentation on thesis and dissertation