School of Engineering & Technology

M.Tech. –Computer Science and Engineering

Semester I, II, III & IV

AY 2023-24

Semester I

Sl. No	Course Type	Course Code	Course Name	Hours per week			Credit	Mark	
				L	T	P	C	CA	FA
Theory									
1.	BSC		Mathematical and Statistical Foundations	3	0	0	3	40	60
2.	ESC		Advanced Data Structures & Algorithms	3	0	0	3	40	60
3.	MC		Research Methodology and IPR	2	0	0	2	40	60
4.	ESC		Machine Learning	3	1	0	4	40	60
5.	ESC		DSE 1	3	0	2	4	40	60
6.	AC		Audit Course	2	0	0	0	0	0
Practical									
1.	ESC		Advanced Data Structures & Algorithms LAB 1	0	0	4	2	50	50
2.	ESC		Machine Learning Lab	0	0	4	2	50	50
TOTAL				16	1	10	**20**	300	400

List of DSE 1:

1 Introduction to Intelligent Systems

2 Cyber security

3 Software Engineering

4 Fundamentals of Data Science

5 Advanced Web Technology

Any other subject offered from time to time with the approval of the University

List of Audit Courses:

1. Constitution of India
2. Disaster Management
3. Industrial Safety

Semester II

Sl. No	Course Type	Course Code	Course Name	Hours per week			Credit	Mark	
				L	T	P	C	CA	FA
Theory									
1.	ESC		Big Data Analytics	3	1	0	4	40	60
2.	ESC		Advanced Database Management System	3	0	0	3	40	60
3.	ESC		DSE 2	3	0	0	3	40	60
4.	ESC		DSE 3	3	0	0	3	40	60
Practical									
1.	ESC		Advanced Database Management System Lab	0	0	2	1	50	50
2.	ESC		DSE 2 LAB	0	0	4	2	50	50
3.			Minor Project	0	0	8	4	50	50
TOTAL				12	1	14	**20**	310	390

List of DSE 2:

1. Advanced Graph Theory
2. Image processing
3. Natural Language Processing
4. Compiler design

Any other subject offered from time to time with the approval of the University

List of DSE 3:

1. Data Communication and Computer Networks
2. Wireless Technologies for WSN & IoT
3. Cloud Computing

Any other subject offered from time to time with the approval of the University

Semester III

Sl. No	Course Type	Course Code	Course Name	Hours per week			Credit	Mark	
				L	T	P	C	CA	FA
Theory									
1.	ESC		Deep Learning	3	0	0	3	40	60
2.	ESC		DSE 4	3	0	0	3	40	60
Practical									
1.	ESC		Deep Learning LAB	0	0	4	2	50	50
2.	ESC		Dissertation Phase-I	0	0	24	12	200	200
TOTAL				6	0	28	**20**	330	370

List of DSE 4:

1. Crypto & Cyber Security
2. Fundamentals Of Bioinformatics
3. Advanced operating system

Any other subject offered from time to time with the approval of the University

Semester IV

Sl. No	Course Type	Course Code	Course Name	Hours per week			Credit	Mark	
				L	T	P	C	CA	FA
Project									
1.	PCC		Dissertation Phase – II	0	0	36	18	300	300
2.	AEC		Seminar	0	1	2	2	50	50
TOTAL				0	1	38	**20**	350	350

Department of Computer Science and Engineering

M.Tech – Computer Science & Engineering

SEMESTER - I

BSC	Mathematical and Statistical Foundations	L	T	P	C
		3	0	0	3

Prerequisite: Basic Statistics

Course Objectives:

1. The Number Theory basic concepts useful for cryptography etc.

2. The theory of Probability, and probability distributions of single and multiple random variables.

3. The sampling theory and testing of hypothesis and making inferences.

4. Stochastic process and Markov chains.

Course Outcome:

Upon completion of this course, the student will be able to

1. Apply the number theory concepts to cryptography domain.

2. Apply the concepts of probability and distributions to some case studies.

3. Correlate the material of one unit to the material in other units.

4. Resolve the potential misconceptions and hazards in each topic of study.

Module: 1 — **9 hours**

Greatest Common Divisors and Prime Factorization: Greatest common divisors, The Euclideanalgorithm, The fundamental theorem of arithmetic, Factorization of integers and the Fermat numbers.

Congruences: Introduction to congruences, Linear congruences, The Chinese remainder theorem,Systems of linear congruences.

Module: 2 — **10 hours**

Simple Linear Regression and Correlation: Introduction to Linear Regression, The Simple LinearRegression Model, Least Squares and the Fitted Model, Properties of the Least Squares Estimators,Inferences Concerning the Regression Coefficients, Prediction, Simple Linear Regression Case Study.

Random Variables and Probability Distributions: Concept of a Random Variable, DiscreteProbability Distributions, Continuous Probability Distributions, Statistical Independence.

Discrete Probability Distributions: Binomial Distribution, Poisson distribution.

Module: 3	**10 hours**
Continuous Probability Distributions: Normal Distribution, Areas under the Normal Curve,Applications of the Normal Distribution, Normal Approximation to the Binomial. **Fundamental Sampling Distributions**: Random Sampling, Sampling Distributions, SamplingDistribution of Means and the Central Limit Theorem, Sampling Distribution of S2, t–Distribution, F-Distribution.	
Module: 4	**9 hours**
Estimation & Tests of Hypotheses: Introduction, Statistical Inference, Classical Methods ofEstimation. Estimating the Mean, Standard Error of a Point Estimate, Prediction Intervals, ToleranceLimits, Estimating the Variance, Estimating a Proportion for single mean, Difference between TwoMeans, between Two Proportions for Two Samples and Maximum Likelihood Estimation.	
Module: 5	**8 hours**
Stochastic Processes and Markov Chains: Introduction to Stochastic processes- Markov process.Transition Probability, Transition Probability Matrix, First order and Higher order Markov process,n-step transition probabilities, Markov chain, Steady state condition, Markov analysis.	
Total hours	**46 hours**

Text Book

1.	Kenneth H. Rosen, Elementary number theory & its applications, sixth edition, AddisonWesley, ISBN 978 0-321-50031-1
2.	Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statisticsfor Engineers & Scientists, 9th Ed. Pearson Publishers.

Reference Books

1.	S C Gupta and V K Kapoor, Fundamentals of Mathematical statistics, Khanna publications
2.	T.T. Soong, Fundamentals of Probability and Statistics For Engineers, John Wiley & SonsLtd, 2004.

ESC	**Advanced Data Structures & Algorithms**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Prerequisite:-- Knowledge of Data Structure

Course Objectives:

Students will be able to-

1. To impart knowledge on advanced data structure and algorithms to analyze complexity of algorithms.

2. The fundamental design, analysis, and implementation of basic data structures.

3. Significance of algorithms in the computer field.

5. Various aspects of algorithm development .

Course Outcome:

At the end of successful completion of the course , students will be able to-

1. Basic ability to analyze algorithms and to determine algorithm correctness and time efficiency class.
2. Master a variety of advanced abstract data type (ADT) and data structures and their implementations.
3. Master different algorithm design techniques (brute-force, divide and conquer, greedy, etc
4. Ability to apply and implement learned algorithm design techniques and data structures to solve problems.

Module: 1 Introduction	**8 hours**

Algorithms, Performance analysis- time complexity and space complexity, Asymptotic Notation-Big Oh, Omega and Theta notations, Complexity Analysis Examples. Data structures-Linear and non linear data structures, ADT concept, Linear List ADT, Array representation, Linked representation, Vector representation, singly linked lists -insertion, deletion, search operations, doubly linked lists-insertion, deletion operations, circular lists. Representation of single, two dimensional arrays, Sparse matrices and their representation.

Module:2 Hashing	**7 hours**

Hashing – General Idea, Hash Function, Separate Chaining, Hash Tables without linked lists: Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Hash Tables in the Standard Library, Universal Hashing, Extendible Hashing.

Module:3 Priority Queues (Heaps)	**6 hours**

– Model, Simple implementations, Binary Heap: Structure Property, Heap Order Property, Basic Heap Operations: insert, delete, Percolate down, Other Heap Operations. Binomial Queues: Binomial Queue Structure, Binomial Queue Operations, Implementation of Binomial Queue, Priority Queues in the Standard Library

Module:4 Trees	**6 hours**

Trees – AVL: Single Rotation, Double Rotation, B-Trees. Multi-way Search Trees – 2-3 Trees: Searching for an Element in a 2-3 Tree, Inserting a New Element in a 2-3 Tree, Deleting an Element from a 2-3 Tree. Red-Black Trees – Properties of red-black trees, Rotations, Insertion, Deletion

Module:5 Graphs Algorithms	**7 hours**

Elementary Graph Algorithms: Topological sort, Single Source Shortest Path Algorithms: Dijkstra's, Bellman-Ford, All-Pairs Shortest Paths: Floyd-Warshall's Algorithm.

Module: 6 Disjoint Sets and String Matching	**7 hours**

Disjoint Sets – Equivalence relation, Basic Data Structure, Simple Union and Find algorithms, Smart Union and Path compression algorithm.

String Matching – The naive string-matching algorithm, The Rabin-Karp algorithm, The

Knuth-Morris-Pratt algorithm.	
Module: 7 Basic algorithmic techniques	**7 hours**
Greedy algorithms, divide & conquer, dynamic programming. Search techniques - backtracking, Sorting algorithms with analysis, integer sorting, selection sort. Graph algorithms: DFS and BFS with applications, MST and shortest paths.	
Total Lecture hours	**48 hours**

Textbook

1. Advanced Data Structures, Reema Thareja, S. Rama Sree, Oxford University Press, 2018
2. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, 4th Edition, 2014, Pearson.
3. Introduction to Algorithms, Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 3rd Edition, 2009, The MIT Press.

Reference Books

1. Fundamentals of Computer Algorithms, Ellis Horowitz, SatrajSahani and Rajasekharam, 2nd Edition, 2009, University Press Pvt. Ltd.
2. S. Sahni, Data Structures, Algorithms, and Applications in C++, Silicon Press, 2/e, 2005.

2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, MIT Press, 3/e, 2009.

3. A. M. Tenenbaum, Y. Langsam, and M. J. Augenstein, Data Structures Using C and C++, Prentice Hall, 2/e, 1995.

MC	Research Methodology and IPR	L	T	P	C
		2	0	0	2

Prerequisite: --

Course Objectives:

1. To impart knowledge on research methodology and subsequent processes involved for successful accomplishment of the research.

2. To impart knowledge on intellectual property rights and subsequent process involved in filing patents and trademark registration process.

3. To inculcate attitude of reflective learning and contribute to the society through fruitful research.

Course Outcome:

Upon completion of this course, the student will be able to

1. Apply the conceptual knowledge of research methodology to formulate the hypothesis, data collection and processing, analyzing the data using statistical methods, interpret the observations and communicating the novel findings through a research report.

2. Practice ethics and have responsibility towards society throughout the research process and indulge in continuous learning process.

3. Apply the conceptual knowledge of intellectual property rights for filing patents and trademark registration process.

Module: 1 Introduction to Research Methodology	**6 hours**
Objectives and Motivation of Research, Types of Research, Defining and Formulating the Research Problem; Features of research design, Different Research Designs; Different Methods of Data Collection, Data preparation and Processing.	
Module: 2 Data Analysis and Hypothesis Testing	**8 hours**
ANOVA; Principles of least squares-Regression and correlation; Normal Distribution; Properties of Normal Distribution; Testing of Hypothesis – Hypothesis Testing Procedure, Types of errors, t-Distribution, Chi-Square Test as a Test of Goodness of Fit.	
Module: 3 Interpretation and Report Writing	**4 hours**
Interpretation – Need, Techniques and Precautions; Report Writing – Significance, Different Steps, Layout, Types of reports,Mechanics of Writing a Research Report, Precautions in Writing Reports; Research ethics.	
Module: 4 Introduction to Intellectual property and Trademarks	**6 hours**
Importance of intellectual property rights; types of intellectual property, international organizations; Purpose and function of trademarks, acquisition of trademark rights, protectable matter, selecting and evaluating trademark, trademark registration processes.	
Module: 5 Law of Copyrights	**6 hours**
Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copyright registration, notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer New Developments in IPR: Administration of Patent System.	
Total hours	**30 hours**

Textbook

1.	C.R. Kothari, Research Methodology: Methods and Techniques, 2nd revised edition, New Age International Publishers, New Delhi, 2004.
2.	Deborah, E. Bouchoux, Intellectual property right, 5th edition, Cengage learning, 2017.

Reference Books	
1.	Deborah, E. Bouchoux, Intellectual property right, 5th edition, Cengage learning, 2017.
2.	Prabuddha Ganguli, Intellectual property right - Unleashing the knowledge economy, Tata McGraw Hill Publishing Company Ltd, 2001.

ESC	**Machine Learning**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Prerequisite:

Course Objectives:

Students will be able to–

1. Understand the basic theory underlying machine learning.
2. Formulate machine learning problems corresponding to different applications.
3. Understand a range of machine learning algorithms along with their strengths and weaknesses.
4. Apply machine learning algorithms to solve problems of moderate complexity.
5. Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Course Outcome:

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

1. Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
2. Understand the strengths and weaknesses of many popular machine learning approaches.
3. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
4. Design and implement various machine learning algorithms in a range of real-world applications.

Module:1 (Introduction)	**8 Hours**

Definition of Learning systems; Goals and applications of Machine learning, Aspects of developing a learning system, training data, Problems, data and tools, supervised vs. unsupervised learning.

Module:2 (Data preprocessing and visualization)	**8 Hours**

Data cleaning and preprocessing, Feature engineering, Handling Outliers, Data visualization

Module:3 (Model evaluation and selection)	**6 Hours**

Model performance metrics, Bias-variance tradeoff, Cross-validation, Grid search

Module:4 (Supervised learning)	**10 Hours**
Linear regression, Logistic regression, Decision trees, Random forests, Support vector machines, Naive Bayes, K-nearest neighbors, Neural networks	
Module:5(Unsupervised learning)	**7 Hours**
K-means clustering, Hierarchical clustering, DBSCAN clustering, Principal component analysis,	
Module :6 (Applications of machine learning)	**6 Hours**
Natural language processing, Image recognition, Recommender systems, Fraud detection	
Total Lecture hours	**46 hours**

Text Book	
1.	Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 1st ed. 2006
2.	Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Shroff/O'Reilly; Third edition (2022)
3	Tom Mitchell, Machine Learning, First Edition, McGraw- Hill (1997)

Reference Books	
1.	Ethem Alpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd., Third edition (2015)
2	Kevin Patrick Murphy, Machine Learning: a Probabilistic Perspective, MIT Press, 2012.
3	Sebastian Raschka, Machine Learning Q and AI.
4	David Barber, Bayesian Reasoning and Machine Learning, Cambridge University Press
5	Richard S. Sutton, Andrew G. Barto, Reinforcement Learning: An Introduction (Adaptive Computation and Machine Learning) MIT Press; second edition (2018).
6	A. Aldo Faisal, and Cheng Soon Ong, Mathematics for Machine Learning, Published by Cambridge University Press, 2020.
7	Yudi Pawitan, In All Likelihood: Statistical Modelling And Inference Using Likelihood, Oxford University Press, 1st edition (2013)

ESC	**Software Engineering**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

Prerequisite: Basic programming skills and knowledge of database management system

Course Objectives:

Students will be able to–

1. To provide the idea of decomposing the given problem into Analysis, Designing, Implementation, Testing and Maintenance phases

2. To provide an idea of using various process models in the software industry according to given circumstances.

3. To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

Course Outcome:

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

1. Design and plan software solutions to real problems.
2. Identify a range of solutions and critically evaluate and justify proposed design solutions.
3. Test systems in terms of general quality attribute and possible trade-offs presented within the given problem.
4. Apply the knowledge, techniques, and skills in the development of a software product.

Module: 1	**10 hours**

Introduction: SE challenges – SE approach – Software process – Characteristics of SW process – SW development process model – S/W Engineering Paradigm – Software life cycle models .

Module: 2	**8 hours**

Software Requirements – Functional & non-functional – user-system requirement engineering process – feasibility studies – elicitation – validation & management – software prototyping – S/W documentation – Analysis and modeling.

Module: 3	**10 hours**

Software Project Management - S/W cost estimation – Function point models – COCOMO model – Delphi method – S/W challenges – S/W maintenance.

Module: 4	**8 hours**

Design Concepts and Principles – Function-oriented software design – Object-oriented software design – Object modeling using UML – User interface design.

Module: 5	**10 hours**

Software Testing and Quality Management – Taxonomy of S/W testing – levels - black box testing – White box testing — regression testing– S/W testing strategies – unit testing – integration testing – validation testing – system testing and debugging, Quality concepts, quality assurance, software reviews, statistical quality assurance.

Total Lecture hours	**46 hours**

Text Book

1.	R. S. Pressman, Software Engineering - A practitioners approach, III Edition, McGraw Hill International editions, 1992
2.	Ian Sommerville, Software Engineering, Pearson Education Asia, VI Edition, 2000

Reference Books

1.	PankajJalote, An Integrated Approach to software Engineering, Springer Verlag, 1997
2.	James F. Peters and WitoldPedryez, Software Engineering – An Engineering Approach, John Wiley and Sons, New Delh

ESC	Advanced Data Structures & Algorithms Lab	L	T	P	C
		0	0	4	2

Prerequisite:-- Knowledge of Data Structure

Course Objectives:

Students will be able to-

1. The fundamental design, analysis, and implementation of basic data structures.

2. Basic concepts in the specification and analysis of programs.

3. Principles for good program design, especially the uses of data abstraction.

4. To understand the sorting techniques

5. To understand the non linear data structures 6. to learn bout the pattern matching

Course Outcome:

At the end of successful completion of the course , students will be able to-

1. Basic ability to analyze algorithms and to determine algorithm correctness and time Efficiency class.
2. Master a variety of advanced abstract data type (ADT) and data structures and their Implementations.
3. Master different algorithm design techniques (brute-force, divide and conquer, greedy, etc.)
4. Ability to apply and implement learned algorithm design techniques and data structures to solve problems

Practical Experiments:

1. Write Java/C/C++ programs that use both recursive and non-recursive functions for

implementing the following searching methods:

a) Linear search b) Binary search

2. Write Java/C/C++ programs to implement the following using arrays and linked lists

a) List ADT

3. Write Java/C/C++ programs to implement the following using an array.

a) Stack ADT b) Queue ADT

4. Write a Java/C/C++ program that reads an infix expression and converts the expression to postfixform. (Use stack ADT).

5. Write a Java/C/C++ program to implement circular queue ADT using an array.

6. Write a Java/C/C++ program that uses both a stack and a queue to test whether the given string isa palindrome or not.

7. Write Java/C/C++ programs to implement the following using a singly linked list.

a) Stack ADT

b) Queue ADT

8. Write Java/C/C++ programs to implement the deque (double ended queue) ADT using

a) Array b) Singly linked list c) Doubly linked list.

9. Write a Java/C/C++ program to implement priority queue ADT.

10. Write a Java/C/C++ program to perform the following operations:

a) Construct a binary search tree of elements.

b) Search for a key element in the above binary search tree

c) Delete an element from the above binary search tree.

11. Write a Java/C/C++ program to implement all the functions of a dictionary (ADT) using Hashing.

12. Write a Java/C/C++ program to implement Dijkstra's algorithm for Single source shortest path problem.

13. Write Java/C/C++ programs that use recursive and non-recursive functions to traverse the given binary tree in

a) Preorder b) Inorder c) Postorder.

14. Write Java/C/C++ programs for the implementation of bfs and dfs for a given graph.

15. Write Java/C/C++ programs for implementing the following sorting methods:

a) Bubble sort d) Merge sort g) Binary tree sort

b) Insertion sort e) Heap sort

c) Quick sort f) Radix sort

16. Write a Java/C/C++ program to perform the following operations:

a) Insertion into a B-tree b) Searching in a B-tree

17. Write a Java/C/C++ program that implements Kruskal's algorithm to generate minimum costspanning tree.

18. Write a Java/C/C++ program that implements KMP algorithm for pattern matching.

ESC	**MACHINE LEARNING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Prerequisite: Basic knowledge of Python/Java,C-C++

Course Objectives:

Students will be able to–

1. Understand the mathematical and statistical prospective of machine learning algorithms through python programming.
2. Formulate machine learning problems corresponding to different applications.
3. Apply a range of machine learning algorithms along with their strengths and weaknesses.

Course Outcome:

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

1. Design and evaluate the unsupervised models through python in built functions.
2. Evaluate the machine learning models pre-processed through various feature engineering algorithms by python programming.
3. Design and apply various reinforcement algorithms to solve real time complex problems.
4. Design application using machine learning techniques

Practical experiments:	**24 Hours**

1. Write a programme using Python to implement the Naive Bayes Classifier.
2. Write a programme using Python to implement the Decision Trees.
3. Write a programme using Python to implement the Linear Regression with one variable.
4. Write a programme using Python to implement the Linear Regression with multiple variable.
5. Write a programme using Python to implement the Logistic Regression with multiple variables .
6. Write a programme using Python to implement theBack-propagation Algorithm.
7. Write a programme using Python to implement the Artificial Neural Network.

8. Write a programme using Python to implement the SVM.
9. Write a programme using Python to implement the K-means clustering algorithm.
10. Write a programme using Python to implement the PCA.

Text Book

1.	Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, The MIT Press.
2.	Simon O. Haykin, "Neural Networks and Learning Machines", Pearson Education, 2016.

Reference Books

1.	C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2010.
2..	Andrew NG, "Machine Learning Yearning", Amazon.com Services LLC, Kindle Edition, 2019.

Department of Computer Science and Engineering

M.Tech – Computer Science & Engineering

SEMESTER –II

ESC	**Big Data Analytics**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Prerequisite: Basic knowledge of Mathematics/ Statistics/Programming

Course Objectives:

This course gives an overview of Big Data, i.e. storage, retrieval and processing of big data. In addition, it also focuses on the "technologies", i.e., the tools/algorithms that are available for storage, processing of Big Data. It also helps a student to perform a variety of "analytics" on different data sets and to arrive at positive conclusions.

Course Outcome:

Learning Outcomes At the end of successful completion of the course, students will be able to

CO1: Understand Big Data and its analytics in the real world

CO2 : Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics

CO3 : Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm

CO4 :Design and Implementation of Big Data Analytics using Spark to solve data intensive problems and to generate analytic

MODULE 1:Introduction	**10 Hours**

Introduction to Big Data, introduction to Enabling Technologies for Big Data, introduction to Big Data Platforms, introduction to Big Data Storage Platforms for Large Scale Data Storage, introduction to Big Data Streaming Platforms for Fast Data, Relationships and Representations, Graph Databases.

MODULE 2:Mapreduce Programming	**12 Hours**

Introduction , Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression, Real time applications using MapReduce, Data serialization and Working with common serialization formats, Big data serialization formats.

MODULE 3:Big Data Applications	**12 Hours**

Introduction to Big Data Applications using machine learning

MODULE 4:Introduction to Spark	**12Hours**

Introduction to Spark, introduction of big data Machine learning with Spark, Language processing with Spark, Analysis of Streaming Data with Spark, Applications of Spark ML Library, Basic Neural Network and Tensor Flow

Total hours	**46 hours**

Text Books

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1. Seema Acharya, Subhashini Chellappan, "Big Data Analytics", 1st Edition, Wiley, 2015

Reference Books

2. Dirk Deroos et al., Hadoop for Dummies, Dreamtech Press, 2014.

3. Chuck Lam, Hadoop in Action, December, 2010.

4. Leskovec, Rajaraman, Ullman, Mining of Massive Datasets, Cambridge University Press.

5. I.H. Witten and E. Frank, Data Mining: Practical Machine learning tools and techniques.

6. Erik Brynjolfsson et al., The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies, W. W. Norton & Company, 2014

7. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", 1 st Edition, Wrox, 2013.

8. Chris Eaton, Dirk Deroos et. al., "Understanding Big data", Indian Edition, McGraw Hill, 2015.

9. Tom White, "HADOOP: The definitive Guide", 3 rd Edition, O Reilly, 2012.

10. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", 1 st Edition, Packet Publishing Limited, 201

ESC	**IMAGE PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Prerequisite: Basic knowledge of Mathematics/ Statistics

Course Objectives:

Students will be able to–

1. To study the image fundamentals and mathematical transforms necessary for image processing.
2. To study the image enhancement techniques.
3. To study image restoration procedures.
4. To study the image compression procedures.

Course Outcome:

Learning Outcomes At the end of successful completion of the course, students will be able

CO1: Review the fundamental concepts of a digital image processing system.
CO2 : Analyze images in the frequency domain using various transforms.

CO3 : Evaluate the techniques for image enhancement and image restoration.
CO4 : Categorize various compression techniques.
CO5: Interpret image segmentation and representation techniques.

MODULE 1:Introduction	**5 Hours**

Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling andquantization

MODULE 2:Spatial Domain Filtering	**6 Hours**

Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian

MODULE 3:Filtering in the Frequency Domain	**6 Hours**

Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering

MODULE 4: Image Segmentation	6 hours

Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation

MODULE 5:Image Restoration	**6 Hours**

Basic Framework, Interactive Restoration, Image deformation and geometric transformations, imagemorphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections

MODULE 6:**Image Compression**	9 hours

Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an informationsource, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG,Lossless predictive coding, Lossy predictive coding, Motion Compensation

MODULE6: Wavelet based Image Compression	6 hours

Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT),Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking

MODULE7: Morphological Image Processing	6 hours
Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion	
MODULE8: Case Studies	10
Different case studies on applications of Image Processing	
Total hours	**60 hours**
Text Book	
1. Digital Image Processing by Rafael C Gonzalez &Richard E Woods, 3rd Edition	
2. Fundamentals of Digital Image Processing by Anil K Jain	
Reference Books	
1. Digital Image Processing by William K Pratt	

ESC	Data Communication and Computer Networks	L	T	P	C
		3	0	0	3

Prerequisite:-- Knowledge of Computer Networks

Course Objectives:

Students will be able to-

1. To Focus on information sharing and networks.
2. To Introduce flow of data, categories of network, different topologies.
3. To Focus on different coding schemes.
4. Brief the students regarding protocols and standards.
5. To give clear idea of signals, transmission media, errors in data communications and their correction, networks classes and devices,etc.

Course Outcome:

At the end of successful completion of the course , students will be able to-

1. The student will be having the basic knowledge of data sharing, transmission media and their protocols.
2. Student will have the basic knowledge of computer networks.
3. Students will be able to find out the shortest path from a source to destination node.
4. Students will be able to find out error and correct it.
5. Students will be able to establish connection among different networks.

Module: 1 Introduction to data communication and networking:	**5 hours**
Why study data communication?, Data Communication, Networks, Protocols and Standards,	

Standards Organizations. Line Configuration, Topology, Transmission Modes, Categories of Networks Internet works	
Module:2 Study of OSI and TCP/IP protocol suit	**5 hours**
The Model,Functions of the layers,TCP/IP Protocol Suites	
Module:3 Study of Signals	**6 hours**
Analog and Digital, Periodic and Aperiodic Signals, Analog Signals, Time and Frequency Domains ,Composite Signals , Digital Signals	
Module:4 Study of Digital and Analog transmission	**8 hours**
Digital to Digital Conversion, Analog to Digital Conversion	
Module: 5Study of Multiplexing	**5 hours**
Many to one/one to Many, Frequency division Multiplexing, Wage division Multiplexing, Time division Multiplexing, Multiplexing applications	
Module: 6 Types of transmission media:	**4 hours**
Guided Media, Unguided Media, Transmission Impairments, Performance Wavelength , Shannon Capacity , Media Comparison, PSTN , Switching	
Module: 7Error Detection and Correction	**7 hours**
Error Detection and Correction: Types of Errors, Detection, Parity Check, Vertical Redundancy Check Longitudinal Redundancy Check, Cyclic Redundancy Check, Checksum, Error Correction	
Module: 8 Study of DTE-DCE in brief	**4 hours**
Digital data transmission, DTE-DCE Interface, Modems, 56K Modems , Cable Modems	
Module 9: Introduction to networks and devices	**4 hours**
Network classes, Repeaters, Hub, Bridges , Switches, Routers, Gateways Routers Routing Algorithms, Distance Vector Routing , Link State Routing	
Total Lecture hours	**48hours**

Text Books

1.	Data communication & Networking by Bahrouz Forouzan. 2.
2.	Computer Networks by Andrew S. Tanenbaum

Reference Book

1.	Data and Computer Communications by William Stallings

ESC	**Advanced Database Management System Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Prerequisite: Basic programming skills

Course Objectives:

Students will be able–

1. To explore the features of a Database Management Systems
2. To interface a database with front end tools
3. To understand the internals of a database system

Course Outcome:

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

5. Apply various advanced queries such as relational constraints, joins, set operations, aggregate functions, trigger, views and embedded SQL
6. Create relational Database system.
7. Analyze the internals of a database system.

Experiments

Students will perform experiments on the following topics:

1. Data Definition Language Commands
2. Data Manipulation Language Commands
3. Data Control Language, Transfer control Language Commands
4. In Built Functions
5. Nested Queries and Join Queries
6. Set Operations
7. Views
8. Control Structure
9. Procedure and Function
10. 10. Trigger

Total Lab hours	**30 hours**

Reference Books

1.	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", 6th edition, Tata McGraw Hill, 2011
2.	Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 4th Edition, Pearson/Addision wesley, 2007

ESC	**IMAGE PROCESSING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Prerequisite: Basic knowledge of Python

Course Objectives:

Students will be able to–

4. Understand the mathematical and statistical prospective of image processing algorithms through python programming.
5. Formulate image processing problems corresponding to different applications.

6. Apply a range of image processing algorithms along with their strengths and weaknesses.

Course Outcome:

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

5. Design and evaluate the image processing algorithms through python in built functions.
6. Evaluate the machine learning models pre-processed through various feature engineering algorithms of image processing by python programming.
7. Design and apply various image processing algorithms to solve real time complex problems.
8. Design application using image processing techniques

Practical experiments:	**30 Hours**

11. Write a programme using Python to do analysis of spatial and intensity resolution of images.
12. Write a programme using Python to implement Intensity transformation of images.
13. Write a programme using Python to implement DFT analysis of images
14. Write a programme using Python to implement the transforms (i)Walsh, (ii) Hadamard, (iii) DCT (iv) Haar
15. Write a programme using Python to implement Histogram Processing.
16. Write a programme using Python to implement Image Enhancement-Spatial filtering
17. Write a programme using Python to implement Image Enhancement- Filtering in frequency domain
18. Write a programme using Python to implement Image segmentation – Edge detection, line detection and point detection
19. Write a programme using Python to implement basic Morphological operations.
20. Write a programme using Python to implement basic Thresholding functions
21. Write a programme using Python to do analysis of images with different color models.

MINI PROJECT(Any one):

A. Applications to Biometric and security

B. Applications to Medical Images

C. Texture analysis with statistical properties 4. Boundary detection
Text Book
Digital Image Processing by Rafael C Gonzalez &Richard E Woods, 3rd Edition
Fundamentals of Digital Image Processing by Anil K Jain

Department of Computer Science and Engineering

M.Tech – Computer Science & Engineering

SEMESTER –III

ESC	DEEP LEARNING	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge of Statistics

Course Objectives:

Students will be able to–

1. Understand the mathematical and statistical prospective of deep learning algorithms through python programming.
2. Formulate deep learning problems corresponding to different applications.
3. Apply a range of deep algorithms along with their strengths and weaknesses.

Course Outcome:

Learning Outcomes At the end of successful completion of the course, students will be able

1. To understand the role of deep neural networks in engineering, artificial intelligence, and cognitive modelling through the study of the most important deep neural network models.

2. To solve the problems using various deep learning techniques.

3. To design application using deep learning techniques.

Module 1: Basics of Deep Learning — 11 Hours

Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent: Momentum, Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Feed forward Neural Networks, Representation Power of Feed forward Neural Networks, Feed forward Neural Networks and Back propagation

Module 2: Deep Feed Forward Neural Networks: — 12 Hours

Gradient based learning; hidden units; architecture design; back-propagation; hyperparameters.Regularization and Practical Aspects of Deep Learning: Regularization and under-constrained problems, dataset augmentation, noise robustness, early stopping, bagging, dropout, normalizing inputs; vanishing/exploding gradients, weight initialization for deep networks; hyperparameter tuning; batch normalization.

Module 3:Convolution Neural Networks and Recurrent Neural Networks — 12 Hours

Convolutional Neural Networks, CNN architectures: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs, Encoder Decoder Models, Attention Mechanism, Attention over images

Module:4 Case studies	**10 Hours**
Image Classification/ Text Classification	
Total hours	**45 hours**

Text Book

1.	Simon O. Haykin, "Neural Networks and Learning Machines", Pearson Education, 2016.
2.	Nielsen, Michael A., Neural Networks and Deep Learning, 2015.

Reference Books

1.	Chollet, Franois. Deep Learning with Python, 2017.
2..	Buduma, Nikhil, and Nicholas Locascio, Fundamentals of Deep Learning: Designing Next-generation Machine Intelligence Algorithms, O'Reilly Media, Inc., 2017.

ESC	**DEEP LEARNING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Prerequisite: Basic knowledge of Python

Course Objectives:

Students will be able to–

7. Understand the mathematical and statistical prospective of deep learning algorithms through python programming.
8. Formulate deep learning problems corresponding to different applications.
9. Apply a range of deep algorithms along with their strengths and weaknesses.

Course Outcome:

Learning Outcomes At the end of successful completion of the course, students will be able

1. To understand the role of deep neural networks in engineering, artificial intelligence, and cognitive modelling through the study of the most important deep neural network models.

2. To solve the problems using various deep learning techniques.

3. To design application using deep learning techniques.

Practical experiments:	**24 Hours**

22. Write a program using Python to implement Self Organizing Maps (SOMs).
23. Write a program using Python to implement the Multilayer Perceptrons (MLPs)
24. Write a program using Python to implement the Radial Basis Function Networks.
25. Write a program to implement Autoencoder.
26. Write a program using Python to implement Convolutional Neural Networks (CNNs).
27. Write a program using Python to implement the Recurrent Neural Networks (RNNs).
28. Write a program using Python to implement the Long Short Term Memory Networks (LSTMs)
29. Write a program to implement encoder-decoder architecture with Attention Mechanism
30. Write a program using Python to implement the Generative Adversarial Networks (GANs).

Text Book

1.	Simon O. Haykin, "Neural Networks and Learning Machines", Pearson Education, 2016.
2.	Nielsen, Michael A., Neural Networks and Deep Learning, 2015.

Reference Books

1. 2..	Chollet, Franois. Deep Learning with Python, 2017. Buduma, Nikhil, and Nicholas Locascio, Fundamentals of Deep Learning: Designing Next-generation Machine Intelligence Algorithms, O'Reilly Media, Inc., 2017.