Kurukshetra University, Kurukshetra

(Established by the State Legislature Act XII of 1956)
('A+' Grade, NAAC Accredited)

|| योगस्थ: कुरु कर्माणि ||

समबुद्धि व योग युक्त होकर कर्म करो

(Perform Actions while Stead fasting in the State of Yoga)

Scheme of Examination and Syllabus of

Master of Technology (M.Tech.) in Computer Science & Engineering(CSE) (CBCS) in Phased Manner

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS

CBCS CURRICULUM (2020-21)

Program Name: Master of Technology (M.Tech.) in Computer Science & Engineering (CSE) (CBCS)

(For the Batches Admitted From 2020-2021)

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

VISION

Pursue conducive advancement towards nurturing globally competent and ethically conscientious professionals and entrepreneurs in agile computing technologies and allied spheres for unceasing evolution of Nations IT affiliated commercial and research endeavours.

MISSION

Thrive to establish a strong foundation for technical competency in spheres concordant to software oriented design and development. Nurture skills and competency for administering expertise gained in computing discipline to a wide horizon of interdisciplinary application domains, thus supporting sustainable development of the society. Habituate the students to strive for technological innovations and successful endeavours ethically, supported by sustained learning continuance and problem solving proficiency that may promote nations welfare in terms of economic acceleration leading to the growth of society.

NAME OF THE PROGRAMME: MASTER OF TECHNOLOGY
(COMPUTER SCIENCE AND ENGINEERING)
DURATION : TWO YEARS

PROGRAMME OUTCOMES (POs)	
PO1	Capable of demonstrating comprehensive disciplinary knowledge gained during course of study
PO2	Capability to ask relevant/appropriate questions for identifying, formulating and analyzing the research problems and to draw conclusion from the analysis
PO3	Ability to communicate effectively on general and Technical topics with the engineering community and with society at large
PO4	Capability of applying knowledge to solve Engineering and other problems
PO5	Capable to learn and work effectively as an individual, and as a member or leader in diverse teams, in multidisciplinary settings.
PO6	Ability of critical thinking, analytical reasoning and research based knowledge including design of experiments, analysis and interpretation of data to provide conclusions
PO7	Ability to use and learn techniques, skills and modern tools for scientific and engineering practices
PO8	Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional Engineering practices
PO9	Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout life

PROGRAMME OUTCOMES (POs)	
PO10	Capability to identify and apply ethical issues related to one's work, avoid unethical behaviour such as fabrication of data, committing plagiarism and unbiased truthful actions in all aspects of work
PO11	Ability to demonstrate knowledge and understanding of the engineering principles and apply these to manage projects

PROGRAMME SPECIFIC OUTCOMES (PSOs)	
PSO1	Supplement potential for pursuing advanced studies, engaging in research & technological development directed towards innovative activities, and nurturing entrepreneurial skills.
PSO2	Strengthen competency for innovating solutions to real-world problems by exercising data analysis skills and adopting contemporary technologies for demanding prospective applications.
PSO3	Inculcate the practice to administer Professional & Ethical virtues, along with Social and Environmental regulations.
PSO4	Stimulate the aptitude for problem analysis and programming skills for computer based system design and modeling in allied spheres related to Algorithmic, Computational, Architectural and Database environments, along with emerging technologies such as Machine Learning& Intelligent systems , Evolutionary Techniques and Optimization, Data Science & Analytics, Distributed and Wireless Communication in cognation with IoT and Cloud Computing , Web and Mobile application designing, and Real World Enhancement using Computer Vision & Augmented Reality.

KURUKSHETRA UNIVERSITY, KURUKSHETRA

SCHEME OF EXAMINATION FOR MASTER OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING) CHOICE BASED CREDIT SYSTEM (CBCS) W. E. F. ACADEMIC SESSION 2020-21 IN PHASED MANNER

Paper Code	Nomenclature of Paper	Credits	Work load Per Week (Hrs.)	Exam Time (Hrs.)	External Marks		Internal Marks	Total Marks	Pass Marks
					Max.	Pass			
First Semester									
MT-CSE-20-11	Mathematical Foundations of Computer Science	4	4	3	75	30	25	100	40
MT-CSE-20-12	Advanced Data Structures	4	4	3	75	30	25	100	40
MT-CSE-20-13	Elective- I	4	4	3	75	30	25	100	40
MT-CSE-20-14	Elective- II	4	4	3	75	30	25	100	40
MT-CSE-20-15	Research Methodology and IPR	3	3	3	75	30	25	100	40
MT-CSE-20-16	S/W Lab–I Based on MT-CSE-20-12	2.5	5	3	100	40	-	100	40
MT-CSE-20-17	S/W Lab-II Based on MT-CSE-20-13	2.5	5	3	100	40	-	100	40
	Total	**24**	**29**		**575**	**230**	**125**	**700**	**280**
Elective – I									
MT-CSE-20-13(i)	Machine Learning using Python	4	4	3	75	30	25	100	40
MT-CSE-20-13(ii)	Data Science using Python	4	4	3	75	30	25	100	40
MT-CSE-20-13(iii)	Wireless Sensor Networks	4	4	3	75	30	25	100	40
MT-CSE-20-13(iv)	Advanced Database Systems	4	4	3	75	30	25	100	40
Elective – II									
MT-CSE-20-14(i)	Intelligent Systems	4	4	3	75	30	25	100	40
MT-CSE-20-14(ii)	Distributed Systems	4	4	3	75	30	25	100	40
MT-CSE-20-14(iii)	Computer Vision and Augmented Reality	4	4	3	75	30	25	100	40
MT-CSE-20-14(iv)	Advanced Computer Architecture	4	4	3	75	30	25	100	40
Second Semester									
MT-CSE-20-21	Advances in Algorithms	4	4	3	75	30	25	100	40
MT-CSE-20-22	Soft Computing	4	4	3	75	30	25	100	40
MT-CSE-20-23	Elective – III	4	4	3	75	30	25	100	40
MT-CSE-20-24	Elective – IV	4	4	3	75	30	25	100	40
MT-CSE-20-25	S/W Lab –III Based on MT-CSE-20-21	2.5	5	3	100	40	-	100	40
MT-CSE-20-26	S/W Lab –IV Based on MT-CSE-20-23	2.5	5	3	100	40	-	100	40
*OE-CSE-20-27	Open Elective Based on MOOCs (The selected course should not be directly related with Computer Science) Or As per University Guidelines	2	2	3	35	14	15	50	20
	Total	**23**	**28**		**535**	**214**	**115**	**650**	**260**
Elective – III									
MT-CSE-20-23(i)	Data Preparation and Analysis	4	4	3	75	30	25	100	40
MT-CSE-20-23(ii)	Optimization Techniques	4	4	3	75	30	25	100	40

Paper Code	Nomenclature of Paper	Credits	Work load Per Week (Hrs.)	Exam Time (Hrs.)	External Marks		Internal Marks	Total Marks	Pass Marks
					Max.	Pass			
MT-CSE-20-23(iii)	Advanced Wireless and Mobile Networks	4	4	3	75	30	25	100	40
MT-CSE-20-23(iv)	Networking and Administration in Linux / Unix	4	4	3	75	30	25	100	40
Elective – IV									
MT-CSE-20-24(i)	Mobile Applications and Services	4	4	3	75	30	25	100	40
MT-CSE-20-24(ii)	Advanced Web Technologies	4	4	3	75	30	25	100	40
MT-CSE-20-24(iii)	Object-Oriented Software Engineering	4	4	3	75	30	25	100	40
MT-CSE-20-24(iv)	Big Data and Pattern Recognition	4	4	3	75	30	25	100	40
Third Semester									
MT-CSE-20-31	Elective-V	4	4	3	75	30	25	100	40
MT-CSE-20-32	Dissertation-I / Industrial Project	10	20	-	200	80	50	250	100
*OE-CSE-20-33	Open Elective Based on MOOCs (The selected course should not be directly related with Computer Science) Or As Per University Guidelines	2	2	3	35	14	15	50	20
Total		**16**	**26**		**310**	**124**	**90**	**400**	**160**
Elective – V									
MT-CSE-20-31(i)	Compiler for High Performance Computing	4	4	3	75	30	25	100	40
MT-CSE-20-31(ii)	Cloud Computing and IoT	4	4	3	75	30	25	100	40
MT-CSE-20-31(iii)	Information Retrieval System	4	4	3	75	30	25	100	40
MT-CSE-20-31(iv)	Digital Image Processing	4	4	3	75	30	25	100	40
Fourth Semester									
MT-CSE-20-41	Dissertation-II	16	32	-	300	120	100	400	160
Total		**16**	**32**	**-**	**300**	**120**	**100**	**400**	**160**
Grand Total		**79**	**115**	**-**	**1720**	**688**	**430**	**2150**	**860**

Note 1: Instructions for Examiners to award marks/grades for Dissertation – II :-

The marks shall be awarded on the basis of three aspects,
(i) Evaluation of Dissertation Report (ii) Viva-Voce and (iii) Publication/Presentation of Research Paper from the dissertation.

Part (i) and (ii) carries 75% of the total marks for both internal and external evaluation. Part (iii) carries 25% of the total marks for both internal and external evaluation.
Part (iii) marks shall be awarded using following criteria:

1. Marks 91% or above: Publication from Dissertation in SCI indexed journal.
2. Marks 81% to 90%: Publication from Dissertation in Scopus indexed or Web of Science Indexed journal.
3. Marks 71% to 80%: Publication from Dissertation in Proceedings of Conference which is Scopus indexed/IEEE/ACM/Elsevier indexed or Publication from Dissertation in UGC Care List journal.
4. Marks 61% to 70%: Presented paper in International Conference.
5. Marks 51% to 60%: Presented paper in National Conference.

***Note 2:** In addition to the credits earned by compulsory and elective courses, every student has to earn 2 more credits by selecting an open elective/MOOC course during second and third semester.

Note 3: The credits for the first year are 47(24+23) and for the second year are 32(16+16). Total credits of the course shall be 47+32=79.

Note 4: For the purpose of computation of work-load the following mechanism shall be adopted:

- 1 Credit = 1 Theory period of one hour duration.
- 1 Credit = 1 Practical period of two hour duration.

Note 5: Evaluation procedure for internal assessment marks:

Two Mid Term Examinations should be conducted by the concerned teacher each of 10 marks. Five marks may be given by the concerned teacher on the basis of performance during the course (puzzles/ assignments/ interactions/ attendance etc).

Note 6: Size of groups in all practical courses should not be more than thirty students.

MT-CSE-20-11: Mathematical Foundations of Computer Science	
Type: Compulsory **Course Credits:** 04 **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30 (i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40 (i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is make students understand the mathematical fundamentals that is prerequisites for a variety of courses like Data mining, Computer security, Software engineering, Computer architecture, distributed systems, Machine learning, etc.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-11.1	understand the basic notions of discrete and continuous probability;
MT-CSE-20-11.2	understand various sampling and classification problems;
MT-CSE-20-11.3	understand the methods of statistical inference, and the role that sampling distributions play in those methods;
MT-CSE-20-11.4	analyse graphs, permutation and combination and their use in various scenarios;

CO-PO Mapping Matrix for the Course Code : MT-CSE-20-11

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-11.1	3	2	1	2	1	1	1	1	2	1	1
MT-CSE-20-11.2	3	3	1	3	1	3	2	2	2	1	2
MT-CSE-20-11.3	3	3	1	3	1	3	2	2	2	1	2
MT-CSE-20-11.4	3	2	1	2	1	2	2	1	2	1	1
Average	**3**	**2.5**	**1**	**2.5**	**1**	**2.25**	**1.75**	**1.5**	**2**	**1**	**1.5**

CO-PSO Mapping Matrix for the Course Code : MT-CSE-20-11

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-11.1	1	2	1	3
MT-CSE-20-11.2	3	2	2	3
MT-CSE-20-11.3	3	3	2	3
MT-CSE-20-11.4	2	2	1	3
Average	**2.25**	**2.25**	**1.5**	**3**

Unit – I

Probability mass, density, and cumulative distribution functions, parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate, Central Limit Theorem, Probabilistic inequalities, Markov chains.

Unit – II

Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood, Recent Trends in various distribution functions in mathematical field of computer science for varying fields.

Unit – III

Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, the problem of over fitting model assessment.

Unit – IV

Graph Theory: Isomorphism, Planar graphs, graph colouring, Hamilton circuits and Euler cycles.
Permutations and Combinations with and without repetition, Specialized techniques to solve combinatorial enumeration problems.

Text Books:

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.

Reference Books:

1. M. Mitzenmacher and E. Upfal, Probability and Computing: Randomized Algorithms and Probabilistic Analysis, Cambridge University Press
2. Alan Tucker, Applied Combinatorics, Wiley.

MT-CSE-20-12: Advanced Data Structures	
Type: Compulsory **Course Credits:** 04 **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30 (i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40 (i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective is to make students able to understand the necessary mathematical abstraction to solve problems and to familiarize them with advanced paradigms and data structure used to solve algorithmic problems.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-12.1	understand the implementation of symbol table using hashing techniques;
MT-CSE-20-12.2	develop and analyse algorithms for red-black trees, B-trees and Splay trees;
MT-CSE-20-12.3	develop algorithms for text processing applications;
MT-CSE-20-12.4	identify suitable data structures and develop algorithms for computational geometry problems.

CO-PO Mapping Matrix for the Course Code : MT-CSE-20-12

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-12.1	3	3	1	3	1	3	3	1	3	1	2
MT-CSE-20-12.2	3	3	1	3	1	3	3	1	2	1	2
MT-CSE-20-12.3	3	3	2	3	1	3	2	2	3	1	3
MT-CSE-20-12.4	3	3	1	3	2	3	3	2	3	1	3
Average	**3**	**3**	**1.25**	**3**	**1.25**	**3**	**2.75**	**1.5**	**2.75**	**1**	**2.5**

CO-PSO Mapping Matrix for the Course Code : MT-CSE-20-12

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-12.1	3	2	2	3
MT-CSE-20-12.2	3	1	1	2
MT-CSE-20-12.3	3	2	2	3
MT-CSE-20-12.4	3	2	2	3
Average	**3**	**1.75**	**1.75**	**2.75**

Unit – I

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Unit – II

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees. Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists.

Unit – III

Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Unit – IV

Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, k-D Trees.

Text Books:

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

Reference Books:

1. Cormen, Leiserson, Rivest, “Introduction to Algorithms”, PHI India.

MT-CSE-20-13(i): Machine Learning using Python	
Type: Elective **Course Credits:** 04 **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30 (i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40 (i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to enable student to perform experiments in Machine Learning using real-world data using Python.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-13(i).1	construct and execute various programs using different data structures in Python;
MT-CSE-20-13(i).2	use the Python programming for machine learning;
MT-CSE-20-13(i).3	understand the machine learning along with concept learning and decision trees;
MT-CSE-20-13(i).4	understand Bayesian, Computational and Instance-based learning.

CO-PO Mapping Matrix for the Course Code : MT-CSE-20-13(i)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-13(i).1	3	3	2	3	2	3	3	1	3	1	3
MT-CSE-20-13(i).2	3	3	2	3	2	3	3	1	3	1	3
MT-CSE-20-13(i).3	3	3	2	2	1	2	2	3	3	1	2
MT-CSE-20-13(i).4	3	3	2	2	1	2	2	3	3	1	2
Average	**3**	**3**	**2**	**2.5**	**1.5**	**2.5**	**2.5**	**2**	**3**	**1**	**2.5**

CO-PSO Mapping Matrix for the Course Code : MT-CSE-20-13(i)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-13(i).1	3	3	3	3
MT-CSE-20-13(i).2	3	3	3	3
MT-CSE-20-13(i).3	2	3	3	3
MT-CSE-20-13(i).4	2	3	3	3
Average	**2.5**	**3**	**3**	**3**

Unit – I

Python Programming: Strings - String slices, immutability, string functions and methods, string module; Lists, Tuples, Dictionaries: Lists - Lists as arrays Traversing a List, list operations, list slices, list methods, Map, Filter

and Reduce, list loop, mutability, aliasing, cloning lists, list parameters; Dictionaries - operations and methods; advanced list processing - list comprehension; Tuples - tuple assignment, tuple as return value.
Files and Modules: Files and exception - text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules.

Unit – II

Packages in Python: PANDAS, NUMPY, SCIKIT-LEARN, MATPLOTLIB.
NumPy - Introduction, Ndarray Object ,Data types, Array Attributes, Array Creation Routines, Indexing & Slicing, Advanced Indexing, Broadcasting, Iterating Over Array, Array Manipulation, Binary Operators, String Functions, Mathematical Functions, Mathematical Functions, Arithmetic Operations, Statistical Functions, Linear Algebra, Matplotlib(Used for data visualization), Histogram Using Matplotlib.
Pandas: Performing data cleaning and analysis, Loading data with Pandas (data manipulation and analysis), Working with and Saving data with Pandas.
Using Scikit-Learn for Linear Regression, Logistic Regression, Decision Tree, Naive Bayes, KNN, SVN, k Mean Clustering, Random Forest.

Unit – III

Introduction to Machine Learning – Well defined learning problems, Designing a Learning System, Issues in Machine Learning.
The Concept Learning Task - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias
Decision Tree Learning - Decision tree learning algorithm-Inductive bias- Issues in Decision tree learning.

Unit – IV

Bayesian Learning: Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm.
Computational Learning Theory: Sample Complexity for Finite Hypothesis spaces, Sample Complexity for Infinite Hypothesis spaces, The Mistake Bound Model of Learning.
Instance-Based Learning – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning.

Text Books:

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education (India) Private Limited.
2. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press.
3. John V Guttag, Introduction to Computation and Programming Using Python, MIT Press.
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd.

Reference Books:

1. Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press.
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Updated for Python 3, Shroff/O,,Reilly Publishers.
3. Peter Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press.
4. Sebastian Raschka, Python Machine Learning.

MT-CSE-20-13 (ii) : Data Science using Python

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: Provide you with the knowledge and expertise to become a proficient data scientist. Demonstrate an understanding of statistics and machine learning concepts that are vital for data science. Student will learn Python code to statistically analyse a dataset.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-13 (ii).1	learn data collection, management and storage methods for data science;
MT-CSE-20-13 (ii).2	understand the implementation of machine learning algorithms;
MT-CSE-20-13 (ii).3	acquire knowledge of visualization techniques used by data scientists;
MT-CSE-20-13 (ii).4	implement data collection and management scripts using Python.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-13 (ii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-13 (ii).1	3	3	3	3	2	2	3	3	2	2	1
MT-CSE-20-13 (ii).2	3	3	3	3	3	1	2	3	3	3	2
MT-CSE-20-13 (ii).3	3	2	2	1	2	2	1	3	2	3	1
MT-CSE-20-13 (ii).4	3	3	3	2	3	3	1	2	3	2	1
Average	**3**	**2.75**	**2.75**	**2.25**	**2.5**	**2**	**1.75**	**2.75**	**2.5**	**2.5**	**1.25**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-13 (ii)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-13 (ii).1	3	2	1	3
MT-CSE-20-13 (ii).2	3	3	2	2
MT-CSE-20-13 (ii).3	3	2	1	3
MT-CSE-20-13 (ii).4	3	3	3	2
Average	**3**	**2.5**	**1.75**	**2.5**

Unit – I

Introduction to core concepts and technologies: Introduction, Data Science Process, Data Science Toolkit, Types of Data, Example Applications. Data Collection and Management: Sources of data, Data collection and APIs, Exploring and Fixing Data, Data Storage and Management, Using Multiple Data Sources.

Unit – II

Data Analysis: Introduction, Terminology and Concepts, Introduction to Statistics, Central Tendencies and Distributions, Variance, Distribution Properties and Arithmetic, Samples/CLT, Basic Machine Learning Algorithms, Linear Regression, SVM, Naive Bayes, Applications of Data Science.

Unit – III

Data Visualisation: Introduction, Types of Data Visualisation, Data for Visualisation: Data Types, Data Encodings, Retinal Variables, Mapping Variables to Encodings, Visual Encodings, Technologies for Visualisation, Recent Trends in Various Data Collection and Analysis Techniques. Application Development Methods of Used in Data Science.

Unit – IV

Python Programming: Python Strings, Operators, Functions, Control Structures, Mutable and Immutable Objects, Recursion, Files and Exception, Classes, List Manipulation, Applications of Python.

Text Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Sheetal Taneja, Naveen Kumar, Python Programming, Pearson.

References Books:

1. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.
2. G Dong and J Pei, Sequence Data Mining, Springer.

MT-CSE-20-13(iii): Wireless Sensor Networks

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of the course is to provide a comprehensive understanding of the fundamental concepts and architecture of WSNs along with major issues, and effective solutions in wireless sensor networking.

Course Outcomes: At the end of this course, the student will be able to:

MT-CSE-20-13(iii).1	understand the fundamental concepts of wireless sensor networks and have a basic knowledge of its components, characterization and categorization, along with design objectives, challenges, applications and technological background of Wireless Sensor Networks;
MT-CSE-20-13(iii).2	get familiar with the Media Access Control and Transport Protocols for Wireless Sensor Networks;
MT-CSE-20-13(iii).3	get research directions for pertinent design issues of Wireless Sensor Networks such as Routing and energy efficiency;
MT-CSE-20-13(iii).4	have an insight into the directions for carrying out research activities to explore and solve issues related to data aggregation, node localization, synchronization and security in Wireless Sensor Networks.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-13(iii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-13(iii).1	3	3	3	2	2	2	2	2	3	-	2
MT-CSE-20-13(iii).2	3	3	3	3	2	3	3	2	3	-	2
MT-CSE-20-13(iii).3	3	3	3	3	2	3	3	2	3	-	2
MT-CSE-20-13(iii).4	3	3	3	3	2	3	3	2	3	-	2
Average	**3**	**3**	**3**	**2.75**	**2**	**2.75**	**2.75**	**2**	**3**	**-**	**2**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-13(iii)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-13(iii).1	3	2	1	3
MT-CSE-20-13(iii).2	3	2	1	3
MT-CSE-20-13(iii).3	3	2	1	3
MT-CSE-20-13(iii).4	3	2	1	3
Average	**3**	**2**	**1**	**3**

Unit – I

Introduction: Overview of Wireless Sensor Networks – Characteristics, Applications, Design objectives & challenges; Basic Components; Operating Systems for Wireless Sensor Networks; Quality of a Sensor Network: Coverage, Exposure.

Technological Background – MEMS Technology, Hardware and Software Platforms, Evolving Standards for Wireless Sensor Networks; Sensor Node Structure; Network Architectures for Wireless Sensor Networks – Layered (UNPF) & Clustered (LEACH) ; Classification of Wireless Sensor Networks; Protocol Stack for Wireless Sensor Networks.

Unit – II

Media Access Control: Fundamental MAC protocols; MAC design issues for Wireless Sensor Networks; MAC Protocols for Wireless Sensor Networks; Contention–Free Protocols; Hybrid Protocols.

Transport Protocols: Transport Protocol Design Issues and Transport Protocols for Wireless Sensor Networks.

Unit – III

Routing and Data Dissemination: Fundamentals & Challenges; Taxonomy of Routing and Data Dissemination Protocols; Location-Aided Protocols; Layered and In-Network processing Based Protocols; Data-Centric Protocols; Multipath-Based Protocols; Mobility-based & Heterogeneity-Based Protocols ; QoS Based Protocols; Data gathering.

Broadcasting, Multicasting, and Geocasting: Concepts, Major Challenges & Mechanisms.

Energy Efficiency: Need for Energy Efficiency; MAC layer and Higher Layers Power Conservation Mechanisms.

Unit – IV

Data Aggregation in Wireless Sensor networks: Challenges & techniques; Node Clustering and its Algorithms in Wireless Sensor Networks.

Node Localization: Concepts, Challenges, & Algorithms; Ranging Techniques.

Time Synchronization: Need and Requirements of Synchronization in Wireless Sensor Networks; Synchronization Protocols for Wireless Sensor Networks.

Security Issues in Wireless Sensor networks: Challenges of Security in Wireless Sensor Networks, Security Attacks in Sensor Networks, Protocols and Mechanisms for Security.

Future Trends in Wireless Sensor Networks.

Text Books:

1. Jun Zheng, Abbas, Wireless Sensor Networks A Networking Perspective, Wiley.
2. Kazem Sohraby, Daniel Minoli, & Taieb Znati, Wireless Sensor Networks-Technology, Protocols, and Applications, Wiley

Reference Books:

1. W. Dargie and C. Poellabauer, Fundamentals of Wireless Sensor Networks –Theory and Practice, Wiley.
2. Thomas Haenselmann, Wireless Sensor Networks: Design Principles for Scattered Systems, Oldenbourg Verlag
3. Waltenegus Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks: Theory and Practice, Wiley
4. Mohammad S. Obaidat, Sudip Misra, Principles of Wireless Sensor Networks, Cambridge,
5. C. Sivarm Murthy & B.S. Manoj, Adhoc Wireless Networks, PHI.

MT-CSE-20-13 (iv) : Advanced Database Systems	
Type: Elective **Course Credits:** 04 **Contact Hours:** 4 hours/week. **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30 (i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40 (i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to provide an in- depth knowledge of SQL and PL/SQL to design database for an organization. This course focuses on advance topics of the database including EER model, object oriented database, and emerging concepts of database.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-13 (iv).1	understand overall process of database modeling & design, Implementation;
MT-CSE-20-13 (iv).2	learn to write complex queries in SQL and to design PL/SQL blocks for database implementation;
MT-CSE-20-13 (iv).3	acquire technical knowhow of the EER modelling, Query Optimization, Transaction management, database backup and recovery along with emerging databases management systems;
MT-CSE-20-13 (iv).4	undertake various projects and job profiles on database applications.

CO-PO Mapping Matrix for the Course Code : MT-CSE-20-13 (iv)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-13 (iv).1	3	3	1	3	1	3	2	3	3	1	2
MT-CSE-20-13 (iv).2	3	2	1	3	1	3	2	3	3	1	2
MT-CSE-20-13 (iv).3	3	3	1	3	3	3	2	3	3	1	3
MT-CSE-20-13 (iv).4	3	2	1	3	3	3	2	3	3	1	3
Average	**3**	**2.5**	**1**	**3**	**2**	**3**	**2**	**3**	**3**	**1**	**2.5**

CO-PSO Mapping Matrix for the Course Code : MT-CSE-20-13 (iv)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-13 (iv).1	2	3	2	3
MT-CSE-20-13 (iv).2	2	3	2	3
MT-CSE-20-13 (iv).3	2	3	3	3
MT-CSE-20-13 (iv).4	2	3	3	3
Average	**2**	**3**	**2.5**	**3**

Unit – I

Database System Concepts and Architecture: Three - Schema Architecture and Data Independence, Entity Relationship Model: Entity Types, Entity Sets, Attributes & keys, Relationships Types & Instances, ER Diagrams, Naming conventions and Design Issues. Relational Model Constraints, Enhanced Entity Relationship Model: Subclasses, Super classes, Inheritance, Specialization and Generalization, Constraints and characteristics of specialization and Generalization.

Unit – II

SQL: Data Definition and Data Types, DDL, DML, and DCL, Views & Queries in SQL, Specifying Constraints & Indexes in SQL. PL/SQL: Architecture of PL/SQL, Basic Elements of PL/SQL, PL/SQL Transactions, Cursors and Triggers.

Relational Database Design: Functional Dependencies, Decomposition, Normal Forms Based on Primary Keys-(1NF, 2NF, 3NF, BCNF), Multi-valued Dependencies, 4 NF, Join dependencies, 5 NF, Domain Key Normal Form.

Unit – III

Query Processing and Optimization: Query Processing, Query Decomposition, Stages of Query Processing, Query Tree, Using Heuristics in Query Optimization, Semantic Query Optimization, Transaction Processing: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Concurrency Control Techniques: Two-Phase Locking Techniques, Timestamp Ordering, Serializability. Database Backup and Recovery: Recovery facilities, Recovery Techniques.

Unit – IV

Object Model: Overview of Object-Oriented concepts, Object identity, Object structure, Type constructors, Databases for Advance Applications: Architecture for Parallel Database, I/O Parallelism, Interquery Parallelism, Intraquery Parallelism, Active Database Concept, Temporal Databases Concepts, Spatial and Multimedia Databases, XML Schema, XQuery and Approaches for XML query processing.

Text Books:

1. Elmasri & Navathe, Fundamentals of Database systems, Pearson Education.
2. Ivan Bayross, SQL, PL/SQL- The Program Language of ORACLE, BPB Publication.
3. Alexis Leon & Mathews Leon, Database Management System, Leon Vikas Publication.

Reference Books:

1. Korth & Silberschatz, Database System Concept, McGraw Hill International Edition.
2. Raghu Ramakrishnan & Johannes Gehrke, Database Management Systems, McGraw Hill.
3. Peter Rob, Carlos Colonel, Database system Design, Implementation, and Measurement, Cengage Learning.
4. Abbey, Abramson & Corey: Oracle 8i-A Beginner's Guide, Tata McGraw Hill.

MT-CSE-20-14 (i) : Intelligent Systems	
Type: Elective **Course Credits:** 04 **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30 (i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40 (i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

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

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-14 (i).1	understand the concepts of neural networks and fuzzy logic;
MT-CSE-20-14 (i).2	learn to use the concepts of artificial intelligence in state space serach;
MT-CSE-20-14 (i).3	acquire technical knowhow about the knowledge representation;
MT-CSE-20-14 (i).4	Understand and use the concepts of reasoning in artificial intelligence.

CO-PO Mapping Matrix for the Course Code : MT-CSE-20-14 (i)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-14 (i).1	3	3	1	3	1	3	2	3	3	1	2
MT-CSE-20-14 (i).2	3	2	1	3	1	3	2	3	3	1	2
MT-CSE-20-14 (i).3	3	3	1	3	3	3	2	3	3	1	3
MT-CSE-20-14 (i).4	3	2	1	3	3	3	2	3	3	1	3
Average	**3**	**2.5**	**1**	**3**	**2**	**3**	**2**	**3**	**3**	**1**	**2.5**

CO-PSO Mapping Matrix for the Course Code : MT-CSE-20-14 (i)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-14 (i).1	2	3	2	3
MT-CSE-20-14 (i).2	2	3	2	3
MT-CSE-20-14 (i).3	2	3	3	3
MT-CSE-20-14 (i).4	2	3	3	3
Average	**2**	**3**	**2.5**	**3**

Unit – I

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

Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Unit – II

Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill-climbing search. Optimization and search such as stochastic annealing and genetic algorithm.

Unit – III

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

Unit – IV

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

Text Books:

1. Luger G.F. and Stubblefield W.A., Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley.

Reference Books:

1. Russell S. and Norvig P., Artificial Intelligence: A Modern Approach. Prentice-Hall.

MT-CSE-20-14 (ii) : Distributed Systems

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester exam:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: To introduce the fundamental concepts and issues of managing large volume of shared data in a distributed environment.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-14 (ii).1	learn fundamental concept and architecture of distributed databases;
MT-CSE-20-14 (ii).2	learn different strategies of distributed database design and integration strategies;
MT-CSE-20-14 (ii).3	implement distributed query processing and optimization in distributed environment;
MT-CSE-20-14 (ii).4	understand concurrency control schemes and database reliability.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-14 (ii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-14 (ii).1	3	3	3	3	2	2	3	2	2	2	1
MT-CSE-20-14 (ii).2	3	2	3	1	3	1	2	3	3	1	3
MT-CSE-20-14 (ii).3	3	3	1	3	1	2	2	2	2	3	1
MT-CSE-20-14 (ii).4	3	3	3	2	3	3	1	2	3	2	3
Average	**3**	**2.75**	**2.5**	**2.25**	**2.25**	**2**	**2**	**2.25**	**2.5**	**2**	**2**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-14 (ii)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-14 (ii).1	3	3	3	3
MT-CSE-20-14 (ii).2	2	2	1	2
MT-CSE-20-14 (ii).3	3	2	2	1
MT-CSE-20-14 (ii).4	3	3	1	2
Average	**2.75**	**2.5**	**1.75**	**2**

UNIT – I

Introduction to Distributed Data Processing and Distributed Database System; Features of Distributed Databases,

An Example of Distributed DBMS, Types of DDBS, Promises and Complications in a Distributed DBMS; Functions and Objectives of Distributed DBMS, Distributed DBMS Architecture: Client/Server System, Peer-to-Peer Distributed System, Multi Database System (MDBS).

UNIT – II

Distributed Database Design: Top-down Design Process, Designing Process and Issues, Data Fragmentation: Benefits, Correctness Rules and Types of Fragmentation, Allocation: Measures of Cost and Benefits for Fragment Allocation, Database Integration: Schema Matching, Schema Integration, Schema Mapping. Data and Access Control: View Management, Data Security, Semantic Integrity Control.

UNIT – III

Distributed Query Processing: Concept and Objectives of Query Processing; Phases/ Layers of Query Processing: Query Decomposition, Query Fragmentation; Global Query Optimization; Local Query Optimization, Join Strategies in Fragmented Relations, Global Query Optimization Algorithms. Distributed Database Security and Catalog Management.

UNIT –IV

Concurrency Control In Centralized Database Systems; Concurrency Control In DDBMS; Distributed Concurrency Control Algorithms; Deadlock Management, Reliability Issues In DDBMS; Types of Failures; Reliability Techniques; Commit Protocols; Recovery Protocols.

Text Books:

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

Reference Books:

1. Stefano Ceri, Giuseppe Pelagatti, Distributed Databases Principles and Systems, McGraw Hill Education.
2. Sunita Mahajan, Seema Shah, Distributed Computing, Oxford Higher Education.

MT-CSE-20-14(iii): Computer Vision and Augmented Reality

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: Provide an overview of theory and practicable methods in Computer Vision and Augmented Reality, with applications. The aspiration is to develop ability to create image-based models related to real-world applications and blend real world imagery with computational visionary techniques.

Course Outcomes: At the end of this course, the student will be able to:	
MT-CSE-20-14(iii).1	understand and use basic concepts in computer vision related to geometric image formation, image processing, and feature detection and matching;
MT-CSE-20-14(iii).2	gain exposure and perform image segmentation for changing the representation of images, feature based alignment for estimating the motion between two or more sets of points, and motion understanding and recognition of images;
MT-CSE-20-14(iii).3	get familiar with the concepts of Augmented Reality along with its related hardware and software and will learn how to create visual and audio content;
MT-CSE-20-14(iii).4	acquire skills necessary to actualize applications correlated to Augmented Reality.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-14(iii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-14(iii).1	3	2	3	2	1	2	2	2	3	-	2
MT-CSE-20-14(iii).2	3	2	3	2	1	3	2	2	3	-	3
MT-CSE-20-14(iii).3	3	2	3	1	1	2	2	2	3	-	2
MT-CSE-20-14(iii).4	3	3	3	3	1	3	3	2	3	-	3
Average	**3**	**2.25**	**3**	**2**	**1**	**2.5**	**2.25**	**2**	**3**	**-**	**2.5**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-14(iii)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-14(iii).1	3	3	1	3
MT-CSE-20-14(iii).2	3	3	1	3
MT-CSE-20-14(iii).3	3	2	1	3
MT-CSE-20-14(iii).4	3	3	1	3
Average	**3**	**2.75**	**1**	**3**

Unit – I

Computer Vision: Introduction; Research and Applications; Representation of a Three-Dimensional Moving Scene.

Image Formation: Geometric Primitives and Transformations, Image Model; Lighting, Reflectance & Shading; Imaging Devices for Computer Vision.

Image Processing: Recovering Intrinsic Structure, Range Information from Geometry, Surface Orientation from Reflectance Models, Filtering the Image; Fourier Transforms; Image Pyramids & Wavelets.

Feature Detection and Matching: Point features & patches; Edge Detection & Linking; Hough Transforms; Applications.

Unit – II

Segmentation: Active Contours & Application; Split & Merge; Mean Shift & Mode Finding; Normalized Cuts; Graph Cuts & Energy Based methods with application.

Feature Based Alignment: 2-D & 3-D Feature Based Alignment; Pose estimation and Application to Augmented Reality; Calibration and its Application.

Structure from Motion: Motion Understanding , Understanding Optical Flow and Image Sequences; Triangulation; Two-Frame structure from motion and application; Factorization; Bundle adjustment and its applications; Dense Motion Estimation; Image Stitching.

Recognition: Object Detection; face Recognition; Instance Recognition; Category Recognition.

Unit – III

Augmented Reality: Overview, AR Components and Working; Augmented Reality Related Concepts: Computer Graphics, Dimensionality, Depth Cues, Registration & Latency; Ingredients of an Augmented Reality Experience; Tracking for Augmented Reality; Coordinate Systems; AR Hardware & Software; Displays; Display Techniques.

Augmented Reality Content: Creating Visual & Audio Content.

Unit – IV

Interaction in Augmented Reality: introduction & Categories; Interaction in Projected Augmented Reality Environments.

Mobile Augmented Reality: Architectures; Advantages & Disadvantages.

Visualization Issues; Augmented Reality Technologies, Computer Vision in Augmented Reality; AR Interfaces.

Augmented Reality Applications: Issues for a good Augmented Reality Application; Application Areas; Collaborative Augmented Reality; Steps for applying Augmented Reality; Evaluating Augmented Reality Applications; Example Augmented Reality Applications.

Text Books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications (CVAA). Springer
2. D. H. Ballard, C. M. Brown. Computer Vision. Prentice-Hall
3. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann

Reference Books:

1. D. Forsyth and J. Ponce, Computer Vision - A modern approach, Prentice Hall
2. E. Trucco and A. Verri, Introductory Techniques for 3D Computer Vision, Prentice Hall.
3. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press
4. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press
5. BoguslawCyganek, J.Paul Siebert, An Introduction to 3D Computer Vision Techniques and Algorithms, Wiley
6. Dieter Schmalstieg and Tobias Höllerer, Augmented Reality: Principles & Practice, Pearson Education.

MT-CSE-20-14 (iv) : Advanced Computer Architecture

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: To learn architecture and organization of high performance computers, principles of pipeline processing, instruction level, data level, thread level & request level parallelism and advanced techniques of cache and virtual memory optimization, MIMD architectures and quantitative analysis of interconnection networks.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-14 (iv).1	understand the various techniques to enhance a processors ability to exploit Instruction-level level parallelisms;
MT-CSE-20-14 (iv).2	understand various architectures for data level parallelism and find differences among them;
MT-CSE-20-14 (iv).3	exploit request level parallelism and learn advanced techniques to improve cache and virtual memory performance;
MT-CSE-20-14 (iv).4	understand various MIMD architectures and evaluate performances of interconnection network used in them.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-14 (iv)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-14 (iv).1	3	1	3	3	3	1	1	2	3	1	1
MT-CSE-20-14 (iv).2	3	2	3	3	3	1	1	2	3	1	1
MT-CSE-20-14 (iv).3	3	2	3	3	3	2	1	2	3	1	2
MT-CSE-20-14 (iv).4	3	3	3	3	3	2	1	2	3	1	2
Average	**3**	**2**	**3**	**3**	**3**	**1.5**	**1**	**2**	**3**	**1**	**1.5**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-14 (iv)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-14 (iv).1	3	2	1	3
MT-CSE-20-14 (iv).2	3	2	1	3
MT-CSE-20-14 (iv).3	3	3	2	3
MT-CSE-20-14 (iv).4	3	3	2	3
Average	**3**	**2.5**	**1.5**	**3**

Unit – I

Instruction Level Parallelism (ILP): Data dependences and hazards – data dependences, control dependences; Basic Compiler Techniques for Exposing ILP – basic pipeline scheduling and loop unrolling, reducing branch costs with advanced branch prediction, overcoming data hazardous with dynamic scheduling, Tomasulo's approach, hardware based speculation; Exploiting ILP using Multiple issue and Static Scheduling – VLIW & Superscalar processors, Advanced techniques for Instruction Delivery and Speculation; Limitations of ILP.

Unit – II

Data Level Parallelism in Vector, SIMD & GPU Architectures: Vector Architecture – working of vector processors, vector execution time, multiple lanes, vector registers, memory banks, stride, gather-scatter; SIMD Instruction Set Extensions for Multimedia; Graphics Processing Units, Vector architecture vs. GPUs, Multimedia SIMD v/s GPUs; detecting and enhancing Loop-Level Parallelism – finding dependences, eliminating dependent computations

Thread-Level Parallel Parallelism: Multiprocessor Architecture – centralized shared-memory architectures, cache coherence problem, schemes enforcing coherence, snooping coherence protocol; Extensions to basic coherence protocol; Distributed Shared-Memory and Directory-Based Coherence.

Unit – III

Warehouse-Scale Computers (WSC) to Exploit Request-Level and Data-Level Parallelism: Programming models and workloads for WSC, architecture of warehouse-scale computers, physical infrastructure and costs of WSC; Cloud Computing.

Memory Hierarchy: Cache performance – average memory access time & processor performance, miss penalty and out-of-order execution processors, cache optimizations; Virtual Memory – fast address translation, selecting page size, protection of virtual memory.

Unit – IV

MIMD Architectures: Architectural concepts of Distributed & Shared Memory MIMD architectures (UMA, NUMA, COMA, CC-NUMA); Interconnection Networks – direct interconnection networks (Linear Array, Ring, Star, 2D Mesh, Hyper cubes), switching techniques; dynamic interconnection networks (shared bus, crossbar, multistage networks); Specifications of top three super computers of Top500 list.

Text Books:

1. J.D. Hennessy, D.A. Patterson, Computer Architecture A Quantitative Approach, Elsevier India.
2. Sima D., Fountain T., Kasuk P., Advanced Computer Architecture-A Design space Approach, Pearson Education.

Reference Books:

1. Hesham El-Rewini, Mostafa Abd-El-Barr, Advanced Computer Architecture and Parallel Processing, Wiley India Pvt. Ltd.
2. Kai Hwang, Advanced computer architecture – Parallelism, Scalability, Programmability, Tata McGraw Hill.
3. Rajaraman V. & Murthy C.S.R., Parallel Computer: Architecture & Programming, PHI Learning.
4. David Culler, Parallel Computer Architecture, Elsevier India.
5. Stallings W., Computer Organization and Architecture, Pearson Education.

MT-CSE-20-15 : Research Methodology and IPR

Type: Compulsory
Course Credits: 03
Contact Hours: 3 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: To understand that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular. To understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-15.1	understand what is research;
MT-CSE-20-15.2	understand how to formulate a research problem;
MT-CSE-20-15.3	analyze the need of IPR;
MT-CSE-20-15.4	learn about patent and new developments in the field of IPR.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-15

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-15.1	3	3	3	3	3	3	2	3	3	3	2
MT-CSE-20-15.2	3	3	3	3	3	3	2	3	3	3	2
MT-CSE-20-15.3	3	3	2	2	2	2	3	3	3	3	2
MT-CSE-20-15.4	3	3	2	2	2	2	3	3	3	3	2
Average	**3**	**3**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**3**	**3**	**3**	**2**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-15

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-15.1	3	2	3	2
MT-CSE-20-15.2	3	2	3	2
MT-CSE-20-15.3	3	2	3	2
MT-CSE-20-15.4	3	2	3	2
Average	**3**	**2**	**3**	**2**

Unit – I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem,

Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit – II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit – III

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

Unit – IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Computer Software.

Text Books:

1. Stuart Melville and Wayne Goddard, Research methodology: An introduction for science & engineering students, Juta & Co Ltd Publishers
2. Wayne Goddard and Stuart Melville, Research Methodology: An Introduction, Juta & Co Ltd Publishers
3. Ranjit Kumar, Research Methodology: A Step by Step Guide for beginners, SAGE Publishers
4. Halbert, Resisting Intellectual Property, Taylor & Francis Ltd.

Reference Books:

1. Niebel , Product Design, McGraw Hill.
2. Asimov, Introduction to Design, Prentice Hall.
3. Robert P. Merges, Peter S. Menell, Mark A. Lemley, Intellectual Property in New Technological Age.
4. T. Ramappa, Intellectual Property Rights Under WTO, S. Chand.
5. Mayall , Industrial Design, McGraw Hill.

MT-CSE-20-21: Advances in Algorithms	
Type: Compulsory **Course Credits:** 04 **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30 (i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40 (i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to introduce the students to recent developments in the area of algorithmic design so that students are able to choose appropriate algorithms and use it for a specific problem.

Course Outcomes (COs)	After the course the students are expected to be able to
MT-CSE-20-21.1	familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems;
MT-CSE-20-21.2	analyse the complexity/performance of different algorithms such as graphs;
MT-CSE-20-21.3	learn and apply the various mathematical algorithms useful in various applications in computer science;
MT-CSE-20-21.4	classify and solving the computational problems.

CO-PO Mapping Matrix for the Course Code : MT-CSE-20-21

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-21.1	3	3	1	3	1	3	2	1	3	1	2
MT-CSE-20-21.2	3	2	1	3	1	3	2	1	3	1	2
MT-CSE-20-21.3	3	2	1	3	1	3	2	1	3	1	2
MT-CSE-20-21.4	3	3	1	3	2	3	2	1	3	1	2
Average	**3**	**2.5**	**1**	**3**	**1.25**	**3**	**2**	**1**	**3**	**1**	**2**

CO-PSO Mapping Matrix for the Course Code : MT-CSE-20-21

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-21.1	3	3	2	3
MT-CSE-20-21.2	3	2	1	3
MT-CSE-20-21.3	3	2	1	3
MT-CSE-20-21.4	3	3	2	3
Average	**3**	**2.5**	**1.5**	**3**

Unit – I

Sorting: Review of various sorting algorithms, topological sorting

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

Unit – II

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

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

Unit – III

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

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

Unit – IV

Linear Programming: Geometry of the feasibility region and Simplex algorithm.

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

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation.

Extension to polynomials. Application: Interpolation problem.

Text Books:

1. Cormen, Leiserson, Rivest, Stein, Introduction to Algorithms, MIT Press.

Reference Books:

1. Aho, Hopcroft, Ullman, The Design and Analysis of Computer Algorithms, Pearson Education.
2. Kleinberg and Tardos, Algorithm Design, Pearson Education.

MT-CSE-20-22: Soft Computing

Type: Compulsory
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: Introduce fundamental soft computing concepts with an exposure to non-traditional techniques for problem solving and optimization. Provide Soft Computing based research oriented direction for solving imprecisely defined problems. Provide a comprehensive introduction to nature-inspired metaheuristic methods for search and optimization, including the latest trends in evolutionary algorithms and other forms of natural computing.

Course Outcomes: At the end of this course, the student will be able to:	
MT-CSE-20-22.1	have a knowledge of soft computing techniques along with their applications and non-traditional metaheuristic optimization and data clustering techniques & algorithms for obtaining optimized solutions to optimization, computational intelligence, and design/scheduling applications;
MT-CSE-20-22.2	apply fuzzy logic theory to imprecisely defined problems;
MT-CSE-20-22.3	use Neural Networks concepts to find solutions to problems where normally algorithmic methods do not exist or are costly;
MT-CSE-20-22.4	design high-quality solutions using Genetic Algorithms for optimization and search problems and have exposure to MATLAB environment for implementing solutions to problems using soft computing techniques.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-22

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-22.1:	3	3	3	3	2	3	3	2	3	-	3
MT-CSE-20-22.2:	3	3	3	3	2	3	3	2	3	-	3
MT-CSE-20-22.3:	3	3	3	3	2	3	3	2	3	-	3
MT-CSE-20-22.4:	3	3	3	3	2	3	3	2	3	-	3
Average	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**-**	**3**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-22

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-22.1:	3	3	1	3
MT-CSE-20-22.2:	3	3	1	3
MT-CSE-20-22.3:	3	3	1	3
MT-CSE-20-22.4:	3	2	1	3
Average	**3**	**2.75**	**1**	**3**

Unit – I

Soft Computing: Conventional AI to Computational Intelligence; Soft Computing Constituents and Applications. **Introduction to Non-traditional Metaheuristic Optimization Techniques:** Random Optimization, Simulated Annealing, Tabu Search, Ant Colony Optimization, Particle Swarm Optimization, Harmony Search, Memetic Algorithms, Other Evolutionary Algorithms such as Firefly Algorithm, Bee Algorithm, Shuffled Frog Leap algorithm, Bat algorithm etc.

Data Clustering Algorithms: K-Means, Fuzzy C-Means, Mountain Clustering, Subtractive Clustering.

Unit – II

Fuzzy Set theory: Fuzzy Sets & Classical Sets; Operations on Fuzzy Sets, Fuzzy Relations, Linguistic Variables. **Membership Functions**: Introduction, Features, & Fuzzification, Methods of Membership Value Assignment; Defuzzification.

Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy Logic; Fuzzy Rule Base and Approximate Reasoning, Fuzzy Quantifiers; Fuzzy Inference Systems, Fuzzy Decision Making, Fuzzy Logic Control System; Fuzzy Expert Systems.

Unit – III

Neural Networks: Fundamental Concepts, Basic Models and Architecture; Machine Learning Using Neural Networks; Associative Memory Networks and their Applications.

Supervised Learning Neural Networks: Perceptron Networks, Radial Basis Function Networks: Back Propagation Neural Network: Architecture, Learning, Applications, & Research Directions; The Boltzman Machine.

Unsupervised Learning Networks: Competitive Learning networks; Kohonen Self-Organizing Networks; Hebbian learning; The Hopfield Network; Counter propagation Networks; Adaptive Resonance Theory: Introduction, Architecture, & Applications; Feed forward Networks; Reinforcement Learning.

Unit – IV

Genetic Algorithms: Introduction to Genetic Algorithms (GA) and their Terminology; Traditional Optimization and Search Techniques vs. Genetic Algorithm ; Operators in Genetic Algorithms; Problem Solving using Genetic Algorithm; Classification of Genetic Algorithms; Holland's Classifier Systems; Genetic Programming; Advantages and Limitations of Genetic Algorithm; Applications of Genetic Algorithm; Applications of GA in Machine Learning.

Introduction to Hybrid Systems; MATLAB Environment for Soft Computing Techniques.

Text Books:

1. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India.
2. Jyh Shing Roger Jang, Chuen Tsai Sun, Eiji Mizutani, Neuro Fuzzy and Soft Computing, Prentice Hall

Reference Books:

1. S.Rajasekaran and G.A.Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, Prentice-Hall of India Pvt. Ltd.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall.
3. George J. Klir, Ute St. Clair, Bo Yuan, Fuzzy Set Theory: Foundations and Applications, Prentice Hall.
4. Simon O. Haykin, Neural networks: a comprehensive foundation, Pearson Education.
5. Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall
6. Goldberg D. E., Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson Education.
7. Ahmad Lotfi, Jonathan Garibaldi, Applications and Science in Soft Computing, Springer.
8. Rajkumar Roy, Mario Koppen Soft Computing and Industry: Recent Applications, Springer.
9. James A. Freeman, David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India.
10. Du, Ke-Lin, Swamy, M. N. S., Search and Optimization by Metaheuristics: Techniques and Algorithms, Springer

11. Omid Bozorg-Haddad, Mohammad Solgi, Hugo A. Loaiciga, Meta-heuristic and Evolutionary Algorithms for Engineering Optimization, Wiley

MT-CSE-20-23 (i) : Data Preparation and Analysis

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives:
Students will learn how to prepare data for analysis, perform exploratory data analysis, and develop meaningful Data Visualizations. Students will learn to perform analysis using R programming language.

Course Outcomes (COs)	After the course the students are expected to be able to
MT-CSE-20-23 (i).1	understand the stages and strategies for data preparation;
MT-CSE-20-23 (i).2	learn data pre-processing methods to remove data anomalies;
MT-CSE-20-23 (i).3	perform exploratory analysis of processed data;
MT-CSE-20-23 (i).4	implement R Language and be self-competent to acquire job as business analytics.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-23 (i)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-23 (i).1	3	3	3	3	2	2	3	2	2	2	1
MT-CSE-20-23 (i).2	3	2	3	2	3	3	2	3	3	3	1
MT-CSE-20-23 (i).3	3	2	2	3	1	2	3	3	2	3	1
MT-CSE-20-23 (i).4	3	3	3	2	3	1	1	2	3	2	3
Average	**3**	**2.5**	**2.75**	**2.5**	**2.25**	**2**	**2.25**	**2.5**	**2.5**	**2.5**	**1.5**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-23 (i)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-23 (i).1	3	3	1	3
MT-CSE-20-23 (i).2	3	2	2	2
MT-CSE-20-23 (i).3	3	1	2	3
MT-CSE-20-23 (i).4	2	3	1	2
Average	**2.75**	**2.25**	**1.5**	**2.5**

Unit- I

Data Exploration as a Process, Data Mining, Motivation behind data mining, Data Preparation: Inputs, Outputs, Data Anomalies: Missing Value, Noise, Inconsistency, Incomplete, Modelling Tools and data

preparation, Stages of Data Preparation, Data Discovery, Data Characterization, Data Set Assembly.

Unit- II

Data Cleaning: Knowledge Discovery Process, Consistency Checking, Heterogeneous and Missing Data, Missing Values Replacement Policies, Types of Missing Data, Techniques of Dealing with Missing Data, Data Transformation, Data Transformation Process , Types of Data Transformation, Benefits and Limitations, Data Segmentation.

Unit- III

Exploratory Analysis: Descriptive and Comparative Statistics, Clustering and Association, Visualization: Designing Visualizations, Time Series, Geolocated Data, Correlations and Connections, Hierarchies and Networks, Interactivity.

Unit- IV

R: Advantages of R over other Programming Languages, Working with Directories and Data Types in R, Control Statements, Loops, Data Manipulation and integration in R, Exploring Data in R: Data Frames, R Functions for Data in Data Frame, Loading Data Frames, Decision Tree packages in R, Issues in Decision Tree Learning, Hierarchical and K-means Clustering functions in R, Mining Algorithm interfaces in R.

Text Books:

1. Glenn J. Myatt., Wayne P. Johnson Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, Wiley.
2. Dorian Pyle, Data Preparation for Data Mining, Morgan Kaufmann Publishers, Inc.
3. S. Acharya, Data Analytics Using R, McGraw Hill Education (India) Private Limited.

References Books:

1. Hector Cuesta, Practical Data Analysis, PACKT Publishing (Open Source).
2. Edwin Moses, R Data Analysis and Visualization, PACKT Publishing (Open Source)

MT-CSE-20-23 (ii): Optimization Techniques	
Type: Elective **Course Credits:** 04 **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30 (i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40 (i.e. 40%)	**Instructions to paper setter for End semester exam:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to provide the in-depth coverage of various linear programming problems and their solution techniques. It focuses on various optimization techniques and their applications in problem solving.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-23(ii).1	understand the role and principles of optimization techniques in business world using LPP;
MT-CSE-20-23(ii).2	understand the techniques to solve and use IPP and Analyse the optimization techniques in strategic planning;
MT-CSE-20-23(ii).3	analyse the optimization techniques for optimal gain;
MT-CSE-20-23(ii).4	understand the techniques to solve networking and queuing problems;

CO-PO Mapping Matrix for the Course Code : MT-CSE-20-23(ii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-23(ii).1	3	3	2	3	1	3	1	2	2	1	1
MT-CSE-20-23(ii).2	3	3	2	3	2	3	1	2	2	1	3
MT-CSE-20-23(ii).3	3	3	2	3	2	3	1	2	2	1	3
MT-CSE-20-23(ii).4	3	3	2	3	3	3	2	2	2	1	3
Average	**3**	**3**	**2**	**3**	**2**	**3**	**1.25**	**2**	**2**	**1**	**2.5**

CO-PSO Mapping Matrix for the Course Code : MT-CSE-20-23(ii)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-23(ii).1	3	2	1	2
MT-CSE-20-23(ii).2	3	2	1	2
MT-CSE-20-23(ii).3	3	2	1	2
MT-CSE-20-23(ii).4	3	3	1	2
Average	**3**	**2.25**	**1**	**2**

Unit – I

Introduction: The Historical development, Nature, Meaning and Management Application of Operations research. Modelling, Its Principal and Approximation of O.R. Models, Main characteristic and phases, General Methods of solving models, Scientific Methods, Scope, Role on Decision Making and Development of Operation Research in India.

Linear Programming: Two-phase Simplex method, Degeneracy.

Duality in LPP: Definition of Dual Problem, General Rules for converting any Primal into its Dual, Dual Simplex method and its flow chart.

Unit – II

Integer Programming: Importance, Applications and Classification, Gomory's all integer programming problem technique and its flow chart, Branch and Bound Method.

Transportation Models: Formulation of problem, Obtaining Initial Basic feasible solution, Optimality tests, Progressing towards optimal solution, Unbalanced Transportation Problems.

Unit – III

Assignment Models: Formulation of problem, Hungarian Method for Assignment Problems, Unbalanced Assignment Problems.

Inventory theory: Costs involved in inventory problems - single item deterministic models-economic lot size models without shortages and with shortages having production rate infinite and finite.

Unit – IV

PERT and CPM: Basic steps in PERT/CPM, Techniques, Network Diagram Representation, Forward and Backward Pass-computation, Representation in Tabular form, Determination of Critical path, Critical activity, Floats and Slack Times, Implementation in any programming language.

Queuing Theory: Introduction; Basic Definitions and Notations; Arrival & Departure in Poisson Queue. Pure Birth and Death Models; Poisson Queue Models: M/M/1: ∞ /FIFO and M/M/1: N/ FIFO.

Text Books:

1. Sharma, S.D., Operations Research, Kedar Nath and Ram Nath, Meerut.
2. Gupta P.K., Hira and D.S., Operation Research, Sultan Chand & Sons, New Delhi.

Reference Books:

1. Kanti Swarup, Gupta P.K. & Man Mohan, Operation Research, Sultan Chand & sons, New Delhi.
2. Rao S.S., Optimization Theory and Applications, Wiley Eastern Ltd. New Delhi.
3. Taha, H.A., Operation Research – An Introduction, McMillan Publishing Co, New York.
4. Gillet, B.E., "Introduction to Operations Research: A Computer Oriented Algorithmic Approach". Tata McGraw Hill, New York.

MT-CSE-20-23(iii): Advanced Wireless and Mobile Networks

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: Provide a comprehensive knowledge of the key concepts of wireless and mobile networks, standards, technologies and their basic operations

Course Outcomes: At the end of this course, the student will be able to:	
MT-CSE-20-23(iii).1	have fundamental knowledge of wireless and mobile communication technologies and their applications along with an exposure to the architectural issues related with the contemporary wireless LAN and PAN technologies;
MT-CSE-20-23(iii).2	get acquainted with the contemporary wireless WAN and MAN technologies along with their architectural and mobility issues;
MT-CSE-20-23(iii).3	get an insight into the research perspective related to Adhoc wireless networks and their routing and media access control mechanisms;
MT-CSE-20-23(iii).4	gain intuitive knowledge of Multicast Routing, energy management and Transport Layer issues of Ad Hoc networks along with the security issues related to Wireless and Mobile Networks that may form a basis for innovative advancements towards research and development.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-23(iii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-23(iii).1	3	2	3	2	1	1	2	2	3	-	2
MT-CSE-20-23(iii).2	3	2	3	3	1	1	3	2	3	-	3
MT-CSE-20-23(iii).3	3	3	3	3	1	3	3	2	3	-	3
MT-CSE-20-23(iii).4	3	3	3	3	1	3	3	2	3	-	3
Average	**3**	**2.5**	**3**	**2.75**	**1**	**2**	**2.75**	**2**	**3**	**-**	**2.75**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-23(iii)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-23(iii).1	3	2	1	3
MT-CSE-20-23(iii).2	3	2	1	3
MT-CSE-20-23(iii).3	3	2	1	3
MT-CSE-20-23(iii).4	3	2	1	3
Average	**3**	**2**	**1**	**3**

Unit – I

Fundamentals of Wireless Communication Technology: Overview and Applications/types of Wireless and Mobile Networks; Evolution and Challenges of Wireless Networks ; The Electromagnetic Spectrum; Spread Spectrum; Frequency Reuse; Radio Propagation Mechanisms, Signals, Antennas; Characteristics of Wireless Channels; Modulation Techniques and Multiple Access Techniques for Wireless Systems.

Wireless LANs & PANs: Use and Design Goals for WLANs; IEEE802.11 standard: Architecture, Infrastructure vs. Ad-hoc Modes, Physical & MAC layer, CSMA/CA mechanism; HIPERLAN 1/2 standards; Technical features of HOMERF; BLUETOOTH specifications and architecture; Introduction to other PAN technologies and their applications.

Unit – II

Wireless WANs & MANs: The Cellular Concept; Call Set-up; Frequency Reuse Channel Allocation Algorithms; Handoffs; Mobility Management.

Telecommunication Systems: GSM and IS-95 architecture, channels and Call Establishment; Wireless Data Service; Generations in Wireless Cellular Networks and their features; DECT, TETRA, UMTS; Satellite Systems.

WiMAX : Physical layer, Media Access Control, Mobility and Networking, Overview of IEEE 802.22 Wireless Regional Area Networks.

Wireless Internet: Address Mobility; Mobile IP; IP and TCP for Wireless Domains; WAP.

Unit – III

AdHoc Wireless Networks: Introduction; Applications & Design Issues.

MAC Protocols for Ad Hoc Wireless Networks: Issues, design Goals and Classification; Contention Based Protocols; Contention Based MAC Protocols with Reservation and Scheduling Mechanism; Other MAC Protocols.

Routing Protocols for Ad Hoc Networks: Introduction, Issues; Classification; Table-Driven Routing Protocols; On-Demand Routing Protocols; Hybrid Routing Protocols; Routing Protocols with Efficient Flooding Mechanisms; Hierarchical Routing Protocols.

Unit – IV

Multicast Routing in Ad Hoc Networks: Introduction; Issues; Operation of Multicast Routing Protocols; Classification; Tree-Based Multicast Routing Protocols; Mesh-Based Multicast Routing Protocols; Energy Efficient Multicasting.

Energy Management in Ad Hoc Wireless Networks: Need and classification of energy management schemes.

Transport Layer for Ad Hoc Wireless Networks: Introduction and Design Issues; TCP over Ad Hoc Wireless Networks.

Security Requirements in wireless networks: Issues and challenges; Network Security Attacks; Key Management; Secure Routing in Ad Hoc Wireless Networks; WEP protocol.

Text Books:

1. C.Siva Ram Murthy and B.S.Manoj, Ad Hoc Wireless Networks- Architecture and Protocols, Pearson Education
2. Schiller J., Mobile Communications, Addison Wesley.

Reference Books:

1. Stallings W., Wireless Communications and Networks, Pearson Education
2. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc
3. Yi Bing Lin and Imrich Chlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc
4. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI
5. Sipra DasBit, Biplab K. Sikdar, Mobile Computing, PHI.

6. William C.Y.Lee, “Mobile Cellular Telecommunications”, McGraw-Hill.
7. Theodore S. Rapparort, Wireless Communications- Principles and Practice, Pearson Education.
8. Hazysztof Wesolowshi, Mobile Communication Systems, Wiley India.

MT-CSE-20-23(iv): Networking and Administration in Linux / Unix

Type: Elective **Course Credits:** 04 **Contact Hours:** 4 hours/week **Examination Duration:** 3 Hours **Mode:** Lecture **External Maximum Marks:** 75 **External Pass Marks:** 30 (i.e. 40%) **Internal Maximum Marks:** 25 **Total Maximum Marks:** 100 **Total Pass Marks:** 40 (i.e. 40%)	**Instructions to paper setter for End semester examination:** Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question, there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objectives of this course are to provide the in-depth coverage of various concepts of Linux. Linux administration and communication is an essential course for the students.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-23(iv).1	understand the basic concepts, commands and file management in Linux / Unix;
MT-CSE-20-23(iv).2	understand the manipulation of processes and system calls in Linux / Unix;
MT-CSE-20-23(iv).3	learn the interprocess communication, system administration and networking concepts in Linux / Unix;
MT-CSE-20-23(iv).4	develop shell programs in Linux / Unix.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-23(iv)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-23(iv).1	3	2	3	3	3	2	1	1	3	1	2
MT-CSE-20-23(iv).2	3	2	3	3	3	2	2	1	3	1	2
MT-CSE-20-23(iv).3	3	2	3	3	3	2	2	1	3	1	2
MT-CSE-20-23(iv).4	3	2	3	3	3	3	2	1	3	1	2
Average	**3**	**2**	**3**	**3**	**3**	**2.25**	**1.75**	**1**	**3**	**1**	**2**

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-23(iv).1	3	3	2	3
MT-CSE-20-23(iv).2	3	3	2	3
MT-CSE-20-23(iv).3	3	3	2	3
MT-CSE-20-23(iv).4	3	3	2	3
Average	**3**	**3**	**2**	**3**

UNIT – I

Introduction: Basic features & architecture.

File System: Files, Organization, Assessing File systems, Structure - boot block, super block, inode block, and data block.

Commands: Basic and Advanced commands, File access permissions: chmod, umask, chgrp, groups.

File management and Compression: Computer devices, Disk related commands: dd, du, df, dfspace, fdisk, compressing and uncompressing files.

UNIT – II

Manipulating Processes and Signals: Basics, process states and transitions, zombie and orphan processes, process oriented commands. Handling foreground and background jobs. Process scheduling using cron, crontab, at, batch. Changing priority. Signal generation and Handling.

System calls: Files related system calls for opening, creating, reading, writing, relocating file descriptors, closing, duplicating file descriptors, linking, unlinking, accessing file status information, checking permissions, changing ownership, groups and permissions of files. Process related system calls: exec, fork, wait, exit.

UNIT – III

Interprocess Communication: Pipes, messages, sockets, shared memory.

System Administration: Booting and shutting down process. Acquiring super user status, Creating, mounting and unmounting file systems. Managing User accounts**:** creating, modifying & deleting user accounts and groups. Maintaining security, password administration, rc scripts used by init, terminal management.

Networking Tools: Communication oriented commands. ping, nslookup, telnet, arp, netstat, route, ftp, trivial file transfer protocol, finger, rlogin.

UNIT – IV

Filters: Connecting processes with pipes, redirecting input and output. Filters: sort, grep, egrep, fgrep, uniq, more, pr, cut, paste, tr.

Shell Programming: Shell meaning & types; Introduction to shell scripting, shell variables, exporting shell variables, Escape mechanisms, Shell meta characters, read command, conditional statements, looping and case statements, expr statement, command line arguments, sleep and basename commands, Bourne Shell Commands, string handling, arrays, shell functions, shell programs to automate system tasks.

Text Books:

1. Harwani B.M., Unix and Shell Programming, Oxford University Press.
2. Das Sumitabha, Your Unix – The Ultimate Guide, Tata Mcgraw Hill.

Reference Books:

1. Matthew Neil, Stones Richjard, Beginning Linux Programming, Wiley India Pvt. Ltd.
2. Christopher Negus, Linux Bible, Wiley India Pvt. Ltd.
3. Goerzen John, Linux Programming Bible, IDG Books, New Delhi.

MT-CSE-20-24 (i): Mobile Application and Services

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to provide the in-depth coverage of various concepts of mobile application development especially android based applications. This course will help the students in learning to develop and publish their own mobile applications.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-24(i).1	know the components and structure of mobile application development frameworks for Android based mobiles
MT-CSE-20-24(i).2	design and implement the user interfaces of mobile applications;
MT-CSE-20-24(i).3	implement fragments and location based services in Android application;
MT-CSE-20-24(i).4	understand the basics of SQLite and develop interactive graphics in mobile applications.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-24(i)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-24(i).1	3	1	2	3	2	2	1	1	1	1	1
MT-CSE-20-24(i).2	3	1	2	2	2	3	2	2	1	1	1
MT-CSE-20-24(i).3	3	1	2	3	2	3	2	2	1	1	1
MT-CSE-20-24(i).4	3	1	2	3	2	3	2	2	1	1	1
Average	**3**	**1**	**2**	**2.75**	**2**	**2.75**	**1.75**	**1.75**	**1**	**1**	**1**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-24(i)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-24(i).1	3	2	1	3
MT-CSE-20-24(i).2	3	3	1	3
MT-CSE-20-24(i).3	1	3	1	3
MT-CSE-20-24(i).4	3	3	2	3
Average	**2.5**	**2.75**	**1.25**	**3**

Unit – I

Introduction: Mobile Applications, Characteristics and Benefits, Application Models, Mobile devices Profiles. Basics of Android, Importance and scope, Android Versions, Features of Android, Android Architecture, Android Stack, Android Applications Structure, Android Emulator, Android SDK, Overview of Android Studio, Android and File Structure, Android Virtual Device Manager, DDMS, LogCat, Understanding Activities.

Android User Interface: Measurements – Device and pixel density independent measuring units. Layouts – Linear, Relative, Grid and Table Layouts.

Unit – II

User Interface (UI) Components – Editable and non-editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers, List View, Spinner View.

Event Handling – Handling clicks or changes of various UI components.

Intents and Broadcasts: Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS

Services- Callbacks and Override in application, Application Signing, API keys for Google Maps, Publishing application to the Android Market.

Unit – III

Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities

Location and Mapping: location based services, Mapping, Google Maps activity, Working with MapView and MapActivity; Playing and Recording of Audio and Video in application; Sensors and Near Field Communication; Native libraries and headers, Building client server applications.

Unit – IV

Using Graphics: Canvas Drawing, Shadows, and Gradients.

Persisting Data to files: Saving to Internal Storage, Saving to External Storage

Introduction to SQLite database: creating and opening a database, creating tables, inserting retrieving and deleting data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update)

Text Books:

1. Zigurd Mednieks, Laird Dornin, G,Blake Meike and Masumi Nakamura, Programming Android, O'Reilly Publications.
2. Wei-Meng Lee, Beginning Android Application Development, Wiley India Ltd.

Reference Books:

1. James C.S., Android Application development for Java Programmer, CENGAGE Learning.
2. Pradeep Kothari, Android Application Development: Black Book, Wiley India Ltd.
3. Gargenta M., Nakamura M., Learning Android, O'Reilly Publications.

MT-CSE-20-24(ii): Advanced Web Technologies

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to provide the coverage of advanced technologies used in the design and development of web based applications such as Ajax/Node JS/Angular JS etc.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-24(ii).1	apply various jQuery methods in building UI projects;
MT-CSE-20-24(ii).2	design single-page applications using Angular JS;
MT-CSE-20-24(ii).3	handle the HTTP request by using Node JS.
MT-CSE-20-24(ii).4	Manage and optimize the web applications.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-24(ii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-24(ii).1	3	1	3	2	3	1	3	2	3	1	1
MT-CSE-20-24(ii).2	3	2	3	2	3	2	3	2	3	1	2
MT-CSE-20-24(ii).3	3	2	3	2	3	2	3	2	3	1	2
MT-CSE-20-24(ii).4	3	3	2	3	3	2	1	2	3	1	2
Average	**3**	**2**	**2.75**	**2.25**	**3**	**1.75**	**2.5**	**2**	**3**	**1**	**1.75**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-24(ii)

COs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
MT-CSE-20-24(ii).1	3	3	1	3
MT-CSE-20-24(ii).2	2	3	1	3
MT-CSE-20-24(ii).3	2	3	1	3
MT-CSE-20-24(ii).4	3	3	3	2
Average	**2.5**	**3**	**1.5**	**2.75**

Unit – I

Advanced Client side programming: Fundamentals of jQuery, Element Selector, Document ready function, Events, jQuery UI, Unobtrusive client validation, working with AJAX and jQuery.
Feature detection: Browser detection, Feature detection, Modernizer.

Unit – II

Introduction to AngularJS: Controllers, Models, Directives and Services, Single Page Applications, Angular User Interfaces: Angular Forms, Using Angular with Angular UI and Angular Bootstrap, Angular Services, Developing Custom Directives, Enhanced End-to End Testing

Unit – III

Introduction to Node JS: Node JS process model, Advantages, Traditional web server model. Setup Install Node.js on windows, REPL, Node JS console, Node JS modules, Events: Event Emitter class, inheriting events, Node

Package Manager, Creating web server: handling http requests, sending requests, File System, Debugging Node JS application, Database Connectivity.

Unit – IV

Search engines: Searching techniques used by search engines, keywords, advertisements, Search engine optimization for individual web pages: header entries, tags, selection of URL, alt tags, Search engine optimization for entire website: Hyperlinks and link structure, page rank of Google, click rate, residence time of website, frames, scripts, content management system, cookies, robots, Pitfalls in Optimization: optimization and testing, keyword density, doorway pages, duplicate contents, quick change of topics, broken links, poor readability, rigid layouts, navigation styles.

Text Books:

1. Shyam Seshadri & Brad Green, AngularJS: Up and Running, O'Relly.
2. Peter Smith, Professional Website performance, Wiley India Pvt. Ltd.

Reference Books:

1. Brad Dayley, Node.js, MongoDB, and AngularJS Web Development (Developer's Library), Addison Wesley.
2. Simon Holmes, Getting MEAN with Mongo, Express, Angular, and Node, Manning Publications.
3. HTML5 Black Book by Dreamtech Press
4. Maro Fischer, Website Boosting: Search Engine, Optimization, Usability, Website Marketing, Firewall Media, New Delhi.

MT-CSE-20-24(iii) : Object Oriented Software Engineering

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: In depth knowledge of software life cycle process using object oriented concept. Design and construction of modular, reusable, extensible and portable software using object-oriented concepts. Object oriented testing of software and its maintenance phase. Impact of object oriented programming on the software life cycle.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-24(iii).1	learn use of UML for object–oriented methodologies;
MT-CSE-20-24(iii).2	perform object oriented analysis for developing software systems;
MT-CSE-20-24(iii).3	understand the concept of planning and software estimation with object oriented approach;
MT-CSE-20-24(iii).4	demonstrate the ability to apply the knowledge of object oriented methods for designing software systems.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-24(iii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-24(iii).1	3	2	3	3	3	2	2	2	3	2	2
MT-CSE-20-24(iii).2	3	2	3	2	3	3	2	3	2	2	2
MT-CSE-20-24(iii).3	3	3	2	3	3	2	2	3	3	2	2
MT-CSE-20-24(iii).4	3	3	2	2	3	3	2	2	2	2	2
Average	**3**	**2.5**	**2.5**	**2.5**	**3**	**2.5**	**2**	**2.5**	**2.5**	**2**	**2**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-24(iii)

COs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
MT-CSE-20-24(iii).1	3	2	3	2
MT-CSE-20-24(iii).2	3	3	3	2
MT-CSE-20-24(iii).3	3	3	3	2
MT-CSE-20-24(iii).4	3	2	3	2
Average	**3**	**2.5**	**3**	**2**

Unit – I

Object Oriented Concepts and Modeling: Object Orientation, Importance of Modeling; Object Oriented

Modeling, Object oriented analysis, Identifying the elements of an object model, Introduction to UML, Conceptual Model of UML, Architecture, Object Oriented methodologies, Basic and Advanced Structural Modeling, Classes Relationship, Class diagram, Advanced Relationship, Interface, Packages, Object Diagram, Basic Behavioral Modeling, Use cases, Use Case Diagram, Interaction Diagram, Activity Diagram, State chart Diagram.

Unit – II

Analysis: Software Requirement: Functional and Non-functional Requirements, Known and Unknown Requirements. Characteristics of a Good Requirement, Software Requirements Specification Document: Nature of the SRS Document, Organization of the SRS Documents, Requirements Change Management, Overview of Analysis, Analysis Object Models and Dynamic Models, Entity, Boundary, and Control Objects, Structured Analysis versus Object-Oriented Analysis, Identification of Classes: Entity Classes, Interface Classes, Control Classes, Identification of Relationships: Association, Aggregation, Multiplicity, Composition, Dependency, Generalization, Modeling Relationships.

Unit – III

Planning and Software Estimation; planning of software process, components of a software project management plan, software project management plan frame work, planning of object oriented projects, Need of Object-Oriented Software Estimation, Use Case Points Method: Classification of Actors and Use Cases, Calculating Environmental Complexity Factors, Calculating Use Case Points, Object-Oriented Function Point: Relationship between Function Points and Object Points, Counting Internal Classes, External Classes and Services, Risk Management: What is Risk, Framework for Managing Risks, Risk Identification, Risk Analysis and Prioritization, Risk Avoidance and Mitigation Strategies, Risk Monitoring Estimating Risk Based on Schedule.

Unit – IV

Object Oriented Design: Interaction Diagrams, Refinement of Use Case Description, Construction of Detailed Class diagram, Development of Detailed Design and Creation of Software Design Document, Generating Test Cases from Use Cases, Object-Oriented Design Principles for Improving Software Quality, Commonly Used Testing Terminology, and Deriving Test Cases from Use Cases. Frameworks and design patterns.

Text Books:

1. Ivar Jacobson - Object Oriented Software Engineering - Addison Wesley.
2. Grady Booch, James Raumbaugh, Ivar Jacobson, The Unified Modeling Language User Guide.

Reference Books:

1. Stephen R. Schach, Classical and Object Oriented Software Engineering, McGraw Hill
2. Bernd Bruegge, Allen H. Dutoit, Object-Oriented Software Engineering Using UML, Patterns, and Java, Pearson Education.

MT-CSE-20-24 (iv): Big Data and Pattern Recognition

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination: Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The objective of this course is to help students learn, understand and practice the basic and advanced methods to big data technology and tools required to manage and analyse big data including MapReduce, NoSQL and Hadoop. The course provides an idea about pattern recognition approaches and gives the practical exposure of NoSQL.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-24 (iv).1	understand big data and big data analytics lifecycle;
MT-CSE-20-24 (iv).2	learn HDFS and MapReduce analytics using Hadoop;
MT-CSE-20-24 (iv).3	understand pattern recognition strategies in big data environment;
MT-CSE-20-24 (iv).4	develop solutions of big data environment in NoSQL.

CO-PO Mapping Matrix for the Course Code : MT-CSE-20-24 (iv)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-24 (iv).1	3	3	3	3	2	2	3	2	1	2	2
MT-CSE-20-24 (iv).2	3	2	3	2	3	1	2	3	3	3	1
MT-CSE-20-24 (iv).3	3	3	2	3	2	2	1	2	2	2	1
MT-CSE-20-24 (iv).4	3	3	3	3	3	3	1	2	3	2	1
Average	**3**	**2.75**	**2.75**	**2.75**	**2.5**	**2**	**1.75**	**2.25**	**2.25**	**2.25**	**1.25**

CO-PSO Mapping Matrix for the Course Code : MT-CSE-20-24 (iv)

COs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
MT-CSE-20-24 (iv).1	3	3	1	1
MT-CSE-20-24 (iv).2	3	2	2	2
MT-CSE-20-24 (iv).3	1	3	1	3
MT-CSE-20-24 (iv).4	2	3	1	2
Average	**2.25**	**2.75**	**1.25**	**2**

UNIT – I

Understanding Big Data: Concepts and Terminology, Big Data Characteristics, Different Types of Data, Identifying Data Characteristics, Business Motivations and Drivers for Big Data Adoption: Business Architecture, Business Process Management, Information and Communication Technology, Big Data Analytics Lifecycle, Enterprise Technologies and Big Data Business Intelligence, Industry examples of big data.

UNIT – II

Big Datasets, Big Data Oversight,Data format, Analyzing Data with Hadoop, Scaling Out, HDFS Concepts, Hadoop I/O, Hadoop Streaming, Design of Hadoop Distributed File System (HDFS), MapReduce Workflows, Unit Tests with MRUnit, Test Data and Local Tests, Anatomy of MapReduce Job Run, Classic Map-Reduce, An Overview of YARN, Zookeeper, HBase, HIVE, Pig, Mahout. Big Data Failure and Legalities.

UNIT – III

Pattern Recognition: Bigotry and Inductive Learning, Bigotry and Inductive Learning, Quantitative and Qualitative Analysis, Pattern Recognition Systems, Fundamental Problems in Pattern Recognition, Feature Extraction and Reduction, Paradigms, Pattern Recognition Approaches, Importance and Applications. Data Domain for Pattern Recognition. Pattern Recognition using Nearest Neighbour Classifier, Classifying using Decision Trees, Obtaining Patterns Rules from Decision Trees.

UNIT – IV

An Introduction to NoSQL, Characteristics of NoSQL, Drawbacks, NoSQL Storage Types, Aggregate Data Models, key-value and document data models, relationships, graph databases, schema less databases, materialized views, Data Management for Big Data: Schema Less Models, Key-Value Stores, Document Stores, Tabular Stores, Object Data Stores, Graph databases, The CAP Theorem, NoSQL Misconceptions..

Text Books:

1. Thomas Erl, Wajid Khattak and Paul Buhler, Big Data Fundamentals Concepts, Drivers & Techniques Prentice Hall.
2. David Loshin, Big Data Analytics from Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph, Morgan Kaufmann.
3. Jules J. Berman, Principles of Big Data Preparing, Sharing and Analyzing Complex Information, Morgan Kaufmann.
4. Gaurav Vaish, Getting Started with NoSQL, Packt Publishing.
5. Rajjan Shinghal, Pattern Recognition Techniques and Applications, Oxford Higher Education.

Reference Books:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer.
2. Jay Liebowitz, Big Data and Business Analytics Auerbach Publications, CRC press.
3. Pete Warden, Big Data Glossary, O'Reily.
4. Michael Mineli, Michele Chambers, Ambiga Dhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley Publications.

MT-CSE-20-31 (i): Compiler for High Performance Computing

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: To introduce structure of compilers and high performance compiler design for students and to discuss concepts of cache coherence and parallel loops in compilers.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-31 (i).1	understand the structure of compiler;
MT-CSE-20-31 (i).2	implement data dependency in compiler;
MT-CSE-20-31 (i).3	learn about parallel loops in compilers;
MT-CSE-20-31 (i).4	analyze and understand exception handling and debugging in compilers.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-31 (i)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-31 (i).1	3	3	2	2	1	2	3	2	3	1	2
MT-CSE-20-31 (i).2	3	3	2	2	1	2	3	2	3	1	2
MT-CSE-20-31 (i)3	3	3	2	2	1	2	3	2	3	1	2
MT-CSE-20-31 (i).4	3	3	2	2	1	2	3	2	3	1	2
Average	**3**	**3**	**2**	**2**	**1**	**2**	**3**	**2**	**3**	**1**	**2**

CO-PSO Mapping Matrix for the Course Code : MT-CSE-20-31 (i)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-31 (i).1	3	2	2	2
MT-CSE-20-31 (i).2	3	2	2	2
MT-CSE-20-31 (i).2	3	2	2	2
MT-CSE-20-31 (i).4	3	2	2	2
Average	**3**	**2**	**2**	**2**

Unit – I

High Performance Systems, Structure of a Compiler, Programming Language Features, Languages for High Performance, Data Dependence: Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph.

Unit – II

Scalar Analysis with Factored Use-Def Chains: Constructing Factored UseDef Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, and Data Dependence for Scalars. Data Dependence Analysis for Arrays. Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis.

Unit – III

Loop Restructuring: Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations. Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.

Unit – IV

Concurrency Analysis: Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers. Vector Analysis: Vector Code, Vector Code from Sequential Loops, Vector Code from for all Loops, Nested Loops, Round off Error, Exceptions, and Debuggers, Multi-vector Computers.

Text Books:

1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson Education.

Reference Books:

1. John Levesque, Gene Wagenbreth, High Performance Computing: Programming and Applications, Chapman & Hall/CRC Computational Science.

MT-CSE-20-31 (ii): Cloud Computing and IoT

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: To study the fundamental concepts of cloud computing, enabling technologies, cloud service models and security concerns. To learn core issues of Internet of Things, IOT communication protocols and security concerns.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-31 (ii).1	understand core issues of cloud computing and enabling technologies;
MT-CSE-20-31 (ii).2	design services based on cloud computing platforms;
MT-CSE-20-31 (ii).3	understand concepts, architecture, applications and design principles for connected devices in IoT;
MT-CSE-20-31 (ii).4	explain, analyze and design IoT-oriented communication protocols and security concerns.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-31 (ii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-31 (ii).1	3	2	3	3	3	2	2	2	3	2	1
MT-CSE-20-31 (ii).2	3	3	3	3	3	2	3	3	3	2	3
MT-CSE-20-31 (ii).3	3	2	3	3	3	2	2	2	3	2	1
MT-CSE-20-31 (ii).4	3	3	3	3	3	2	3	3	3	2	3
Average	**3**	**2.5**	**3**	**3**	**3**	**2**	**2.5**	**2.5**	**3**	**2**	**2**

CO-PSO Mapping Matrix for the Course Code : MT-CSE-20-31 (ii)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-31 (ii).1	2	2	3	3
MT-CSE-20-31 (ii).2	3	3	3	3
MT-CSE-20-31 (ii).3	2	2	3	3
MT-CSE-20-31 (ii).4	3	3	3	3
Average	**2.5**	**2.5**	**3**	**3**

Unit – I

Cloud Computing: Definition, roots of cloud computing, characteristics, cloud architecture, deployment models, service models.

Virtualization: Benefits & drawbacks of virtualization, server virtualization, virtualization of - operating system, platform, CPU, network, application, memory and I/O devices etc.

Unit – II

Cloud Computing Service Platforms – Compute services, storage services, database services, application services, queuing services, e-mail services, notification services, media services, content delivery services, analytics services, deployment & management services, identity & access management services and their case studies.

Security in cloud computing: issues, threats, data security and information security

Unit – III

Internet of Thing (IoT): overview, conceptual framework, architecture, major components, common applications

Design principles for connected devices: Modified OSI Model for IoT/M2M systems, ETSI M2M Domains and High-level capabilities, wireless communication technologies - NFC, RFID, Bluetooth BR/EDR and Bluetooth low energy, ZigBee, WiFi, RF transceiver and RF modules. Data enrichment, data consolidation & device management at gateway.

Unit – IV

Design principles for web connectivity: web communication protocols for connected devices: constrained application protocol, CoAP Client web connectivity, client authentication, lightweight M2M communication protocol. Message communication protocols for connected devices - CoAP-SMS, CoAP-MQ, MQTT, XMPP.

IoT privacy, security and vulnerabilities and their solutions.

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, Cloud Computing – A Hands-on Approach, University Press.
2. Rajkumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing – Principles and Paradigms, Wiley India Pvt. Ltd.
3. Raj Kamal, Internet of Things - Architecture and Design Principles, McGraw Hills

Reference Books:

1. Kai Hwang, Geoffrey C.Fox, and Jack J. Dongarra, Distributed and Cloud Computing, Elsevier India Private Limited
2. Saurabh Kumar, Cloud Computing, Wiley India Pvt. Ltd.
3. Shailendra Singh, Cloud Computing, Oxford
4. Coulouris, Dollimore and Kindber, Distributed System: Concept and Design, Addison Wesley
5. Michael Miller, Cloud Computing, Dorling Kindersley India
6. Anthony T. Velte, Toby J. Velte and Robert Elsenpeter, Cloud computing: A practical Approach, McGraw Hill
7. Dimitrios Serpnos, Marilyn Wolf, Internet of Things (IoT) Systems, Architecture, Algorithms, Methodologies, Springer
8. Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on Approach), VPT
9. Francis daCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, Apress Publications

MT-CSE-20-31 (iii): Information Retrieval System

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: The main objective of this course is to present the scientific support in the field of information search and retrieval.

Course Outcomes (COs)	At the end of this course, the student will be able to:
MT-CSE-20-31 (iii).1	understand the basics of information retrieval along with models used in information retrieval;
MT-CSE-20-31 (iii).2	learn management and types of information retrieval;
MT-CSE-20-31 (iii).3	categorize, filter and indexing the information;
MT-CSE-20-31 (iii).4	Implement the concepts of information retrieval systems to sentiment analysis.

CO-PO Mapping Matrix for Course Code: MT-CSE-20-31 (iii)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-31 (iii).1	3	3	3	3	3	3	3	3	3	2	2
MT-CSE-20-31 (iii).2	3	3	3	3	3	3	3	3	3	2	2
MT-CSE-20-31 (iii).3	3	3	3	3	3	3	3	3	3	2	2
MT-CSE-20-31 (iii).4	3	3	3	3	3	3	3	3	3	3	3
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2.25**

CO-PSO Mapping Matrix for the Course Code : MT-CSE-20-31 (iii)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-31 (iii).1	3	3	3	3
MT-CSE-20-31 (iii).2	3	3	2	3
MT-CSE-20-31 (iii).3	3	3	2	3
MT-CSE-20-31 (iii).4	3	3	3	3
Average	**3**	**3**	**2.5**	**3**

Unit – I

Introduction: Text analysis, Types of text analysis, Information retrieval, IR system architecture: Text processing (Text format, Tokenization, stemming, lemmatization, Language modelling), Indexes and query matching.

Informational Retrieval: Query processing models. Probabilistic models (Binary independence model, Robertson/Spark Jones weighting formula, Two-Poisson model), Relevance feedback (Term selection, Pseudo relevance feedback); language models: Unigram, Bigram language models, Generating queries from documents, Language models and smoothing, Ranking with language models, KullbackLeibler divergence, Divergence from randomness, Passage retrieval and ranking.

Unit – II

Management of Information Retrieval Systems: Knowledge management, Information management, Digital asset management, Network management, Search engine optimization, Records compliance and risk management, Version control, Information system failure.

Types of information retrieval systems: Web retrieval and mining, Semantic web, XML information retrieval, Recommender systems and expert locators, Knowledge management systems, Decision support systems, Geographic information system(GIS).

Unit – III

Indexing: Inverted indices, Index components and Index life cycle, Interleaving Dictionary and Postings lists, Index construction, Query processing for ranked retrieval, Compression: General purpose data compression, Symbol-wise data compression, Compressing posting lists, Compressing the dictionary.

Information categorization and filtering: Classification, Probabilistic classifiers, linear classifiers, Similarity-based classifiers, Multi category ranking and classification, learning to rank, Introduction to the clustering problem, Partitioning methods, Clustering versus classification, Reduced dimensionality/spectral methods.

Unit – IV

Sentiment Analysis: Introduction to sentiment analysis, Document-level sentiment analysis, Sentence-level sentiment analysis, Aspect-based sentiment analysis, Comparative sentiment analysis, baseline algorithm, Lexicons, Corpora , Tools of Sentiment analysis, Applications.

Text Books:

1. Butcher S., Clarke C.L.A., Cormack G. Information Retrieval, MIT
2. Bates M.J., Understanding Information Retrieval Systems, CRC press

Reference Books:

1. Manning C.D., Raghavan P. and Schütze H. Introduction to Information Retrieval, Cambridge University Press.
2. David A. Grossman, OphirFrieder, Information Retrieval – Algorithms and Heuristics, Springer, Distributed by Universal Press.
3. Gerald J Kowalski, Mark T Maybury Information Storage and Retrieval Systems: Theory and Implementation, Springer
4. SoumenChakrabarti, Mining the Web : Discovering Knowledge from Hypertext Data, Morgan – Kaufmann Publishers

MT-CSE-20-31 (iv): Digital Image Processing

Type: Elective
Course Credits: 04
Contact Hours: 4 hours/week
Examination Duration: 3 Hours
Mode: Lecture
External Maximum Marks: 75
External Pass Marks: 30 (i.e. 40%)
Internal Maximum Marks: 25
Total Maximum Marks: 100
Total Pass Marks: 40 (i.e. 40%)

Instructions to paper setter for End semester examination:
Total number of questions shall be nine. Question number one will be compulsory and will be consisting of short/objective type questions from complete syllabus. In addition to compulsory first question there shall be four units in the question paper each consisting of two questions. Student will attempt one question from each unit in addition to compulsory question. All questions will carry equal marks.

Course Objectives: Provide an introduction to the basic concepts and methodologies for Digital Image Processing. To develop a foundation that can be used as a basis for further studies and research. Introduce the fundamental techniques and algorithms used for acquiring, processing and extracting useful information from digital images.

Course Outcomes: At the end of this course, the student will be able to:	
MT-CSE-20-31.1	get acquainted with digital image fundamentals and its applications and get acquainted with the image representation and description methods
MT-CSE-20-31.2	Learn and perform image pre-processing and enhancement to improve the image for further processing
MT-CSE-20-31.3	reconstruct photometric properties degraded by the imaging process and partition a digital image into multiple segments
MT-CSE-20-31.4	represent and analyze images at different resolutions , process images according to their shapes, and apply compression techniques to reduce the storage space of images

CO-PO Mapping Matrix for Course Code: MT-CSE-20-31 (iv)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
MT-CSE-20-31.1	3	2	3	2	1	1	2	1	3	-	2
MT-CSE-20-31.2	3	3	3	2	1	2	2	1	3	-	2
MT-CSE-20-31.3	3	3	3	3	1	2	2	1	3	-	2
MT-CSE-20-31.4	3	3	3	3	1	2	2	1	3	-	2
Average	**3**	**2.75**	**3**	**2.5**	**1**	**1.75**	**2**	**1**	**3**	**-**	**2**

CO-PSO Mapping Matrix for Course Code: MT-CSE-20-31 (iv)

COs	PSO1	PSO2	PSO3	PSO4
MT-CSE-20-31.1	3	2	1	3
MT-CSE-20-31.2	3	3	1	3
MT-CSE-20-31.3	3	3	1	3
MT-CSE-20-31.4	3	3	1	3
Average	**3**	**2.75**	**1**	**3**

Unit – I

Digital Image Fundamentals: Introduction to Digital Image Processing and its applications; Components of an Image Processing System.

Image Representation and Description: Image Representation ; Digital Image Properties; Boundary descriptors; Regional descriptors; Phases in Digital Image Processing; Elements of Visual perception; Image Sensing and Acquisition; Image Sampling and Quantization; Relationship between Pixels; Color Representation.

Data Structures for Image Analysis: Levels of Image Data Representation; Traditional Image Data Structures: Matrices, Chains, Topological Data Structures, Relational Structures; Hierarchical Data Structures: Pyramids, Quadtrees, Other Pyramidal Structures.

Unit – II

Image Pre-Processing: Pixel Brightness Transformations: Position-Dependent Brightness Correction, Gray-Scale Transformation; Geometric Transformations: Pixel Co-ordinate Transformations, Brightness Interpolation; Local Pre-Processing.

Image Enhancement: Spatial Domain: Gray level transformations; Histogram processing; enhancement using arithmetic and logic operators; Basics of Spatial Filtering; Smoothing and Sharpening Spatial Filtering.

Frequency Domain: Introduction to Fourier Transform; Filtering in the Frequency Domain; Smoothing and Sharpening frequency domain filters; Homomorphic Filtering.

Unit – III

Image Restoration and Segmentation: Noise models; Mean Filters; Order Statistics; Adaptive filters; Noise Reduction by Frequency Domain Filtering; Inverse and Wiener filtering; Constrained Least Squares Filtering.

Segmentation: Point, line, and Edge Detection; Edge Linking and Boundary detection; Thresholding; Region based segmentation; Edge based Segmentation; Segmentation by Morphological Watersheds; Matching.

Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing.

Unit – IV

Wavelets And Multiresolution Processing: Background: Image Pyramids; Subband coding; Multiresolution expansions.

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms.

Compression – Fundamentals ; Image Compression models; Error-Free Compression; Variable Length Coding , LZW coding, Bit-Plane Coding, Lossless Predictive Coding; Lossy Compression: Lossy Predictive Coding, Transform Coding, wavelet Coding; Image Compression Standards.

Text Books:

1. Rafael C. Gonzales, Richard E. Woods, Digital Image Processing, Pearson Education

Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, Tata Mc Graw Hill
2. Anil Jain K., Fundamentals of Digital Image Processing, PHI
3. Willliam K Pratt, Digital Image Processing, John Willey.
4. Malay K. Pakhira, Digital Image Processing and Pattern Recognition, PHI
5. S. Jayaraman, S. Esakkirajan and T. Veerakumar, Digital Image Processing, McGraw Hill
6. B. Chanda , D.Dutta Majumder, Digital Image Processing and Analysis, PHI
7. Vipula Singh, Digital Image Processing with MATLAB and LABVIEW, Elsevier India.

CO-PO-PSO MAPPING MATRIX FOR ALL THE COURSES OF

MASTER OF TECHNOLOGY (COMPUTER SCIENCE AND ENGINEERING)

SEMESTER	COURSE CODE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3	PSO4
I	MT-CSE-20-11	3	2.5	1	2.5	1	2.25	1.75	1.5	2	1	1.5	2.25	2.25	1.5	3
	MT-CSE-20-12	3	3	1.25	3	1.25	3	2.75	1.5	2.75	1	2.5	3	1.75	1.75	2.75
	MT-CSE-20-13 (i)	3	3	2	2.5	1.5	2.5	2.5	2	3	1	2.5	2.5	3	3	3
	MT-CSE-20-13 (ii)	3	2.75	2.75	2.25	2.5	2	1.75	2.75	2.5	2.5	1.25	3	2.5	1.75	2.5
	MT-CSE-20-13 (iii)	3	2.75	3	2	1.75	2	2.25	2	3	-	2	3	2.25	1	3
	MT-CSE-20-13 (iv)	3	2.5	1	3	2	3	2	3	3	1	2.5	2	3	2.5	3
	MT-CSE-20-14 (i)	3	2.5	1	3	2	3	2	3	3	1	2.5	2	3	2.5	3
	MT-CSE-20-14 (ii)	3	2.75	2.5	2.25	2.25	2	2	2.25	2.5	2	2	2.75	2.5	1.75	2
	MT-CSE-20-14 (iii)	3	2.5	3	2	1	2.5	2	2	3	-	2.25	3	2.5	1	3
	MT-CSE-20-14 (iv)	3	2	3	3	3	1.5	1	2	3	1	1.5	3	2.5	1.5	3
	MT-CSE-20-15	3	3	2.5	2.5	2.5	2.5	2.5	3	3	3	2	3	2	3	2
II	MT-CSE-20-21	3	2.5	1	3	1.25	3	2	1	3	1	2	3	2.5	1.5	3
	MT-CSE-20-22	3	2.75	3	2.5	1.75	2.5	3	2	3	-	2.25	3	2.75	1	3
	MT-CSE-20-23 (i)	3	2.5	2.75	2.5	2.25	2	2.25	2.5	2.5	2.5	1.5	2.75	2.25	1.5	2.5
	MT-CSE-20-23 (ii)	3	3	2	3	2	3	1.25	2	2	1	2.5	3	2.25	1	2
	MT-CSE-20-23 (iii)	3	2.5	3	2.75	1	2	2.25	2	3	-	2.75	3	2.25	1	3
	MT-CSE-20-23 (iv)	3	2	3	3	3	2.25	1.75	1	3	1	2	3	3	2	3
	MT-CSE-20-24 (i)	3	1	2	2.75	2	2.75	1.75	1.75	1	1	1	2.5	2.75	1.25	3
	MT-CSE-20-24 (ii)	3	2	2.75	2.25	3	1.75	2.5	2	3	1	1.75	2.5	3	1.5	2.75
	MT-CSE-20-24 (iii)	3	2.5	3	2.5	3	2.5	1.5	2.25	2.5	2	1.5	2.5	2.5	2	3
	MT-CSE-20-24 (iv)	3	2.75	2.75	2.75	2.5	2	1.75	2.25	2.25	2.25	1.25	2.25	2.75	1.25	2

SEMESTER	COURSE CODE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3	PSO4
III	**MT-CSE-20-31 (i)**	3	3	2	2	1	2	3	2	3	1	2	3	2	2	2
	MT-CSE-20-31 (ii)	3	2.5	3	3	3	2	2.5	2.5	3	2	2	2.5	2.5	3	3
	MT-CSE-20-31 (iii)	3	3	3	3	3	3	3	3	3	2	2.25	3	3	2.5	3
	MT-CSE-20-31 (iv)	3	3	3	2.75	2.25	2.5	2.25	2	3	-	2.75	3	2.5	1	3
I to III	**Average**	**3.00**	**2.57**	**2.37**	**2.63**	**2.07**	**2.38**	**2.13**	**2.13**	**2.72**	**1.51**	**2**	**2.74**	**2.53**	**1.75**	**2.74**

Note : 4th Semester is not included as it comprises of Dissertation only.