MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CURRICULUM
AND
SCHEME OF EXAMINATION

M.TECH - COMPUTER ENGINEERING & NETWORKING

BATCH: 2018-20

INDEX

VISION OF THE DEPARTMENT

To empower the graduates to be technologically adept, innovative, self-motivated and responsible citizens, possessing human values and contribute significantly towards being a center of excellence in providing global standard education, through a conducive Teaching and Research environment, that responds swiftly to the challenges of the ever-changing world.

MISSION OF THE DEPARTMENT

- To achieve academic excellence by imparting in-depth knowledge to the students through effective pedagogies and hands-on experience on the latest tools and technologies.
- To pursue interdisciplinary research that will serve the needs of the entire global community.
- To prepare students to be continuous learners in a connected world and imbibe professional skills and ethical responsibilities in them.
- To strengthen the Industry-Academia interface that will help the graduates to emerge as leaders in academics or an inspiring revolutionary in entrepreneurship.

ABOUT THE DEPARTMENT

The Department of Computer Science & Engineering was established in 1997. The Department has been offering M. Tech in computer Science since 2005. The B. Tech Computer Science & Engineering programme offered by the Department had been accredited thrice by the National Board of Accreditation (NBA) in 2003, 2007, and 2018. The Department focuses on mastering the fundamental concepts both theoretically and practically. It motivates learning, intellectual efficacy, and self-reliance, which provides the best foundation for continuing professional achievement. Master of Technology in Computer Engineering and Networking (CEN) programme provides intensive training to the students at an advanced level to enable them to take up research and development activities. The course curriculum has been specially tailored to fulfill the growing global outlook and focus on upcoming technologies in the field of Computer Science and Engineering to cater to the needs of the industry and R&D organizations. The faculty members of the Department are actively involved in the research and development activities and continuously participating and contributing to National and International Conferences and Seminars. The faculty members of the Department are well published, experienced, conferred with M. Tech/Ph. D degree.

The Department is having several student chapters of the professional bodies like IEEE, CSI, ACM & ISTE. Students are participating in various activities regularly to enhance their technical and interpersonal skills under the banner of these professional societies. The Department also interacts regularly with Information Technology organizations like TCS, IBM, Sun Microsystems, L&T, Infosys, HCL, Tech Mahindra, Dell-EMC, R Systems International, etc. This interaction provides the latest technology updates to the students, Learning Management System, Industry Projects for students, Expert Lectures, Industry connectivity for students & teachers to enable them to experience the live IT environment. This interaction also help students to acquire domain skills in the most advanced areas of IT and preferential placements by IT companies. Students undertake live projects under the mentorship of industry experts and go for industry visits in software development and testing centers. They also attend extensive training programme in which hands-on training is provided by IT company experts. This leads to a big increase in job opportunities and industry readiness for the students. The Department has also collaborated with other leading industries like Infosys, Dell-EMC & R-Systems International Ltd. to give exposure to the students. These collaborations help the students to work on the technologies which are currently being used in the industry. TCG Digital solutions private Limited will set up a virtual Cyber Security platform lab for training the students in the area of cybersecurity.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Department of Computer Science and Engineering (CSE), in consultation with various stakeholders, has formulated the Programme Educational Objectives (PEOs). These are broad statements describing the career and professional accomplishments of the graduates, that the programme is preparing them to achieve, after receiving the degree. The PEOs of the M.Tech Programme in Computer Engineering and Networking are as follows:

PEO-1: To impart knowledge and skills to analyze, design, test and implement various softwares and be engaged in life-long learning.

PEO-2: To promote the development of innovative systems and optimized solutions by professional practices.

PEO-3: To work collaboratively on multidisciplinary projects and exhibit high levels of professional and ethical values within organization and society globally.

PEO-4: To Enhance skills and adapt new computing technologies for attaining professional excellence and carrying research.

PROGRAMME OUTCOMES (POs)

PO1.Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-longlearning in the broadest context socio-technological changes.

PROGRAMME SPECIFIC OUTCOMES (PSOs)-

PSO-1: To apply Software Engineering Principles and Practices to provide software solutions.

PSO-2: To design and Develop Network, Mobile and Web-based Computational systems under realistic constraints.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES TO PROGRAMME OUTCOMES

POs / PEOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PEO 1	3	2	2	2	2	2	3	3	3
PEO 2	3	2	2	2	2	1	3	2	3
PEO 3	2	3	3	2	2	2	2	3	3
PEO 4	3	2	2	2	2	2	2	3	3

Semester system and Choice Based Credit System (CBCS)

The Credit-Based system of study and students' performance/progress is measured by the number of credits earned, i.e. completed satisfactorily by the students. Based on the course credits and grades obtained by the student, Grade Point Average (GPA) is calculated.

(a) Course credits assignment

Each course has a certain number of credits assigned to it depending upon its duration in periods for a lecture, tutorial, and laboratory/clinical practice in a week. A few courses/activities are without credit (s) and are referred to as Audit Pass Courses (APC) but are mandatory to pass as partial fulfillment of the award of the degree.

(b) Earning of credits

At the end of every course, a letter "Grade" shall be awarded in each course for which a student has registered. On obtaining a minimum Pass Grade, the student shall accumulate the course credits as Earned Credits. A student's performance shall be measured by the number of credits that he/she has earned and by the weighted grade point average. Grades obtained in the audit courses shall not be counted for computation of grade point average, however shall be mandatory to pass as partial fulfillment of the award of the degree.

For the award of M.Tech Degree in Computer Engineering and Networking, the student has to earn a minimum of 68- credits during the two-year duration of the programme in 4 semesters. The total credits required to be earned have been further classified under two baskets of courses: "Compulsory Courses Basket", and "Elective Courses Basket". A total of 46- credits are required to be earned under the "Compulsory Courses Basket" and 22- credits under the "Elective Courses Basket".

All courses under the "Compulsory Courses Basket" are required to be qualified and cleared/passed by each student enrolled under the programme and are semester-wise listed in the study scheme along with the credits assigned to each course.

Under the "Elective Courses Basket", there will be three types of courses:

· Semester-wise courses offered by the parent department

· Open/Inter-disciplinary courses offered at the Institute/University level notified from the office of Dean-Academics.

· Massive Open Online Courses (MOOCs) available on the SWAYAM platform or any other platform as recommended by UGC/AICTE and notified from the office of Dean-Academics.

Each course shall have credits assigned to it. The Students are required to register in courses every semester for as many courses/credits specified under the "Elective Courses Basket" depending upon an individual interest, capability/pace of learning, and availability of non-clashing time slot as per the time table to earn the requisite credits under the "Elective Courses Basket" during the entire programme duration.

However, for registration of courses including courses under the "Compulsory Courses Basket", "Elective Courses Basket", and Previous Semester Courses wherein the student was declared in-eligible based on attendance or could not clear the course within permissible given chances, if any, the maximum limit in a semester is 30 credits.

Study Scheme of M.Tech (CEN)

SEMESTER I										
		Periods/Week				Marks				
Subject Code	Subject	L	T	P	Total	Continuous Evaluation	End Semester Examination	Total	Duration of Exam	Credits
PC-CS-M-101	Mathematical foundations of Computer Science	3	0	0	3	50	100	150	3 hrs	3
PC-CS-M-102	Advanced Data Structures	3	0	0	3	50	100	150	3 hrs	3
	Program Elective I	3	0	0	3	50	100	150	3 hrs	3
	Program Elective II	3	0	0	3	50	100	150	3 hrs	3
COM-100	Research Methodology and IPR	2	0	0	2	50	50	100	3 hrs	2
	Audit Course	2	0	0	2	-	-	-	-	0
LC-CS-M-112	Advanced Data Structures Lab	0	0	4	4	50	50	100	3 hrs	2
	Program Elective III	0	0	4	4	50	50	100	3 hrs	2
	TOTAL	**16**	**0**	**8**	**24**	**350**	**550**	**900**		**18**

Audit course 1 & 2	
AC-M-101	English for Research Paper Writing
AC-M-102	Disaster Management
AC-M-103	Sanskrit for Technical Knowledge
AC-M-104	Value Education
AC-M-105	Constitution of India
AC-M-106	Pedagogy Studies
AC-M-107	Stress Management by Yoga
AC-M-108	Personality Development through Life Enlightenment Skills

Program Elective I	
PE-CS-M-121	Machine Learning
PE-CS-M-122	Wireless Sensor Networks
PE-CS-M-123	Introduction to Intelligent Systems

Program Elective II	
PE-CS-M-124	Data Science
PE-CS-M-125	Distributed Systems
PE-CS-M-126	Advanced Wireless and Mobile Networks

Program Elective III	
PE-CS-M-134	Data Science Lab
PE-CS-M-131	Machine Learning Lab
PE-CS-M-133	Introduction to Intelligent Systems Lab

SEMESTER II										
		Periods/Week				Marks				
Subject Code	Subject	L	T	P	Total	Continuous Evaluation	End Semester Examination	Total	Duration of Exam	Credits
PC-CS-M-201	Advance Algorithms	3	0	0	3	50	100	150	3 hrs	3
PC-CS-M-202	Soft Computing	3	0	0	3	50	100	150	3 hrs	3
	Program Elective IV	3	0	0	3	50	100	150	3 hrs	3
	Program Elective V	3	0	0	3	50	100	150	3 hrs	3
	Audit Course	2	0	0	2	50	50	100	2 hrs	0
LC-CS-M-211	Advance Algorithms Lab	0	0	4	4	50	50	100	3 hrs	2
	Program Elective VI (Lab Course Based on Elective)	0	0	4	4	50	50	100	3 hrs	2
CS-M-200	Mini Project with Seminar	2	0	0	2	100	50	150	3 hrs	2
	TOTAL	**16**	**0**	**8**	**24**	**450**	**600**	**1050**		**18**

Program Elective IV	
PE-CS-M-221	Data Preparation and Analysis
PE-CS-M-222	Secure Software Design & Enterprise Computing
PE-CS-M-223	Computer Vision

Program Elective V	
PE-CS-M-224	Human and Computer Interaction
PE-CS-M-225	GPU Computing
PE-CS-M-226	Digital Forensics
PE-CS-M-227	Adhoc Networks

Program Elective VI	
PE-CS-M-231	Data Preparation and Analysis Lab

SEMESTER-III										
		Periods/Week				Marks				
Subject Code	Subject	L	T	P	Total	Continuous Evaluation	End Semester Examination	Total	Duration of Exam	Credits
	Program Elective VII	3	0	0	3	50	100	150	3 hrs	3
	Open Elective 1	3	0	0	3	50	100	150	3 hrs	3
CS-M-350	Colloquium	0	2	0	2	50	0	50	-	0
CS-M-300	Dissertation-Phase-I/ Industrial Project	0	0	20	20	200	100	300	-	10
	TOTAL	**6**	**2**	**20**	**28**	**350**	**300**	**650**		**16**

*Students going for Industrial Project/Thesis will complete these courses through MOOCs.

Program Elective VII	
PE-CS-M-321	Mobile Applications and Services
PE-CS-M-322	Compiler for HPC
PE-CS-M-323	Optimization Techniques

Open Elective	
OE-M-301	Business Analytics
OE-M-302	Industrial Safety
OE-M-303	Operations Research
OE-M-304	Cost Management of Engineering Projects
OE-M-305	Composite Materials
OE-M-306	Waste to Energy

Notes:

1. Any Elective course to be offered from the above lists will be finalized by HOD, depending on the availability of the expertise as well as the faculty strength in the Department. The choice of the student for any elective will be considered but shall not be binding for the department to offer it.

2. For Course colloquium each Student would be required to give atleast Three Seminars under the supervision of some of faculty member on current emerging areas of Computer Science among which atleast one would be research oriented.

Semester- IV										
		Periods/Week				Marks				
Subject Code	Subject	L	T	P	Total	Continuous Assessment	End Semester Examination	Total	Duration of Exam	Credits
CS-M-400	Dissertation-Phase-II	20 weeks (minimum)				400	200	600	3 hrs	16
	TOTAL					**400**	**200**	**600**		**16**

Note:

*The Dissertation can be taken up on any emerging areas of Computer Science or on any topic of Industrial Importance related to Computer Science and should include critical review of the literature in the area.

SEMESTER –I

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PC-CS-M-101: MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE

Periods/week	Credits	Max. Marks	: 150
L: 3 T: 0	3	Continuous Evaluation	: 50
Duration of Examination: 3 Hrs		End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of mathematical concepts of Intermediate level.

Course Outcomes: The students will be able to-

PC-CS-M-101.1: Understand the mathematical fundamentals that is prerequisites for avariety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.

PC-CS-M-101.2: Develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design and concurrency.

PC-CS-M-101.3: Study various sampling and classification Problems.

Unit-1: Probability

1.1 Probability mass, density
1.2 Cumulative distribution functions,
1.3 Parametric families of distributions
1.4 Expected value, variance
1.5 Conditional expectation
1.6 Applications of the univariate and multivariate Central Limit Theorem
1.7 Probabilistic inequalities
1.8 Markov chains

Unit-2: Random Samples

2.1 Random samples
2.2 sampling distributions of estimators
2.3 Methods of Moments and Maximum Likelihood

Unit-3: Statistical inference

3.1 Statistical inference
3.2 Introduction to multivariate statistical models regression and classification problems
3.3 Principal components analysis
3.4 The problem of over fitting model assessment.

Unit-4: Graph Theory

4.1 Graph Theory
- 4.1.1 Isomorphism,
- 4.1.2 lanar graphs
- 4.1.3 Graph coloring
- 4.1.4 Hamilton circuits and Euler cycles.

4.2 Permutations and Combinations with and without repetition.
4.3 Specialized techniques to solve combinatorial enumeration problems

Unit-5: Computer science and engineering applications

5.1 Data mining,
- 5.1.1 Network protocols
- 5.1.2 Analysis of Web traffic

5.2 Computer security,
5.3 Software engineering
5.4 Computer architecture
5.5 Operating systems, distributed systems
5.6 Bioinformatics
5.7 Machine learning.

Unit-6: Recent Trends

6.1 Recent Trends in various distribution functions in Mathematical field of computer science for varying fields
- 6.1.1 Bioinformatics
- 6.1.2 Soft computing
- 6.1.3 Computer vision.

Text Books/Reference Books:

1. John Vince, 2015, Foundation Mathematics for Computer Science, 1st edition, Springer.
2. K. Trivedi, 2016, Probability and Statistics with Reliability, Queuing, and Computer Science Applications, 2nd edition, Wiley.
3. M. Mitzenmacher and E. Upfal, 2012, Probability and Computing: Randomized Algorithms and Probabilistic Analysis, Cambridge University press.
4. Alan Tucker, 2012, Applied Combinatorics, 6th edition,Wiley

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PC-CS-M-101.1	3	2	1	3	2	2	1	2	2
PC-CS-M-101.2	3	2	3	2	1	1	1	2	2
PC-CS-M-101.3	3	1	2	1	2	2	1	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PC-CS-M-102: ADVANCED DATA STRUCTURES

Periods/week	Credits	Max. Marks	: 150
L: 3 T: 0	3	Continuous Evaluation	: 50
Duration of Examination: 3 Hrs		End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of Data Structures

Course Outcomes: The students will be able to-
PC-CS-M-102.1. Define the concepts of Advanced data structure
PC-CS-M-102.2. Understand the Advanced data structure like skip list and their applications
PC-CS-M-102.3. Apply the Advanced data structures to real life problems
PC-CS-M-102.4. Analyze the complexity of different data structure operations, Text Processing
PC-CS-M-102.5. Evaluate the Advanced data structures based on their applicability
PC-CS-M-102.6. Design the best solution for real life problems using various data structures

Unit-1: Dictionaries & Hashing
1.1 Dictionaries: Definition, Dictionary Abstract Data Type
    1.1.1 Implementation of Dictionaries.
1.2 Hashing**:** Review of Hashing and Hash Function
1.3 Collision Resolution Techniques in Hashing
1.4 Separate Chaining
1.5 Open Addressing
1.6 Linear Probing
1.7 Quadratic Probing
1.8 Double Hashing
1.9 Rehashing and Extendible Hashing.

Unit-2: Skip Lists
2.1 Need for Randomizing Data Structures and Algorithms
2.2 Search and Update Operations on Skip Lists
2.3 Probabilistic Analysis of Skip Lists
2.4 Deterministic Skip Lists

Unit-3: Trees
3.1 Binary Search Trees
3.2 AVL Trees
3.3 Red Black Trees
3.4 2-3 Trees
3.5 B-Trees
3.6 Splay Trees

Unit-4: Text Processing
4.1 Sting Operations
    4.1.1 Brute-Force Pattern Matching
    4.1.2 The Boyer- Moore Algorithm
    4.1.3 The Knuth-Morris-Pratt Algorithm,
4.2 Standard Tries
    4.2.1 Compressed Tries

4.2.2 Suffix Tries
4.2.3 The Huffman Coding Algorithm
4.3 The Longest Common Subsequence Problem (LCS)
4.4 Applying Dynamic Programming to the LCS Problem.

Unit-5: Computational Geometry:
5.1 One Dimensional Range Searching
5.2 Two Dimensional Range Searching
5.3 Constructing a Priority Search Tree
5.4 Searching a Priority Search Tree
5.5 Priority Range Trees
5.6 Quadtrees, k-D Trees.

Unit 6 Recent Trends
6.1 Recent Trends in Hashing
6.2 Trees and various computational geometry methods for efficiently solving the new evolving problem

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

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PC-CS-M-102.1	1	1	1	1	1	1	1	1	1
PC-CS-M-102.2	1	1	1	1	1	2	2	2	2
PC-CS-M-102.3	1	1	1	1	1	3	1	2	3
PC-CS-M-102.4	3	1	1	1	2	1	2	2	3
PC-CS-M-102.5	3	1	1	1	2	2	2	3	2
PC-CS-M-102.6	2	1	1	1	1	2	1	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

COM-100: RESEARCH METHODOLOGY AND IPR

Periods/week	Credits		Max. Marks	: 100
L: 2 T: 0	2		Continuous Evaluation	: 50
Duration of Examination: 2 Hrs			End Sem Examination	: 50

Pre-requisites: The students must have the knowledge to interpret the problems of various domains

Course Outcomes: The students will be able to-

COM-100.1. Understand research problem formulation.
COM-100.2. Analyze research related information
COM-100.3. Follow research ethics
COM-100.4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
COM-100.5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
COM-100.6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Unit-1:

1.1 Meaning of research problem, Sources of research problem,
1.2 Criteria Characteristics of a good research problem,
1.3 Errors in selecting a research problem,
1.4 Scope and objectives of research problem.
1.5 Approaches of investigation of solutions for research problem,
1.6 data collection, analysis, interpretation, Necessary instrumentations

Unit-2:

2.1 Effective literature studies approaches, analysis
2.2 Plagiarism,
2.3 Research ethics

Unit-3:

3.1 Effective technical writing,
3.2 how to write report, Paper
3.3 Developing a Research Proposal,
3.4 Format of research proposal, a presentation and assessment by a review committee

Unit-4:

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

Unit-5:

5.1 Patent Rights: Scope of Patent Rights.
5.2 Licensing and transfer of technology.
5.3 Patent information and databases.
5.4 Geographical Indications.

Unit-6:

6.1 New Developments in IPR: Administration of Patent System.
6.2 New developments in IPR; IPR of Biological Systems, Computer Software etc.
6.3 Traditional knowledge Case Studies,
6.4 IPR and IITs.

Text Books/ Reference Books:

1. Stuart Melville and Wayne Goddard, 1996,Research methodology: an introduction for science & engineering students, Juta Academic.
2. Wayne Goddard and Stuart Melville,2004, Research Methodology: An Introduction, 2nd Edition, Juta and Company Ltd.
3. Ranjit Kumar, 2014, Research Methodology: A Step by Step Guide for beginners, 2nd Edition, SAGE.
4. Debora J. Halbert, 2005, Resisting Intellectual Property, 1st edition, Taylor & Francis Ltd.
5. W. H. Mayall, 1992, Industrial Design, McGraw Hill.
6. Benjamin W. Niebel and Alan B. Draper, 1974, Product design and process engineering, Mc GrawHill.
7. Morris Asimov, 1962, Introduction to Design, 1st edition Prentice Hall.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2012, Intellectual Property in New Technological Age, 6th edition, Aspen Publishers.
9. T. Ramappa, 2008, Intellectual Property Rights Under WTO, S. Chand.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
COM-100.1	1	1	1	2	3	3	3	2	1
COM-100.2	1	2	1	2	1	2	1	2	2
COM-100.3	1	2	2	2	3	3	1	1	1
COM-100.4	1	1	3	2	3	3	1	2	2
COM-100.5	2	1	2	3	1	1	2	2	1
COM-100.6	1	2	3	2	1	2	1	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

LC-CS-M-112: ADVANCED DATA STRUCTURES LAB

Periods/week	Credits	Max. Marks	: 100
P: 4	2	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Pre-requisites: The students must have the knowledge of Data Structures

Course Outcomes: The students will be able to-
LC-CS-M-112.1. Define the elementary and advanced data structure
LC-CS-M-112.2. Understand the various Data structures using C
LC-CS-M-112.3. Deploy the advance C programming techniques to developing solutions for particular problems
LC-CS-M-112.4. Analyze various operation performed on elementary and advanced data structures
LC-CS-M-112.5. Select the appropriate data structure based upon problem environment
LC-CS-M-112.6. Design the solutions for the realworld problems

Following are some of the suggested topics for the Lab Practicals:
Practical 1: Design, Develop and Implement a menu driven program in C for the following ARRAY operations:

a) Creating an array of N integer elements.
b) Inserting an element at a given valid position
c) Deleting an element from a given valid position
d) Exit

Support the programs with functions for each of the above operations.

Practical 2: Design, Develop and Implement a menu driven program in C for the following operations on strings:

a) Read a main String(STR), a Pattern String (PAT) and a Replace string(REP)
b) Perform Pattern Matching Operation: Find all occurrences of PAT in STR using
    a. Brute-Force Pattern Matching
    b. The Boyer- Moore Algorithm
    c. The Knuth-Morris-Pratt Algorithm,
c) Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR

Support the program with functions for each of the above operations. Don't use Built-in functions
.
Practical 3: Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers

a) Create a BST of N Integers: 6, 9, 5,2, 8,15, 24, 14,7,8, 5, 2
b) Traverse the BST in Inorder, Preorder and Post Order
c) Search the BST for a given element (KEY) and report the appropriate message
d) Delete anelement(ELEM) from BST
e) Exit

Practical 4: Design, Develop and Implement a Program in C for the following operations on Graph (G) of Cities

a) Create a Graph of N cities using Adjacency Matrix.
b) Print all the nodes reachable from a given starting node in a digraph using BFS method
c) Check whether a given graph is connected or not using DFS method.

Practical 5: Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table(HT) of m memory locations with L as the set of memory addresses(2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Design and develop a Program in C that uses Hash function H:K ® L as H(K)=K mod m(remainder method), and implement hashing technique to map a given key K to the address space L . Resolve the collision (if any)using linear probing.

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
LC-CS-M-112.1	-	-	-	-	1	-	-	1	1
LC-CS-M-112.2	-	-	-	-	-	1	2	2	2
LC-CS-M-112.3	1	-	-	-	-	2	1	2	3
LC-CS-M-112.4	3	-	-	-	1	-	2	2	3
LC-CS-M-112.5	3	-	-	-	1	2	2	3	2
LC-CS-M-112.6	2	-	-	-	-	2	1	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

AC-M-101: ENGLISH FOR RESEARCH PAPER WRITING

Periods/week	Credits
L: 2 T: 0	0

Pre-requisites: The students must have the knowledge of Basic English

Course Outcomes: The students will be able to-
AC-M-101.1. Understand that how to improve your writing skills and level of readability
AC-M-101.2. Learn about what to write in each section
AC-M-101.3. Understand the skills needed when writing a Title
AC-M-101.4. Ensure the good quality of paper at very first-time submission

Unit-1:
- 1.1 Planning and Preparation, Word Order,
- 1.2 Breaking up long sentences,
- 1.3 Structuring Paragraphs and Sentences,
- 1.4 Being Concise and Removing Redundancy,
- 1.5 Avoiding Ambiguity and Vagueness

Unit-2:
- 2.1 Clarifying Who Did What,
- 2.2 Highlighting Your Findings,
- 2.3 Hedging and Criticising,
- 2.4 Paraphrasing and Plagiarism,
- 2.5 Sections of a Paper, Abstracts. Introduction

Unit-3:
- 3.1 Review of the Literature,
- 3.2 Methods, Results, Discussion, Conclusions,
- 3.3 The Final Check.

Unit-4:
- 4.1 key skills are needed when writing a Title,
- 4.2 key skills are needed when writing an Abstract,
- 4.3 key skills are needed when writing an Introduction,
- 4.4 skills needed when writing a Review of the Literature

Unit-5:
- 5.1 skills are needed when writing the Methods,
- 5.2 skills needed when writing the Results,
- 5.3 skills are needed when writing the Discussion,
- 5.4 skills are needed when writing the Conclusions.

Unit-6:
- 6.1 useful phrases,
- 6.2 how to ensure paper is as good as it could possibly be the first- time submission

Text Books/ Reference Books:

1. R. Goldbort, 2006, Writing for Science, Yale University Press (available on Google Books).
2. Robert A. Day, 2011, How to Write and Publish a Scientific Paper, 7th edition Cambridge University Press.
3. N. Highman, 1998, Handbook of Writing for the Mathematical Sciences, 2nd edition, SIAM. Highman'sbook.
4. Adrian Wallwork, 2011, English for Writing Research Papers, 1st edition, Springer New York Dordrecht Heidelberg London.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O 1	PS O 2
AC-M-101.1	1	3	1	2	1	1	2	1	1
AC-M-101.2	1	3	1	1	1	2	1	1	1
AC-M-101.3	1	3	2	1	1	2	1	1	1
AC-M-101.4	1	3	1	1	2	1	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

AC-M-107: STRESS MANAGEMENT BY YOGA

Periods/week Credits
L: 2 T: 0 0

Pre-requisites: Nil

Course Outcomes: The students will be able to-
AC-M-107.1. Develop healthy mind in a healthy body thus improving social health also.
AC-M-107.2. Improve efficiency.

Unit 1(8 Hours):
Definitions of Eight parts of yoga. (Ashtanga)

Unit 2(8 Hours) :
Yam and Niyam. Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit 3(8 Hours) :
Asan and Pranayam i) Various yoga poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects-Types of pranayam

Text Books/ Reference Books:
1. Ackers J, Hardman F , 2001, Classroom interaction in Kenyan primary schools, Compare, 31 (2), 245-261.
2. Agrawal M, 2004, Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3), 361-379.
3. Akyeampong K, 2003, Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J,2013, Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3), 272–282.
4. Alexander RJ, 2001, Culture and pedagogy: International comparisons in primary education. Oxford and Boston, Blackwell.
5. Chavan M, 2003, Read India: A mass scale, rapid, 'learning to read' campaign, www.pratham.org/images/resource%20working%20paper%202.pdf.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
AC-M-107.1	3	2	2	2	3	2	2	3	2	2
AC-M-107.2	3	3	2	2	2	3	2	1	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-121: MACHINE LEARNING

Periods/week Credits	Max. Marks : 150
L: 3 T: 0 3	Continuous Evaluation : 50
Duration of Examination: 3 Hrs	End Sem Examination : 100

Pre-requisites: The students must have the knowledge of statistical concepts

Course Outcomes: The students will be able to-
PE-CS-M-121.1. Gain knowledge about basic concepts of Machine Learning
PE-CS-M-121.2. Identify machine learning techniques suitable for a given problem
PE-CS-M-121.3. Solve the problems using various machine learning techniques
PE-CS-M-121.4. Apply Dimensionality reduction techniques.
PE-CS-M-121.5. Design application using machine learning techniques

Unit-1: Supervised Learning (Regression/Classification)
1.1 Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes
1.2 Linear models: Linear Regression, Logistic Regression, Generalized Linear Models ·
1.3 Support Vector Machines, Nonlinearity and Kernel Methods ·
1.4 Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Unit-2: Unsupervised Learning
2.1 Clustering: K-means/Kernel K-means ·
2.2 Dimensionality Reduction: PCA and kernel PCA ·
2.3 Matrix Factorization and Matrix Completion ·
2.4 Generative Models (mixture models and latent factor models

Unit-3:
3.1 Evaluating Machine Learning algorithms and Model Selection
3.2 Introduction to Statistical Learning Theory,
3.3 Ensemble Methods (Boosting, Bagging, Random Forests)

Unit-4:
4.1 Sparse Modeling and Estimation,
4.2 Modeling Sequence/Time-Series Data,
4.3 Deep Learning and Feature Representation Learning

Unit-5:
5.1 Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning
5.2 Active Learning,
5.3 Reinforcement Learning,
5.4 Inference in Graphical Models,
5.5 Introduction to Bayesian Learning and Inference

Unit-6:
6.1 Recent trends in various learning techniques of machine learning and classification methods for IOT applications.
6.2 Various models for IOT applications

Text Books/ Reference Books:

1. Kevin Murphy,2012, Machine Learning: A Probabilistic Perspective, MIT Press.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, 2009, The Elements of Statistical Learning, Springer (freely available online).
3. Christopher Bishop, 2007, Pattern Recognition and Machine Learning, Springer.
4. Han, Kamber & Pei**,** 2013, Data Mining: Concepts and Techniques, Third Edition, Morgan Kaufmann Publishers

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PS O 1**	**PS O 2**
PE-CS-M-121.1	1	1	1	1	1	1	2	1	2
PE-CS-M-121.2	3	1	2	1	1	1	2	1	2
PE-CS-M-121.3	3	1	1	1	1	1	2	1	2
PE-CS-M-121.4	3	1	1	1	1	1	2	1	3
PE-CS-M-121.5	3	2	1	1	1	1	3	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-122: WIRELESS SENSOR NETWORKS

Periods/week Credits	Max. Marks : 150
L: 3 T: 0 3	Continuous Evaluation : 50
Duration of Examination: 3 Hrs	End Sem Examination : 100

Pre-requisites: The students must have the knowledge of computer networks

Course Outcomes: The students will be able to-
PE-CS-M-122.1. Understand basic concepts of Wireless Sensor Networks
PE-CS-M-122.2. Apply the concepts of wireless sensor networks on Network Simulator 3
PE-CS-M-122.3. Understand the MAC protocols thoroughly.
PE-CS-M-122.4. Understand various security related concepts of wireless sensor network
PE-CS-M-122.5. Understand various routing protocols of wireless sensor network
PE-CS-M-122.6. Study advanced topics in wireless sensor network

Unit-1: Introduction to Wireless Sensor Networks
1.1 Course Information,
1.2 Introduction to Wireless Sensor Networks: Motivations,
1.3 Applications,
1.4 Performance metrics,
1.5 History and Design factors
1.6 Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture
1.7 Hardware Platforms: Motes, Hardware parameters

Unit-2: Introduction to ns-3
2.1 Introduction to Network Simulator 3 (ns-3),
2.2 Description of the ns-3 core module and simulation example

Unit-3:
3.1 Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled
3.2 Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis
3.3 MAC Protocol Analysis: Asynchronous duty-cycled. X-MAC Analysis (Markov Chain)

Unit 4:
4.1 Security: Possible attacks, countermeasures
4.2 SPINS
4.3 Static and dynamic key distribution

Unit 5:
5.1 Routing protocols: Introduction, MANET protocols
5.2 Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast
5.3 Opportunistic Routing Analysis: Analysis of opportunistic routing (Markov Chain) Advanced topics in wireless sensor networks.

Unit-6: ADVANCED TOPICS

6.1 Recent development in WSN standards.
6.2 software applications.

Text Books/ Reference Books:

1. W.Dargie and C, Poellabauer, 2010, Fundamentals of wireless sensor networks – theory and Practice, Wiley.
2. KazemSohraby, Daniel Minoli and TaiebZnati, 2007, wireless sensor networks -Technology, Protocols, and Applications, Wiley Interscience.
3. Takahiro Hara, Vladimir I. Zadorozhny, and Erik Buchmann, 2010, Wireless sensor network technologies for the information explosion era, Springer.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2
PE-CS-M-122.1	3	2	1	1	1	1	1	3	3
PE-CS-M-122.2	3	2	1	2	1	1	1	3	3
PE-CS-M-122.3	3	2	2	1	2	1	1	3	3
PE-CS-M-122.4	3	2	1	2	1	1	1	3	3
PE-CS-M-122.5	3	2	2	1	2	1	1	3	3
PE-CS-M-122.6	3	2	1	2	1	2	1	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-123: INTRODUCTION TO INTELLIGENT SYSTEMS

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of artificial intelligent concepts

Course Outcomes: The students will be able to-
PE-CS-M-123.1. Outline and identify foundations to intelligent systems
PE-CS-M-123.2. Explain the Knowledge Representation and its basic components
PE-CS-M-123.3. Apply Basic and Heuristic search method
PE-CS-M-123.4. Compare Knowledge-based systems structures and Inference Mechanisms
PE-CS-M-123.5. Relate Learning Techniques on uncertainty reasonings
PE-CS-M-123.6. Compose trends in Fuzzy logic

Unit-1:
1.1 Biological foundations to intelligent systems I
1.2 Artificial neural networks
1.3 Backpropagation
1.4 Radial basis function networks
1.5 Recurrent Networks

Unit-2:
2.1 Biological foundations to intelligent systems II
2.2 Fuzzy logic
2.3 Knowledge Representation
2.4 Inference Mechanism
2.5 Genetic algorithm
2.6 Fuzzy Neural

Unit-3:
3.1 Search Methods
3.2 Basic concepts of graph and tree search
3.3 Three simple methods: breadth-first search, depth-first search, iterative deepening search
3.4 Heuristic search methods: best-first search, admissible evaluation functions, hill climbing search
3.5 Optimisation and search such as stochastic annealing and genetic algorithm.

Unit 4:
4.1 Knowledge representation and logical inference Issues in knowledge representation
4.2 Structured representation, such as frames and scripts
4.3 Semantic networks and conceptual graphs
4.4 Formal logic and logical inference
4.5 Knowledge-based systems structures and its basic components
4.6 Ideas of Blackboard architectures

Unit 5:
5.1 Reasoning under uncertainty
5.2 Learning Techniques on uncertainty reasoning such as Bayesian reasoning

5.3 Certainty factors
5.4 Dempster-Shafer Theory of Evidential reasoning
5.5 A study of different learning and evolutionary algorithms such as statistical learning and induction learning.

Unit-6:
6.1 Recent trends in Fuzzy logic
6.2 Knowledge Representation

Text Books/ Reference Books:
1. Luger G.F. and Stubblefield W.A., 2008, Artificial Intelligence: Structures and strategies for Complex Problem Solving, 6th edition, Addison Wesley.
2. Russell S. and Norvig P, 2009, Artificial Intelligence: A Modern Approach, 3rd edition, Prentice-Hall

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2
PE-CS-M-123.1	2	2	1	1	2	1	1	2	2
PE-CS-M-123.2	2	2	1	1	2	1	2	1	2
PE-CS-M-123.3	2	2	1	1	2	1	2	2	2
PE-CS-M-123.4	2	2	1	1	1	1	2	1	2
PE-CS-M-123.5	2	2	1	1	1	1	2	2	2
PE-CS-M-123.6	2	2	2	1	2	1	2	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-124: DATA SCIENCE

Periods/week	Credits		Max. Marks	: 150
L: 3	T: 0	3	Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of statistical concepts

Course Outcomes: The students will be able to-
PE-CS-M-124.1. Study the core concepts and technologies used for data Science.
PE-CS-M-124.2. Understand the Data collection and management techniques.
PE-CS-M-124.3. Identify the concept of data Analysis and machine learning algorithms for Data Science.
PE-CS-M-124.4. Categorize different types of Data visualization Techniques.
PE-CS-M-124.5. Compare and Analyze different Data Science Applications.
PE-CS-M-124.6. Discuss Recent trends in various data collection and analysis techniques.

Unit-1: Introduction to core concepts and technologies
- 1.1 Introduction
- 1.2 Terminology
- 1.3 Data science process
- 1.4 Data science toolkit
- 1.5 Types of data
- 1.6 Example applications.

Unit-2: Data collection and management
- 2.1 Introduction
- 2.2 Sources of data
- 2.3 Data collection and APIs
- 2.4 Exploring and fixing data
- 2.5 Data storage and management
- 2.6 Using multiple data sources

Unit-3: Data Analysis
- 3.1 Introduction
- 3.2 Terminology and concepts
- 3.3 Introduction to statistics
- 3.4 Central tendencies and distributions
- 3.5 Variance
- 3.6 Distribution properties and Arithmetic
- 3.7 Samples/CLT
- 3.8 Basic machine learning algorithms
- 3.9 Linear regression
- 3.10 Naive Bayes
- 3.11 SVM

Unit 4: Data visualization
- 4.1 Introduction
- 4.2 Types of data visualization

4.3 Data for visualization : Data types
4.4 Data encodings
4.5 Retinal variables
4.6 Mapping variables to encodings
4.7 Visual encodings

Unit 5: Applications of Data Science

5.1 Applications of Data Science
5.2 Technologies for visualization
5.3 Bokeh (Python)

Unit-6: Recent trends in various data collection and analysis techniques

6.1 Recent trends in various data collection
6.2 Analysis techniques
6.3 Various visualization techniques
6.4 Application development methods of used in data science.

Text Books/ Reference Books:

1. Cathy O'Neil and Rachel Schutt., 2013, Doing Data Science, Straight Talk From The Frontline, O'Reilly.
2. Jure Leskovek, AnandRajaraman and Jeffrey Ullman,2014, Mining of Massive Datasets, 3rd edition, Cambridge University Press.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2
PE-CS-M-124.1	2	2	2	1	2	1	2	2	2
PE-CS-M-124.2	2	2	2	2	2	1	2	1	2
PE-CS-M-124.3	2	2	2	1	2	1	2	2	2
PE-CS-M-124.4	2	2	2	2	2	1	2	1	2
PE-CS-M-124.5	2	2	2	1	2	1	2	2	2
PE-CS-M-124.6	2	2	2	2	2	1	2	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-125: DISTRIBUTED SYSTEMS

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of operating systems concepts

Course Outcomes: The students will be able to-

PE-CS-M-125.1. Introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems .

PE-CS-M-125.2. Understand issues concurrent transaction management and procedures to deal with the issues.

PE-CS-M-125.3. Analyze the query execution plan and to optimize the query plan in distributed environment.

Unit-1: INTRODUCTION

1.1 Distributed data processing
1.2 What is a DDBS
1.3 Advantages and disadvantages of DDBS
1.4 Transparencies in a distributed DBMS
1.5 Distributed DBMS architecture
1.6 Global directory issues

Unit-2: DISTRIBUTED DATABASE DESIGN

2.1 Alternative design strategies
2.2 Distributed design issues
2.3 Fragmentation
2.4 Data allocation
2.5 SEMANTICS DATA CONTROL
2.6 View management
2.7 Data security
2.8 Semantic Integrity Control
2.9 QUERY PROCESSING ISSUES
2.10 Objectives of query processing
2.11 Characterization of query processors
2.12 Layers of query processing
2.13 Query decomposition
2.14 Localization of distributed data

Unit-3: DISTRIBUTED QUERY OPTIMIZATION

3.1 Factors governing query optimization
3.2 Centralized query optimization
3.3 Ordering of fragment queries
3.4 Distributed query optimization algorithms
3.5 The transaction concept
3.6 Goals of transaction management
3.7 Characteristics of transactions

3.8 Taxonomy of transaction models
3.9 Concurrency control in centralized database systems
3.10 Concurrency control in DDBSs
3.11 Distributed concurrency control algorithms
3.12 Deadlock management
3.13 Characteristics of transactions

Unit-4: RELIABILITY
4.1 Reliability issues in DDBSs
4.2 Types of failures
4.3 Reliability techniques
4.4 Commit protocols
4.6 Recovery protocols

Unit-5: PARALLEL DATABASE SYSTEMS
5.1 Parallel architectures
5.2 Parallel query processing
5.3 Optimization
5.4 Load balancing

Unit-6: ADVANCED TOPICS
6.1 Mobile Databases
6.2 Distributed Object Management
6.3 Multi-databases

Text Books/ Reference Books:
1. M.T. Ozsu and P. Valduriez, 1991, Principles of Distributed Database Systems, 4th edition, Prentice-Hall.
2.D. Bell and J. Grimson, 1992, Distributed Database Systems, Addison-Wesley.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-125.1	3	1	1	1	1	1	2	3	1
PE-CS-M-125.2	2	1	1	1	1	1	1	1	1
PE-CS-M-125.3	3	1	1	1	1	3	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-126: ADVANCED WIRELESS AND MOBILE NETWORKS

Periods/week	Credits	Max. Marks	: 150
L: 3 T: 0	3	Continuous Evaluation	: 50
Duration of Examination: 3 Hrs		End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of mobile computing

Course Outcomes: The students will be able to-
PE-CS-M-126.1. Study and analyze about wireless/mobile market and the future needs and challenges.
PE-CS-M-126.2. Understand key concepts of wireless networks, standards, technologies and their basic operations.
PE-CS-M-126.3. Learn how to design and analyse various medium access
PE-CS-M-126.4. Evaluate MAC and network protocols using network simulation software tools.

Unit 1: INTRODUCTION:
1.1 Wireless Networking Trends,
1.2 Key Wireless Physical Layer Concepts,
1.3 Multiple Access Technologies -CDMA, FDMA, TDMA,
1.4 Spread Spectrum technologies, Frequency reuse, Radio Propagation and Modelling,
1.5 Challenges in Mobile
1.6 Computing: Resource poorness, Bandwidth, energy etc.

WIRELESS LOCAL AREA NETWORKS:
1.7 IEEE 802.11 Wireless LANs Physical & MAC layer,
1.8 802.11 MAC Modes (DCF & PCF) IEEE 802.11 standards,
1.9 Architecture & protocols, Infrastructure vs. Adhoc Modes,
1.10 Hidden Node & Exposed Terminal Problem, Problems,
1.11 Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues

Unit 2: WIRELESS CELLULAR NETWORKS:
2.1 1G and 2G, 2.5G, 3G, and 4G,
2.2 Mobile IPv4, Mobile IPv6,
2.3 TCP over Wireless Networks,
2.4 Cellular architecture, Frequency reuse,
2.5 Channel assignment strategies, Handoff strategies,
2.6 Interference and system capacity, Improving coverage and capacity in cellular systems,
2.7 Spread spectrum Technologies.

Unit 3: WiMAX
3.1 WiMAX (Physical layer, Media access control, Mobility and Networking),
3.2 IEEE 802.22 Wireless Regional Area Networks,
3.3 IEEE 802.21 Media Independent Handover, Overview
3.4 WIRELESS SENSOR NETWORKS**-** Introduction, Application, Physical,
3.5 MAC layer and Network Layer,
3.6 Power Management, Tiny OS Overview.

Unit 4: WIRELESS PANs
4.1 Bluetooth AND Zigbee,
4.2 Introduction to Wireless Sensors.

Unit 5: SECURITY

5.1 Security in wireless Networks Vulnerabilities,
5.2 Security techniques,
5.3 Wi-Fi Security,
5.4 DoS in wireless communication.

Unit 6: ADVANCED TOPICS

6.1 IEEE 802.11x and IEEE 802.11i standards,
6.2 Introduction to Vehicular Adhoc Networks

Text Books / Reference Books:

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

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-126.1	3	2	2	2	2	2	3	2	3
PE-CS-M-126.2	3	2	2	1	2	1	2	2	3
PE-CS-M-126.3	3	1	2	1	1	1	1	2	3
PE-CS-M-126.4	3	2	2	2	2	1	1	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-134: DATA SCIENCE LAB

Periods/week	Credits	Max. Marks	: 100
P: 4	2	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Pre-requisites: The students must have the knowledge of statistics and probability

Course Outcomes: The students will be able to-
PE-CS-M-134.1. Study the Basic of for data analysis.
PE-CS-M-134.2. Understand the Qualitative Data Analysis and Quantitative Data Analysis techniques.
PE-CS-M-134.3. Identify the concept of Numerical Measures and Probability Distribution.
PE-CS-M-134.4. Categorize different types of Data as statistical Inference.
PE-CS-M-134.5. Compare and Analyze different classification and Clustering Techniques.
PE-CS-M-134.6. Design a Text Mining problem dealing with Text based data set.

List of Experiments:

Experiment 1: Basic of for data analysis R:Basic data types, Vector, Matrix, List, Data Frame.

Experiment 2: *Qualitative* Data Analysis:Frequency Distribution of Qualitative Data, Relative Distribution of Qualitative Data, Bar Chart, Pie Chart.

Experiment 3: Quantitative Data Analysis: Frequency Distribution of Quantitative Data, Histogram, Cumulative Frequency Distribution.

Experiment 4: Numerical Measures: Mean, Median, Modes, Variance, Standard Deviation, Correlation Coefficient.

Experiment 5: Probability Distribution: Binomial Distribution, Poisson Distribution, Continuous Uniform Distribution, Normal Distribution, Chi-Squared Distribution.

Experiment 6: Statistical inference:comparison between two independent samples, Population Mean Between two matched samples.

Experiment 7: Goodness Fit:Chi Square Test of independence

Experiment 8: Classification:Naïve Bayesian, Support Vector Machine, Maximum Likelihood Estimators.

Experiment 9: Clustering:K-Mean

Experiment 10: Text Mining:Text Classification, TF-IDF.

Text Books/ Reference Books:

1. R Statistical Application Development by Example Beginner's Guide Kindle Edition by Prabhanjan Narayanachar Tattar.
2. John Vince, Foundation Mathematics for Computer Science, Springer.
3. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
4. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
5. Alan Tucker, Applied Combinatorics, Wiley
6. Practical Statistics for Data Scientists: 50 Essential Concepts 1st Edition, Kindle Edition

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

Course Articulation Matrix:

CO Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2
PE-CS-M-134.1	2	2	2	1	2	1	2	2	2
PE-CS-M-134.2	2	2	2	2	2	1	2	1	2
PE-CS-M-134.3	2	2	1	1	2	1	2	2	2
PE-CS-M-134.4	2	2	1	2	2	1	2	1	2
PE-CS-M-134.5	2	2	1	1	2	1	2	2	2
PE-CS-M-134.6	2	2	2	2	2	1	2	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-131: MACHINE LEARNING LAB

Periods/week	Credits	Max. Marks	: 100
P: 4	2	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Pre-requisites: The students must have the knowledge of R/Python

Course Outcomes: The students will be able to-
PE-CS-M-131.1. Preprocess the dataset for building a model.
PE-CS-M-131.2. Implement various machine learning techniques suitable for a given problem.
PE-CS-M-131.3. Gain understanding of weka machine learning toolkit.
PE-CS-M-131.4. Evaluate machine learning model performance.

Following are some of the suggested topics for the Lab Practicals:

1) Implement classification of Dataset using K nearest neighbor algorithm.
2) Implement decision tree based algorithm and
   a) Calculate Gini Index
   b) Create Split
   c) Build a Tree
   d) Make a Prediction using any Dataset.
3) Implement Bayes Classifier.
4) Implement Euclidean Distance for two features then perform clustering using K-means algorithm and visualize the clusters.
5) Write a program to classify the tuples using linear regression.
6) Introduction to weka Machine Learning ToolKit.
7) Classification using the weka ToolKit.

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-131.1	2	1	1	1	1	1	2	1	2
PE-CS-M-131.2	2	1	1	1	1	1	2	1	2
PE-CS-M-131.3	2	1	1	1	1	1	2	1	2
PE-CS-M-131.4	1	1	1	1	1	1	2	1	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-133: INTRODUCTION TO INTELLIGENT SYSTEMS LAB

Periods/week	Credits		Max. Marks	: 100
P: 4	2		Continuous Evaluation	: 50
Duration of Examination: 2 Hrs			End Sem Examination	: 50

Pre-requisites: The students must have the knowledge of artificial intelligence concepts.

Course Outcomes: The students will be able to-
PE-CS-M-133.1. Perform basic set operations.
PE-CS-M-133.2. Explain the various membership functions and plot.
PE-CS-M-133.3. Represent knowledge and develop inferences.
PE-CS-M-133.4. Develop various kinds of neural network.

Following are some of the suggested topics for the Lab Practicals:

1. To perform Union, Intersection and Complement operations.
2. To implement De-Morgan's Law.
3. To plot various membership functions.
4. Generate ANDNOT function using McCulloch-Pitts neural net.
5. Generate XOR function using McCulloch-Pitts neural net.
6. Hebb Net to classify two dimensional input patterns in bipolar with given targets.
7. Perceptron net for an AND function with bipolar inputs and targets.
8. To calculate the weights for given patterns using hetero associative neural net.
9. To store vector in an auto-associative net. Find weight matrix & test the net with input
10. To store the vector, find the weight matrix with no self connection. Test this using a discrete Hopfield

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

Course Articulation Matrix:

CO Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2
PE-CS-M-133.1	2	2	1	1	2	1	1	2	2
PE-CS-M-133.2	2	2	1	1	2	1	2	2	2
PE-CS-M-133.3	2	2	1	1	2	1	2	2	2
PE-CS-M-133.4	2	2	1	1	1	1	2	2	2

SEMESTER –II

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PC-CS-M-201 : ADVANCE ALGORITHMS

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of design of algorithms.

Course Outcomes: The students will be able to-
PC-CS-M-201.1. Understand advanced methods of designing and analyzing algorithms.
PC-CS-M-201.2. Choose appropriate algorithms and use it for a specific problem.
PC-CS-M-201.3. Understand basic paradigms and data structures used to solve advanced algorithmic problems.
PC-CS-M-201.4. Describe different classes of problems concerning their computation difficulties.
PC-CS-M-201.5. Analyze recent developments in the area of algorithmic design.

Unit-1:
1.1. **Sorting:** Review of various sorting algorithms,
1.2. topological sorting
1.3. **Graph:** Definitions and Elementary Algorithms: Shortest path by BFS,
1.4. shortest path in edge-weighted case (Dijkasra's),
1.5. depth-first search and computation of strongly connected components,
1.6. emphasis on correctness proof of the algorithm and time/space analysis,
1.7. example of amortized analysis.

Unit-2:
2.1. **Matroids:** Introduction to greedy paradigm,
2.2. algorithm to compute a maximum weight maximal independent set.
2.3. Application to MST.
2.4. **Graph Matching:** Algorithm to compute maximum matching.
2.5. Characterization of maximum matching by augmenting paths,
2.6. Edmond's Blossom algorithm to compute augmenting path.

Unit-3:
3.1. **Flow-Networks:** Maxflow-mincut theorem,
3.2. Ford-Fulkerson Method to compute maximum flow,
3.3. Edmond-Karp maximum-flow algorithm.
3.4. **Matrix Computations:** Strassen's algorithm and introduction to divide and conquer paradigm,
3.5. inverse of a triangular matrix, relation between the time complexities of basic matrix operations,
3.6. LUP-decomposition.

Unit-4:
4.1. **Shortest Path in Graphs:** Floyd-Warshall algorithm and introduction to dynamic programming paradigm.
4.2. More examples of dynamic programming.
4.3. **Modulo Representation of integers/polynomials:** Chinese Remainder Theorem,
4.4. Conversion between base-representation and modulo-representation.
4.5. Extension to polynomials. Application: Interpolation problem.

4.6. **Discrete Fourier Transform (DFT):** In complex field, DFT in modulo ring.
4.7. Fast Fourier Transform algorithm.
4.8. Schonhage-Strassen Integer Multiplication algorithm

Unit-5:
5.1. **Linear Programming:** Geometry of the feasibility region and Simplex algorithm
5.2. **NP-completeness:** Examples, proof of NP-hardness and NP-completeness.
5.3. **One or more of the following topics based on time and interest:** Approximation algorithms,
5.4. Randomized Algorithms, Interior Point Method,
5.5. Advanced Number Theoretic Algorithm

Unit-6:
6.1. Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Text Books/ Reference Books:
1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein,2009, Introduction to Algorithms, 3rd edition, MIT Press.
2. Aho, Hopcroft, Ullman, 1974, The Design and Analysis of Computer Algorithms, Pearson.
3. Kleinberg and Tardos, 2005, Algorithm Design, Addison Wesley.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PC-CS-M-201.1	3	2	2	2	2	2	3	2	3
PC-CS-M-201.2	3	2	2	1	2	1	2	2	3
PC-CS-M-201.3	3	1	2	1	1	1	1	2	3
PC-CS-M-201.4	3	2	2	2	2	1	1	2	3
PC-CS-M-201.5	3	1	2	1	2	2	1	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PC-CS-M-202: SOFT COMPUTING

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of mathematics

Course Outcomes: The students will be able to-
PC-CS-M-202.1. Define Soft Computing and Machine Learning Basics
PC-CS-M-202.2. Understand Soft Computing Constituents, Fuzzy Logic,NN,GA, etc.
PC-CS-M-202.3. Identify the concept of Fuzzy Inference Systems
PC-CS-M-202.4. Categorize different types of Machine Learning Using Neural Network
PC-CS-M-202.5. Apply GA in Machine Learning
PC-CS-M-202.6. Implement Arrays and array operations, Functions and Files, Study of neural network Toolbox using Python Lib.

Unit-1:
1.1. **INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS:** Evolution of Computing:
1.2. Soft Computing Constituents,
1.3. From Conventional AI to Computational Intelligence: Machine Learning Basics.

Unit-2:
2.1. **FUZZY LOGIC:** Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations,
2.2. Membership Functions: Fuzzy Rules and Fuzzy Reasoning,
2.3. Fuzzy Inference Systems, Fuzzy Expert Systems,
2.4. Fuzzy Decision Making.

Unit-3:
3.1. **NEURAL NETWORKS:** Machine Learning Using Neural Network,
3.2. Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks,
3.3. Radial Basis Function Networks : Reinforcement Learning,
3.4. Unsupervised Learning Neural Networks,
3.5. Adaptive Resonance architectures, Advances in Neural networks.

Unit-4:
4.1. **GENETIC ALGORITHMS:** Introduction to Genetic Algorithms (GA),
4.2. Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.

Unit-5:
5.1. **Matlab/Python Lib:** Introduction to Matlab/Python,
5.2. Arrays and array operations,
5.3. Functions and Files, Study of neural network toolbox and fuzzy logic toolbox,
5.4. Simple implementation of Artificial Neural Network and Fuzzy Logic.

Unit-6:
6.2. Recent Trands in deep learning, various classifiers,
6.3. neural networks and genetic algorithm.
6.4. Implementation of recently proposed soft computing techniques.

Text Books/ Reference Books:

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

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PC-CS-M-202.1	2	1	1	1	1	1	2	2	2
PC-CS-M-202.2	2	1	1	1	1	1	2	2	2
PC-CS-M-202.3	3	1	1	1	1	1	2	1	2
PC-CS-M-202.4	3	1	1	1	1	1	2	1	3
PC-CS-M-202.5	3	1	1	1	1	1	2	1	3
PC-CS-M-202.6	2	1	1	1	1	1	3	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

LC-CS-M-211: ADVANCE ALGORITHMS LAB

Periods/week	Credits	Max. Marks	: 100
P: 4	2	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Sem Examination	: 50

Pre-requisites: The students must have the knowledge of Basic data structures

Course Outcomes: The students will be able to-
LC-CS-M-211.1. Choose appropriate advanced data structure for given problem.
LC-CS-M-211.2. Calculate complexity.
LC-CS-M-211.3. Select appropriate design techniques to solve real world problems.
LC-CS-M-211.4. Apply the dynamic programming technique to solve the problems.
LC-CS-M-211.5. Apply the greedy programming technique to solve the problems.
LC-CS-M-211.6. Select a proper pattern matching algorithm for given problem.

Following are some of the suggested topics for the Lab Practicals:

1. Implement DFS and BFS procedures to search a node in a graph.
2. Implement a solution to find maximum weight maximal independent set from a set of connected nodes.
3. Implement Edmond's Blossom algorithm for computing augmenting path.
4. Implement Strassen's algorithm for matrices multiplication using divide and conquer paradigm.
5. Implement Prim's algorithm to find minimum spanning tree.
6. Implement matrix chain multiplication solution using dynamic approach.
7. Implement Floyd-Warshall algorithm to find the shortest path in a graph.
8. Implement Fast Fourier Transform procedure.
9. Implement approximate solution for Travelling Salesman Problem.
10. Implement approximate solution for set covering problem.

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
LC-CS-M-211.1	3	2	2	2	2	2	3	2	3
LC-CS-M-211.2	3	2	2	1	2	1	2	2	3
LC-CS-M-211.3	3	1	2	1	1	1	1	2	3
LC-CS-M-211.4	3	2	2	2	2	1	1	2	3
LC-CS-M-211.5	3	1	2	1	2	2	1	2	3
LC-CS-M-211.6	3	2	2	2	2	1	1	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

CS-M-200 : MINI PROJECT WITH SEMINAR

Periods/week	Credits	Max. Marks	: 150
L: 2 T: 0	2	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs		End Sem Examination	: 50

Pre-requisites: Nil

Course Outcomes: The students will be able to-
CS-M-200.1. Understand contemporary / emerging technology for various applications.
CS-M-200.2. Share knowledge effectively in oral and written form and formulate documents.

Distribution of Continuous Evaluation:

Synopsis	20%
Relavance	20%
Performance	30%
Report	20%
Attendance	10%

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
CS-M-200.1	3	2	2	2	2	2	3	2	3
CS-M-200.2	3	2	2	1	2	1	2	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-221: DATA PREPARATION AND ANALYSIS

Periods/week Credits	Max. Marks : 150
L: 3 T: 0 3	Continuous Evaluation : 50
Duration of Examination: 3 Hrs	End Sem Examination : 100

Pre-requisites: The students must have the knowledge of data science concepts

Course Outcomes: The students will be able to-
PE-CS-M-221.1. Understand and implement classical algorithms in data mining and data warehousing;
PE-CS-M-221.2. Assess the strengths and weaknesses of the algorithms,
PE-CS-M-221.3. Identify the application area of algorithms, and apply them.
PE-CS-M-221.4. Learn data mining techniques as well as methods in integrating and interpreting the data sets.
PE-CS-M-221.5. Improve effectiveness, efficiency and quality for data analysis.

Unit-1: Data Gathering and Preparation:
1.1 Data formats,
1.2 parsing and transformation,
1.3 Scalability and real-time issues

Unit-2: Data Cleaning:
2.1 Consistency checking,
2.2 Heterogeneous and missing data,
2.3 Data Transformation and segmentation

Unit-3: Exploratory Analysis:
3.1 Descriptive and comparative statistics,
3.2 Clustering and association,
3.3 Hypothesis generation

Unit-4: Visualization:
4.1 Designing visualizations, Time series,
4.2 Geolocated data, Correlations and connections,
4.3 Hierarchies and networks, interactivity

Text Books/ Reference Books:

1. Glenn J. Myatt, Wayne P. Johnson, 2014, Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining, 2nd edition, Wiley.
2. Julie Pallant,2007, SPSS Survival Manual:A Step –by-step Guide to Data Analysis using SPSS version 15, Third edition.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-221.1	1	2	2	1	1	1	1	1	1
PE-CS-M-221.2	1	2	2	2	1	1	1	2	1
PE-CS-M-221.3	1	1	2	2	2	2	1	1	1
PE-CS-M-221.4	1	1	1	1	2	2	2	1	1
PE-CS-M-221.5	2	1	1	1	2	1	2	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-222: SECURE SOFTWARE DESIGN & ENTERPRISE COMPUTING

Periods/week	Credits	Max. Marks	: 150
L: 3 T: 0	3	Continuous Evaluation	: 50
Duration of Examination: 3 Hrs		End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of software engineering concepts

Course Outcomes: The students will be able to-
PE-CS-M-222.1. Understand software vulnerabilities and software security, their programming practices and quality issues.
PE-CS-M-222.2. Design distributed and enterprise software applications
PE-CS-M-222.3. Implement components and database at the different tiers in an enterprise system
PE-CS-M-222.4. Analyze insecure exceptions and command/SQL injection
PE-CS-M-222.5. Evaluate web and mobile applications against attackers
PE-CS-M-222.6. Design new software and concepts containing minimum vulnerabilities and flaws.

Unit-1:
1.1. **Secure Software Design :**Identify software vulnerabilities and perform software security analysis,
1.2. Master security programming practices,
1.3. Master fundamental software security design concepts,
1.4. Perform security testing and quality assurance.

Unit-2:
2.1. **Enterprise Application Development:**Describe the nature and scope of enterprise software applications,
2.2. Design distributed N-tier software application,
2.3. Research technologies available for the presentation,
2.4. business and data tiers of an enterprise software application,
2.5. Design and build a database using an enterprise database system,
2.6. Develop components at the different tiers in an enterprise system,
2.7. Design and develop a multi-tier solution to a problem using technologies used in enterprise system, Present software solution.

Unit-3:
3.1. **Enterprise Systems Administration:**Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment,
3.2. Monitor server resource utilization for system reliability and availability,
3.3. Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

Unit-4:
4.1. Obtain the ability to manage and troubleshoot a network running multiple services,
4.2. Understand the requirements of an enterprise network and how to go about managing them.

Unit-5:
5.1. Handle insecure exceptions and command/SQL injection,
5.2. Defend web and mobile applications against attackers,
5.3. software containing minimum vulnerabilities and flaws.

Unit-6:

6.1. Case study of DNS server,
6.2. DHCP configuration and SQL injection attack.

Text Books/ Reference Books:

1. Theodor Richardson, Charles N Thies, 2013, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, 2015,Enterprise Software Security, Addison Wesley.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-222.1	1	1	1	1	1	1	1	1	2
PE-CS-M-222.2	2	1	1	1	1	1	2	2	2
PE-CS-M-222.3	3	1	1	1	2	2	2	2	2
PE-CS-M-222.4	3	1	1	1	1	1	3	2	2
PE-CS-M-222.5	3	1	1	1	1	1	3	2	2
PE-CS-M-222.6	3	1	1	1	1	1	3	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University
PE-CS-M-223: COMPUTER VISION

Periods/week Credits	Max. Marks : 150
L: 3 T: 0 3	Continuous Evaluation : 50
Duration of Examination: 3 Hrs	End Sem Examination : 100

Pre-requisites: The students must have the knowledge of basics of computer Graphics

Course Outcomes: The students will be able to-
PE-CS-M-223.1. Learn basic concept of computer vision, Image formation and preprocessing methods.
PE-CS-M-223.2. Understand various Edge detection algorithm and apply them in real applications.
PE-CS-M-223.3. Understand the Image Segmentation techniques and analysis them using real applications.
PE-CS-M-223.4. Learn and compare various feature extraction techniques with emphasis on applications.
PE-CS-M-223.5. Use the concept of Pattern recognition, various learning techniques and apply them in various applications.
PE-CS-M-223.6. Implement computer vision systems with emphasis on applications and problem solving

Unit-1:
1.1. Overview, computer imaging systems,
1.2. Lenses, Image formation and sensing, Image analysis,
1.3. pre-processing and Binary image analysis

Unit-2:
2.1. Edge detection, Edge detection performance
2.2. Hough transform, corner detection

Unit-3:
3.1. Segmentation,
3.2. Morphological filtering,
3.3. Fourier transform

Unit-4:
4.1. Feature extraction, shape, histogram,
4.2. color, spectral, texture, using CVIPtools,
4.3. Feature analysis, feature vectors, distance /similarity measures,
4.4. data preprocessing

Unit-5:
5.1. Pattern Analysis:
5.2. Clustering: K-Means, K-Medoids,
5.3. Mixture of Gaussians
5.4. Classification: Discriminant Function, Supervised, Un-supervised, Semisupervised
5.5. Classifiers: Bayes, KNN, ANN models;
5.6. Dimensionality Reduction: PCA, LDA,
5.7. ICA, and Non-parametric methods.

Unit-6:
6.1. Recent trends inActivity Recognition,
6.2. computational photography,
6.3. Biometrics.

Text Books/ Reference Books:

1. Richard Szeliski,2010," Computer Vision: Algorithms and Applications" 1 st edition, Springer.
2. Goodfellow, Bengio, and Courville, 2016," Deep Learning", 1 st edition, MIT Press.
3. Fisher et al, 2014, "Dictionary of Computer Vision and Image Processing" 2 nd Edition, Wiley.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-223.1	1	1	3	1	2	1	3	1	1
PE-CS-M-223.2	3	1	2	1	1	1	2	1	3
PE-CS-M-223.3	3	1	1	1	2	2	1	1	1
PE-CS-M-223.4	2	1	1	1	1	1	1	2	2
PE-CS-M-223.5	1	1	2	1	2	1	2	1	2
PE-CS-M-223.6	2	1	1	1	1	1	1	1	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

PE-CS-M-224: HUMAN AND COMPUTER INTERACTION

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites:

Course Outcomes: The students will be able to-

PE-CS-M-224.1 : Summarize the concept of I/O channels.
PE-CS-M-224.2 : Illustrate the HCI in software process.
PE-CS-M-224.3 : Apply the concept of navigation.
PE-CS-M-224.4 : Summarize the concept of stake holder
PE-CS-M-224.5 : Analyze the concept of Designing Web Interfaces

Unit-1:

1.1 Human: I/O channels – Memory – Reasoning and problem solving;
1.2 The computer: Devices – Memory – processing and networks;
1.3 Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.

Unit-2:

2.1 Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping.
2.2 HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale.
2.3 Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

Unit-3:

3.1 Cognitive models –Socio-Organizational issues and stake holder requirements.
3.2 Communication and collaboration models-Hypertext,
3.3 Multimedia and WWW.

Unit-4:

4.1 Mobile Ecosystem: Platforms, Application frameworks-
4.2 Types of Mobile Applications: Widgets,
4.3 Applications, Games- Mobile Information Architecture,
4.4 Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

Unit-5:

5.1 Designing Web Interfaces – Drag & Drop,
5.2 Direct Selection, Contextual Tools,
5.3 Overlays, Inlays and Virtual Pages,
5.4 Process Flow.
5.5 Case Studies.

Unit-6:

6.1 Recent Trends: Speech Recognition and Translation,
6.2 Multimodal System

Text Books/ Reference Books:

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

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:

Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-224.1	-	-	-	-	-	-	3	2	2
PE-CS-M-224.2	-	-	-	2	1	-	-	2	2
PE-CS-M-224.3	-	1	-	-	-	-	-	2	2
PE-CS-M-224.4	3	-	-	-	-	-	-	2	2
PE-CS-M-224.5	-	-	2	-	3	-	-	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-225: GPU COMPUTING

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of computer architecture

Course Outcomes: The students will be able to-
PE-CS-M-225.1. Understand the basic concepts of Graphic Processing Unit Processing
PE-CS-M-225.2. Explain the detailed architecture of GPU computing.
PE-CS-M-225.3. Work on different case studies based on GPU Computing.
PE-CS-M-225.4. Analyze different programming environment of GPU Computing.
PE-CS-M-225.5. Relate the available architectural concepts for synthesizing an efficient GPU.
PE-CS-M-225.6. To do some research by studying the advanced topics in GPU computing

Unit-1:
1.1 **Introduction:** History, Graphics Processors, Graphics
1.2 Processing Units, GPGPUs. Clock speeds,
1.3 CPU / GPU comparisons, Heterogeneity, Accelerators,
1.4 Parallel programming, CUDA OpenCL / OpenACC,
1.5 Hello World Computation Kernels, Launch parameters,
1.6 Thread hierarchy, Warps / Wavefronts,
1.7 Thread blocks / Workgroups, Streaming multiprocessors,
1.8 1D / 2D / 3D thread mapping, Device properties,
1.9 Simple Programs

Unit-2:
2.1 **Memory:** Memory hierarchy, DRAM / global, local / shared, private / local, textures,
2.2 Constant Memory, Pointers, Parameter Passing,
2.3 Arrays and dynamic Memory, Multi-dimensional Arrays,
2.4 Memory Allocation, Memory copying across devices,
2.5 Programs with matrices,
2.6 Performance evaluation with different memories

Unit-3:
3.1 **Synchronization:** Memory Consistency, Barriers (local versus global),
3.2 Atomics, Memory fence. Prefix sum, Reduction.
3.3 Programs for concurrent Data Structures such as Worklists,
3.4 Linked-lists. Synchronization across CPU and GPU.
3.5 **Functions:** Device functions, Host functions,
3.6 Kernels functions, Using libraries (such as Thrust), and developing libraries.

Unit-4:
4.1 **Support:** Debugging GPU Programs.
4.2 Profiling, Profile tools, Performance aspects
4.3 **Streams:** Asynchronous processing, tasks,
4.4 Task-dependence, Overlapped data transfers, Default Stream,

4.5 Synchronization with streams. Events, Event-based- Synchronization –
4.6 Overlapping data transfer and kernel execution,
4.7 pitfalls.

Unit-5:
5.1 **Case Studies:** Image Processing,
5.2 Graph algorithms,
5.3 Simulations,
5.4 Deep Learning

Unit-6:
6.1 Advanced topics: Dynamic parallelism,
6.2 Unified Virtual Memory, Multi-GPU processing,
6.3 Peer access, Heterogeneous processing

Text Books/ Reference Books:
1. David Kirk, Wen-meiHwu, 2010, Programming Massively Parallel Processors: A Hands-on Approach, ISBN: 978-0123814722, Morgan Kaufman.
2. Shane Cook, 2012, CUDA Programming: A Developer's Guide to Parallel Computing with GPUs, ISBN: 978-0124159334 Newnes.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-225.1	2	1	1	1	1	1	2	2	2
PE-CS-M-225.2	2	1	1	1	1	1	2	2	2
PE-CS-M-225.3	3	1	2	1	1	1	3	3	2
PE-CS-M-225.4	3	1	1	1	1	1	3	3	2
PE-CS-M-225.5	3	1	1	1	1	2	3	3	3
PE-CS-M-225.6	3	1	2	2	2	2	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

PE-CS-M-226 : DIGITAL FORENSICS

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites:

Course Outcomes: The students will be able to-

PE-CS-M-226.1. Understand the basic digital forensics and techniques for conducting the forensic examination on different digital devices.

PE-CS-M-226.2. Identify the essential concepts, protocols tools, and methodology of mobile forensics.

PE-CS-M-226.3. Illustrate the examination of digital evidences such as the data acquisition, identification analysis.

PE-CS-M-226.4. Assess and cite appropriate instances for the application of digital forensics

PE-CS-M-226.5. Analyze digital forensic evidence.

Unit-1:

1.1 **Digital Forensics Science:** Forensics science,
1.2 computer forensics, and digital forensics.
1.3 **Computer Crime:** Criminalistics as it relates to the investigative process,
1.4 analysis of cyber-criminalistics area,
1.5 holistic approach to cyber-forensics

Unit-2:

2.1 **Cyber Crime Scene Analysis:** Discuss the various court orders etc.,
2.2 methods to search and seizure electronic evidence,
2.3 retrieved and un-retrieved communications,
2.4 Discuss the importance of understanding what court documents would be required for a criminal investigation.

Unit-3:

3.1 **Evidence Management & Presentation:** Create and manage shared folders using operating system,
3.2 importance of the forensic mindset, define the workload of law enforcement,
3.3 Explain what the normal case would look like,
3.4 Define who should be notified of a crime, parts of gathering evidence,
3.5 Define and apply probable cause.

Unit-4:

4.1 **Computer Forensics:** Prepare a case, Begin an investigation,
4.2 Understand computer forensics workstations and software, Conduct an investigation,
4.3 Complete a case, Critique a case,
4.4 **Network Forensics:** open-source security tools for network forensic analysis,
4.5 requirements for preservation of network data.

Unit-5:

5.1 **Mobile Forensics:** mobile forensics techniques,
5.2 mobile forensics tools.
5.3 **Legal Aspects of Digital Forensics:** IT Act 2000,
5.4 amendment of IT Act 2008.

Unit-6:
6.1 Recent trends in mobile forensic technique and methods to search and seizure electronic evidence.

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

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-226.1	2	1	2	1	1	1	1	3	3
PE-CS-M-226.2	2	1	1	1	1	1	1	3	3
PE-CS-M-226.3	2	1	1	1	2	1	1	3	3
PE-CS-M-226.4	2	1	1	1	2	1	1	3	3
PE-CS-M-226.5	2	1	1	1	2	1	1	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-227: ADHOC NETWORKS

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of computer networks

Course Outcomes: The students will be able to-

PE-CS-M-227.1. Describe and explain the basics of Wireless Communication , cellular technology and Adhoc networks plus various technologies associated with it.

PE-CS-M-227.2. Analyze and discuss various Routing ,Transport and Security protocols pertaining to Adhoc Wireless Networks.

PE-CS-M-227.3. Apply this knowledge to Adhoc and sensor based networks and compute various parameters associated with it.

Unit-1: Fundamentals of Wireless communication technology

1.1 Electromagnetic spectrum, Radio Propagation spectrum
1.2 Characteristics of Wireless Channels
1.3 Multiple access techniques
1.4 Voice coding
1.5 Error control
1.6 Fundamentals of WLANs, IEEE 802.11 Standard, HIPERLAN Standard
1.7 Bluetooth specifications, Transport Protocol Group, Middleware Protocol Group, Bluetooth policies.

Unit-2: Wireless WANS, MANS and Internet

2.1 The Cellular Concept
- 2.1.1 Cellular architecture
- 2.1.2 First-Generation Cellular Systems
- 2.1.3 Second-Generation Cellular Systems
- 2.1.4 Third Generation Cellular Systems

2.2 Wireless in Local Loop
2.3 Wireless ATM, IEEE 802.16 Standard
2.4 HIPERACCESS
2.5 Wireless Internet
2.6 Mobile IP
2.7 TCP in wireless domains
2.8 WAP
2.9 Optimizing Web over Wireless.

Unit-3: Adhoc Wireless Networks and Mac Protocols

3.1 Cellular and Adhoc Wireless Networks
3.2 Applications of Adhoc wireless networks
3.3 Issues in Adhoc Networks, Adhoc Wireless Internet
3.4 Issues in designing a MAC protocol for Adhoc Wireless Networks,
3.5 Design Goals of a MAC protocol for Adhoc Wireless Sensor Networks
3.6 Classifications of MAC protocols
3.7 Contention based protocols
- 3.7.1 Contention based protocols with reservation mechanism

3.7.2 Contention based MAC protocols with scheduling mechanisms
3.8 MAC protocols that use Directional Antennas.

Unit-4: Routing protocols for Adhoc Wireless Networks
4.1 Issues in designing a Routing protocol for Adhoc networks
4.2 Classification of Routing Protocols
4.3 Table driven Routing protocols
4.4 On demand Routing Protocols
4.5 Hybrid Routing Protocols
4.6 Routing protocols with efficient flooding mechanisms
4.7 Hierarchical routing protocols
4.8 Power aware routing Protocols.

Unit-5: Multicast routing in Adhoc Wireless Networks
5.1 Issues in designing a Multicast Routing Protocols
5.2 Operations of Multicast routing protocols
5.3 Architecture Reference Model
5.4 Classification of Multicast Protocols
5.5 Tree based Routing protocols
5.6 Mesh based Routing protocols
5.7 Energy efficient multicasting
5.8 Multicasting with Quality of Service guarantee
5.9 Application dependent multicast routing.

Unit-6: Transport Layer and Security Protocols for Adhoc Networks
6.1 Issues in designing a Transport layer protocol for Ad hoc wireless networks
6.2 Design Goals
6.3 Classification of Transport layer solutions
6.4 TCP Over Ad hoc networks, Other transport layer protocols for Ad Hoc wireless networks
6.5 Security in Ad hoc wireless networks
6.6 Network Security requirements
6.7 Issues and challenges in security provisioning
6.8 Network Security attacks
6.9 Key management
6.10 Secure routing in wireless networks.

Text Books/ Reference Books:

1. C. Siva Ram Murthy and B.Smanoj, 2004, Ad Hoc Wireless Networks – Architectures and Protocols, Low Price Edition, Pearson Education.
2. Feng Zhao and Leonidas Guibas, 2004, Wireless Sensor Networks, Morgan Kaufman Publishers.
3. C.K.Toh, 2002, Ad Hoc Mobile Wireless Networks, Prentice Hall.
4. Thomas Krag and Sebastin Buettrich, 2007, Wireless Mesh Networking, O'Reilly Publishers.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-227.1	3	2	2	2	3	1	1	1	1
PE-CS-M-227.2	3	2	3	3	3	1	1	1	1
PE-CS-M-227.3	2	3	3	3	2	1	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-231: DATA PREPARATION AND ANALYSIS LAB

Periods/week	Credits		
P: 4	2	Continuous Evaluation	: 50
Duration of Examination: 3 Hrs		End Sem Examination	: 50

Pre-requisites: The students must have the knowledge of data science concepts

Course Outcomes: The students will be able to-
PE-CS-M-231.1. Perform preprocessing of various datasets.
PE-CS-M-231.2. Implement various data mining algorithms.
PE-CS-M-231.3. Analyze the results and get insights into data.
PE-CS-M-231.4. To evaluate data mining techniques and optimize the solution.

Following are some of the suggested topics for the Lab Practicals:

1. Demonstration of preprocessing on dataset student.arff
2. Demonstration of preprocessing on dataset labor.arff
3. Demonstration of Association rule process on dataset contactlenses.arff using apriori algorithm
4. Demonstration of Association rule process on dataset test.arff using apriori algorithm
5. Demonstration of classification rule process on dataset student.arff using j48 algorithm
6. Demonstration of classification rule process on dataset employee.arff using j48 algorithm
7. Demonstration of classification rule process on dataset employee.arff using id3 algorithm
8. Demonstration of classification rule process on dataset employee.arff using naïve bayes algorithm
9. Demonstration of clustering rule process on dataset iris.arff using simple k-means
10. Demonstration of clustering rule process on dataset student.arff using simple kmeans

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-231.1	2	2	2	1	2	1	1	2	2
PE-CS-M-231.2	2	2	2	2	2	2	1	1	2
PE-CS-M-231.3	1	1	2	1	2	1	1	2	1
PE-CS-M-231.4	2	2	2	2	2	1	2	2	2

SEMESTER-III

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

CS-M-350: Colloquium

Periods/week	Credits		
L: 0 T: 2	0	Max. Marks	: 50
		Continuous Evaluation	: 50

Pre-requisites: The students must have done mini project with seminar

Course Outcomes: The students will be able to-
CS-M-350.1. Understand contemporary / emerging technology for various applications.
CS-M-350.2. Share knowledge effectively via presentation and formulate documents.

FOR COLLOQUIUM EACH STUDENT WOULD BE REQUIRED TO GIVE AT LEAST THREE SEMINARS UNDER THE SUPERVISION OF SOME OF FACULTY MEMBER ON CURRENT EMERGING AREAS OF COMPUTER SCIENCE AMONG WHICH ATLEAST ONE WOULD BE RESEARCH ORIENTED.

Distribution of Continuous Evaluation:

Synopsis	20%
Relevance	20%
Performance	30%
Report	20%
Attendance	10%

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
CS-M-350.1	3	3	1	1	3	1	3	3	3
CS-M-350.2	3	3	1	1	3	1	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

CS-M-300: Dissertation (Phase-I)

Periods/week	Credits		
P: 20	10	Continuous Evaluation	: 200
Duration of Examination: 4 Hrs		End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of research methodology

Course Outcomes: The students will be able to-
CS-M-300.1. Demonstrate knowledge of contemporary issues in their chosen field of research.
CS-M-300.2. Consolidate the literature search to identify and formulate the engineering problem.
CS-M-300.3. Design engineering solutions to complex problems utilizing a systems approach.
CS-M-300.4. Apply knowledge and abilities in practical activities with regards to relevant scientific professional and social judgments.

THE TOPIC OF THE DISSERTATION OF 4TH SEMESTER IS TO BE APPROVED BY THE INTERNAL COMMITTEE IN THE 3RD SEMESTER AS PER ORDINANCE FOR M.TECH PROGRAMME. THE DISSERTATION CAN BE TAKEN UP ON ANY EMERGING AREAS OF COMPUTER SCIENCE OR ON ANY TOPIC OF INDUSTRIAL IMPORTANCE RELATED TO COMPUTER SCIENCE AND SHOULD INCLUDE CRITICAL REVIEW OF THE LITERATURE IN THE AREA.

Distribution of Continuous Evaluation:

Synopsis	20%
Relevance	20%
Performance	30%
Report	20%
Attendance	10%

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PSO 1	PSO 2
CS-M-300.1	3	3	1	1	3	1	3	3	3
CS-M-300.2	3	3	1	1	3	1	3	3	3
CS-M-300.3	3	3	1	1	3	1	3	3	3
CS-M-300.4	3	3	1	1	3	1	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-321: Mobile Applications and Services

Periods/week Credits	Max. Marks : 150
L: 3 T: 0 3	Continuous Evaluation : 50
Duration of Examination: 3 Hrs	End Sem Examination : 100

Pre-requisites: The students must have the knowledge of programming language

Course Outcomes: The students will be able to-
PE-CS-M-321.1. Describe different aspects of Android architecture that make it unique from other programming platforms.
PE-CS-M-321.2. Critique mobile applications on their design pros and cons.
PE-CS-M-321.3. Illustrate wireless communications standards and data transmission standards
PE-CS-M-321.4. Conceptualize Mobile App Development Hurdles, Testing and Security issues.
PE-CS-M-321.5. Assess vision and State of the Art of IoT

Unit-1: Introduction
1.1. Introduction to Mobile Computing,
1.2. Introduction to Android Development Environment
1.3. Factors in Developing Mobile Applications
1.4. Mobile Software Engineering, Frameworks and Tools
1.5. Generic UI Development Android User

Unit-2: User Interface Design
2.1. VUIs and Mobile Apps,
2.2. Text-to-Speech Techniques,
2.3. Designing the Right UI,
2.4. Multichannel and Multimodal Uis,
2.5. Storing and Retrieving Data,
2.6. Synchronization and Replication of Mobile Data,
2.7. Getting the Model Right,
2.8. Android Storing and Retrieving Data,
2.9. Working with a Content Provider

Unit-3: Communications via Network and the Web
3.1. State Machine,
3.2. CorrectCommunications Model,
3.3. Android Networking and Web,
3.4. TelephonyDeciding Scope of an App,
3.5. Wireless Connectivity and Mobile Apps,
3.6. AndroidTelephony, Notifications and Alarms
3.7. Performance, Performance and Memory Management,
3.8. Android Notifications and Alarms,
3.9. Graphics, Performance and Multithreading, Graphics and UI Performance, Android, Graphics

Unit-4: Mobile Application Deployment
4.1. Packaging and Deploying,
4.2. Performance BestPractices,
4.3. Android Field Service App,

4.4. Location Mobility and Location Based Services
4.5. Android Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia

Unit-5: Platforms and Additional Issues
5.1. Development Process,
5.2. Architecture,Design,
5.3. Technology Selection,
5.4. Mobile App Development Hurdles, Testing, Security and Hacking, Active Transactions,
5.5. More on Security, Hacking Android.

Unit-6: Recent Trends in Mobile Applications
6.1. Recent trends in Communication protocols for IOT nodes,
6.2. mobile computing techniques in IOT, agents based communications in IOT

Text Books/ Reference Books:
1. Wei-Meng Lee, 2012, Beginning Android™ 4 Application Development, Ist edition, John Wiley & Sons.
2. Ryan Cohen, Tao Wang, 2014, GUI Design for Android Apps : 1 st Edition, Heinz Weinheimer

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-321.1	1	1	1	1	1	1	1	1	1
PE-CS-M-321.2	2	1	1	1	1	1	1	1	2
PE-CS-M-321.3	1	1	1	1	1	1	1	1	3
PE-CS-M-321.4	2	1	1	1	1	2	3	2	2
PE-CS-M-321.5	2	1	2	2	2	2	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

PE-CS-M-322: Compiler for HPC

Periods/week	Credits		
L: 3 T: 0	3	Continuous Evaluation	: 50
Duration of Examination: 3 Hrs		End Sem Examination	: 100

Pre-requisites:

Course Outcomes: The students will be able to-

PE-CS-M-322.1 Describe the different phases of the compilation process , different language translators.
PE-CS-M-322.2 Understand dependency of data in different domain.
PE-CS-M-322.3 Apply appropriate algorithms for various types of machines.
PE-CS-M-322.4 Design structures for recent complier trends.
PE-CS-M-322.5 Analyze concurrency and array region using different techniques.

Unit-1: High Performance Systems

1.1. Structure of a Compiler
1.3. Programming Language
1.4. Features
1.5. Languages for High Performance

Unit-2: Data Dependence

2.1. Data Dependence in Loops
- 2.1.1. Data Dependence in Conditionals
- 2.1.2 Data Dependence in Parallel Loops
- 2.1.3 Program Dependence Graph

2.2 Scalar Analysis with Factored Use-Def Chains
- 2.2.1 FUD Chains for Arrays
- 2.2.2. Induction Variables Using FUD Chains
- 2.2.3. Constant Propagation with FUD Chains
- 2.2.4. Data Dependence for Scalars
- 2.2.5. Dependence Analysis for Arrays.

Unit-3: Array Region Analysis

3.1. Pointer Analysis
- 3.1.1. I/O Dependence
- 3.1.2. Procedure Calls,
- 3.1.3. Inter-procedural Analysis,

3.2. Loop Restructuring
- 3.2.1. Simple Transformations
- 3.2.2. Loop Fusion
- 3.2.3. Loop Fission
- 3.2.4. Loop Reversal
- 3.2.5. Loop Interchanging
- 3.2.6. Loop Skewing
- 3.2.7. Linear Loop Transformations
- 3.2.8. Strip-Mining, Loop Tiling
- 3.2.9. Other Loop Transformations, and Inter-procedural Transformations.

3.3. Optimizing for Locality
- 3.3.1. Single Reference to Each Array

3.3.2. Multiple References
3.3.3. General Tiling
3.3.4. Fission and Fusion for Locality.

Unit-4: Concurrency Analysis

4.1. Concurrency from Sequential Loops
4.2. Concurrency from Parallel Loops
4.3. Nested Loops, Round off Error
4.4. Exceptions and Debuggers.
4.5. Vector Analysis
4.5.1. Vector Code
4.5.2. Vector Code from Sequential Loops
4.5.3. Vector Code from For all Loops
4.5.4. Nested Loops
4.5.5. Round off Error
4.5.6. Exceptions, and Debuggers
4.5.7. Multi-vector Computers.

Unit-5: Message-Passing Machines

5.1. SIMD Machines
5.2. MIMD Machines
5.3. Data Layout
5.4. Parallel Code for Array Assignment
5.5. Remote Data Access
5.6. Automatic Data Layout
5.7. Multiple Array Assignments
5.8. Other Topics
5.9. Scalable Shared-Memory Machines:
5.9.1. Global Cache Coherence
5.9.2. Local Cache Coherence
5.9.3. Latency Tolerant Machines.

Unit-6:

6.1. Recent trends in compiler design for high performance computing
6.2. Recent trends in compiler design for message passing machines
6.3. Recent trends in compiler design for scalable shared memory machine.

Text Books/ Reference Books:

1. High-Performance Compilers for Parallel Computing, Michael Wolfe, 1995: Pearson

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-322.1	2	1	1	1	1	1	1	2	2
PE-CS-M-322.2	2	1	1	1	1	1	1	2	2
PE-CS-M-322.3	2	1	1	1	1	1	1	3	3
PE-CS-M-322.4	2	1	1	1	1	1	1	2	3
PE-CS-M-322.5	2	1	1	1	1	1	2	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

PE-CS-M-323: Optimization Techniques

Periods/week Credits	Max. Marks : 150
L: 3 T: 0 3	Continuous Evaluation : 50
Duration of Examination: 3 Hrs	End Sem Examination : 100

Pre-requisites: The students must have the knowledge of Algorithms

Course Outcomes: The students will be able to-
PE-CS-M-323.1. Outline the Optimization Fundamentals
PE-CS-M-323.2. Understand General Structure of Optimization Algorithms
PE-CS-M-323.3. Identify different Optimization Programming Techniques
PE-CS-M-323.4. Categorize Branches of Mathematical Programming
PE-CS-M-323.5. Compare and contrast different Genetic Optimization Techniques
PE-CS-M-323.6. Formulate Real life Problems and their mathematical formulation

Unit-1: Optimization fundamentals
1.1 Engineering application of Optimization
1.2 Formulation of design problems as mathematical programming problems.

Unit-2: Problem Solving
2.1 General Structure of Optimization Algorithms,
2.2 Constraints,
2.3 The Feasible Region

Unit-3: Optimization Programming Techniques
3.1 Branches of Mathematical Programming
3.2 Optimization using calculus,
3.3 Graphical Optimization,
3.4 Linear Programming,
3.5 Quadratic Programming,
3.6 Integer Programming,
3.7 Semi Definite Programming.

Unit-4: Genetic Optimization
4.1 Optimization Algorithms: Genetic Optimization,
4.2 Particle Swarm Optimization,
4.3 Ant Colony Optimization etc.

Unit-5: Case Study
5.1 Real life Problems and their mathematical formulation as standard programming problems.

Unit-6: Recent trends
6.1 Recent trends: Applications of ant colony optimization,
6.2 Genetics and linear and quadratic programming in real world applications.

Text Books/ Reference Books:
1. Laurence A. Wolsey, 1998, Integer programming, Wiley,ISBN 978-0-471-28366-9.
2. Andreas Antoniou ,Practical Optimization Algorithms and Engineering Applications, Springer.

3. Edwin K., P. Chong & Stanislaw h. Zak, 2017,An Introduction to Optimization, 4th Edition, Wiley-Interscience Publication. JOHN WILEY & SONS, INC.
4. Dimitris Bertsimas; Robert Weismantel , 2005,Optimization over integers.Dynamic Ideas, ISBN 978-0-9759146-2-5.
5. John K. Karlof, 2006, Integer programming: theory and practice, CRC Press. ISBN 978-0-8493- 1914-3.
6. H. Paul Williams, 2009, Logic and Integer Programming, ISBN 978-0-387-92279-9. Springer
7. Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. , 2009,50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art, Springer.ISBN 978-3- 540-68274-5.
8. Der-San Chen; Robert G. Batson; Yu Dang, 2010, Applied Integer Programming: Modeling and Solution, John Wiley and Sons.ISBN 978-0-470-37306-4.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
PE-CS-M-323.1	2	3	1	1	3	1	3	3	3
PE-CS-M-323.2	2	3	1	1	3	1	3	3	3
PE-CS-M-323.3	1	3	1	1	3	1	3	3	3
PE-CS-M-323.4	3	3	1	1	3	1	3	3	3
PE-CS-M-323.5	2	3	1	1	3	1	3	3	3
PE-CS-M-323.6	3	3	1	1	3	1	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

OE-M-301: BUSINESS ANALYTICS

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites: The students must have the knowledge of statistics

Course Outcomes: The students will be able to-
OE-M-301.1. Understand the concepts of business analytics, statistical notations, and develop reasoning for various methods of statistical analysis.
OE-M-301.2. Design data preprocessing methods based on different types of dataset.
OE-M-301.3. Implement linear and regression techniques, visualizing data and relationships among data variables, forecasting on time series data.
OE-M-301.4. Analyze business performance and opportunities
OE-M-301.5. Evaluate the appropriate use of tools and techniques to inference optimal results.
OE-M-301.6. Design new heights and statistical methods based on performances.

Unit-1: Introduction to Business Analytics
1.1 Overview and scope of business analytics
1.2 Step by step process of business analytics
1.3 Relationship of business analytics and organizations
1.4 Important considerations to Support Business Analytics
1.5 Statistical tools: statistical notation
1.6 Descriptive statistical methods
1.7 Predictive Analytics methods

Unit-2: Trendiness and Regression Analysis
2.1 Types of Data and its importance
2.2 Methods of data preprocessing
2.3 Challenges associated with data preprocessing
2.4 Modeling relationships in data
2.5 Regression techniques
2.6 Models for business analytics
2.7 visualizing and exploring data
2.8 Technologies support business analytics

Unit-3: Organization Structures and types of Analytics
3.1 Organization structures and business analytics
3.2 Team management and management issues
3.3 Designing information policy
3.4 Outsourcing
3.5 Ensuring data quality
3.6 Measuring business analytics contribution
3.7 Data mining methodologies

Unit-4: Forecasting Techniques
4.1 Qualitative and judgmental forecasting
4.2 Statistical forecasting models

4.3 Forecasting models for stationary time series
4.4 Forecasting models for time series with a linear trend
4.5 Forecasting time series with seasonality
4.6 Regression forecasting with casual variables
4.7 Selecting appropriate forecasting models

Unit-5: Decision Analysis
5.1 Formulating decision problems
5.2 Decision strategies with the without outcome probabilities
5.3 Decision trees
5.4 The value of information for decision making
5.5 Utility and decision making

Unit-6: Recent Trends
6.1 Embedded and collaborative business intelligence
6.2 Visual data recovery
6.3 Data storytelling
6.4 Data journalism

Text Books/ Reference Books:

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, 2014,Business analytics Principles, Concepts, and Applications, Pearson FT Press.
2. James Evans, 2016 Business Analytics, 2nd edition, persons Education.
3. S. Christian Albright, Wayne L. Winston, Business Analytics: Data Analysis & Decision Making , Cengage Learning,
4. Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl, Data Mining for Business Analytics: Concepts, Techniques, and Applications in R, WILEY

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
OE-M-301.1	2	3	1	1	2	1	3	3	3
OE-M-301.2	2	3	1	1	3	1	3	3	3
OE-M-301.3	1	2	1	1	2	1	3	3	3
OE-M-301.4	3	3	1	1	3	1	3	3	3
OE-M-301.5	2	2	1	1	3	1	3	3	3
OE-M-301.6	3	3	1	1	3	1	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

OE-M-302: Industrial Safety

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites: Nil

Course Outcomes: The students will be able to-

OE-M-302.1. Apply standard safety procedures in an industrial environment.
OE-M-302.2. Be familiar with standard workplace hazard/warning signs and labels.
OE-M-302.3. Be familiar with standard categories of hazardous materials.
OE-M-302.4. Identify hazard and potential hazard areas.
OE-M-302.5. Develop safety programs to prevent or mitigate damage or losses.
OE-M-302.6. Assess safety practices and programs.
OE-M-302.7. Conduct safety audits and improve safety practices.

Unit-1: Industrial safety:

1.1 Accident, causes, types, results and control,
1.2 Mechanical and electrical hazards,
1.3 Types, causes and preventive steps/procedure,
1.4 Describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes.
1.5 Fire prevention and firefighting, equipment and methods.

Unit-2: Fundamentals of maintenance engineering:

2.1 Definition and aim of maintenance engineering
2.2 Primary and secondary functions and responsibility of maintenance department,
2.3 Types of maintenance,
2.4 Types and applications of tools used for maintenance,
2.5 Maintenance cost & its relation with replacement economy,
2.6 Service life of equipment.

Unit-3: Wear and Corrosion and their prevention:

3.1 Wear- types, causes, effects, wear reduction methods,
3.2 lubricants-types and applications,
3.3 Lubrication methods, general sketch, working and applications,
3.4 Screw down grease cup,
3.5 Pressure grease gun,
3.6 Splash lubrication,
3.7 Gravity lubrication,
3.8 Wick feed lubrication
3.9 Side feed lubrication,
3.10 Ring lubrication, Definition, principle and factors affecting the corrosion.
3.11Types of corrosion, corrosion prevention methods.

Unit-4: Fault tracing:

4.1 Fault tracing-concept and importance,
4.2 Decision tree concept, need and applications

4.3 Sequence of fault finding activities,
4.4Show as decision tree, draw decision tree for problems in machine tools,
4.5 Hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I.
4.6 i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors,
4.7Types of faults in machine tools and their general causes.

Unit-5: Periodic maintenance:
5.1 Periodic inspection-concept and need,
5.2 Degreasing, cleaning and repairing schemes,
5.3 Overhauling of mechanical components,
5.4 Overhauling of electrical motor, common troubles and remedies of electric motor,

Unit-6: Preventive maintenance:
6.1 Repair complexities and its use, definition, need, steps and advantages of preventive maintenance.
6.2 Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets,
6.3 Program and schedule of preventive maintenance of mechanical and electrical equipment,
6.4 advantages of preventive maintenance.
6.5 Repair cycle concept and importance

Text Books/ Reference Books:
1. Higgins & Morrow , Maintenance Engineering Handbook, , Da Information Services.
2. H. P. Garg , Maintenance Engineering,S. Chand and Company.
3. Audels , Pump-hydraulic Compressors, Mcgraw Hill Publication.
4. Winterkorn, Hans, Chapman & Hall London , Foundation Engineering Handbook.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O 1	PS O 2
OE-M-302.1	1	1	-	2	2	3	1	-	-
OE-M-302.2	2	2	2	-	2	-	2	-	-
OE-M-302.3	1	2	3	-	2	-	3	-	-
OE-M-302.4	2	1	2	-	1	2	2	-	-
OE-M-302.5	2	2	3	1	2	2	2	-	-
OE-M-302.6	2	2	1	-	3	1	2	-	-
OE-M-302.7	1	3	3	-	2	1	2	-	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

OE-M-303: Operations Research

Periods/week Credits	Max. Marks : 150
L: 3 T: 0 3	Continuous Evaluation : 50
Duration of Examination: 3 Hrs	End Sem Examination : 100

Pre-requisites: The students must have the knowledge of mathematics

Course Outcomes: The students will be able to-
OE-M-303.1. Apply the dynamic programming to solve problems of discreet and continuous variables.
OE-M-303.2. Apply the concept of non-linear programming.
OE-M-303.3. Carry out sensitivity analysis
OE-M-303.4. Model the real world problem and simulate it.

Unit 1:
1.1 Optimization Techniques, Model Formulation,
1.2 models, General L.R Formulation,
1.3 Simplex Techniques, Sensitivity Analysis,
1.4 Inventory Control Models.

Unit 2:
2.1 Formulation of a LPP - Graphical solution revised simplex method
2.2 duality theory - dual simplex method
2.3 sensitivity analysis - parametric programming.

Unit 3:
3.1 Nonlinear programming problem - Kuhn-Tucker conditions
3.2 min cost flow problem - max flow problem - CPM/PERT.

Unit 4:
4.1 Scheduling and sequencing - single server and multiple server models
4.2 deterministic inventory models
4.3 Probabilistic inventory control models
4.4 Geometric Programming.

Unit 5:
5.1 Competitive Models,Single and Multi-channel Problems,
5.2 Sequencing Models, Dynamic Programming,
5.3 Flow in Networks, Elementary Graph Theory,
5.4 Game Theory Simulation.

Text Books/ Reference Books:
1 H.A. Taha, 2008, Operations Research, An Introduction, PHI.
2. H.M. Wagner, 1982, Principles of Operations Research, PHI, Delhi.
3. J.C. Pant, 2008, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi.
4. Hitler Libermann, 2009, Operations Research: McGraw Hill Pub.
5. Pannerselvam, 2010, Operations Research: Prentice Hall of India.
6. Harvey M Wagner, 2010, Principles of Operations Research: Prentice Hall of India.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
OE-M-303.1	3	1	2	-	1	-	3	-	-
OE-M-303.2	3	1	2	-	1	-	2	-	-
OE-M-303.3	3	1	1	-	1	-	1	-	-
OE-M-303.4	2	1	3	1	1	-	2	-	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

OE-M-304: Cost Management of Engineering Projects

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites: Nil

Course Outcomes: The students will be able to-
OE-M-304.1. Demonstrate an understanding of, and apply, the fundamentals of project planning and project management.
OE-M-304.2. Prepare and evaluate cost estimates, tender documentation and contract documentation.
OE-M-304.3. Administer and supervise contracts in accordance with the relevant Standards and/or Codes of Practice.
OE-M-304.4. Critically evaluate professional practice principles and their application to an engineering environment.

Unit-1: Introduction
- 1.1 Overview of Class and Team Project
- 1.2 Review Operational Effectiveness
- 1.3 SE Process and Costing
- 1.4 Engineering Cost Estimation
- 1.5 Colors of Money/Costing:
- 1.6 Acquisition, Procurement, SystemsLife Cycle Cost Estimation (SLCC),
- 1.7 Design/Development
- 1.8 Colors of Money
- 1.9 Various names, and need to understand as the SE what can pay for what
- 1.10 Cost Estimation

Unit-2: Review of Engineering Economics
- 2.1 Choice Among Alternatives
- 2.2 Cash Flows
- 2.3 Time Value of Money
- 2.4 Equivalence
- 2.5 Economic Worth
- 2.6 Figures of Merit
- 2.7 Lease Versus Buy
- 2.8 Some Case Studies

Unit-3: LCC
- 3.1 What is LCC
- 3.2 Four Ways of LCC
- 3.3 Simulation Based Costing
  - 3.3.1 Introduction to Simulation Based Acquisition
  - 3.3.2 Simulation Overview
  - 3.3.3 Process Generators
  - 3.3.4 Simulation Using Spreadsheets
  - 3.3.5 Using Crystal Ball

Unit-4: Systems Engineering Scoping and Cost Estimation

4.1 Design to Cost (DTC)
4.2 Trade Studies
4.3 Baseline and Standards Management
4.4 Requirements
4.5 Make sure that the stakeholders understand the differences and consciously choose from:
  4.5.1 Design to Value
  4.5.2 Design to Cost
  4.5.3 Design to Affordability
  4.5.4 Design to Schedule
  4.5.6 Design to Performance
4.6 WBS Development
4.7 Systems Estimating Techniques
4.8 Hardware and Software
4.9 COSYSMO/COSYMOR
4.10 Parametric Cost Estimating-Cost Estimating Relationships

Unit-5: Software

5.1 Sizing
5.2 Cost Estimation
5.3 COCOMO
5.4 Other tools: Price S/H, Galorath's SEER-SEM, etc.
5.5 Handling the various code types:Developed, reused, modified, purchased COTS, tailored COTS, open source, etc.

Unit-6: Management

6.1 Cost as An Independent Variable (CAIV)
  6.1.1 Definitions
  6.1.2 Tradeoffs
6.2 COTS and Open Source
  6.2.1 COTS, GOTS, MOTS
  6.2.2 Technology Refreshment
  6.2.3 Open System Standards
  6.2.4 Cost of Software Reuse
6.3 Cost of Quality
6.4 Project Management

Text Books/ Reference Books:

1. Systems Life Cycle Costing: Economic Analysis, Estimation, and Management, John V. Farr, Draft Textbook, Version 1.0.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O 1	PS O 2
OE-M-304.1	2	2	2	-	1	-	2	-	-
OE-M-304.2	1	3	2	1	-	1	1	-	-
OE-M-304.3	1	3	2	-	2	-	2	-	-
OE-M-304.4	3	2	1	-	2	-	2	-	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

OE-M-305: Composite Materials

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites: Nil

Course Outcomes: The students will be able to-

OE-M-305.1. Identify, describe and evaluate the properties of fibre reinforcements, polymer matrix materials and commercial composites.
OE-M-305.2. Develop competency in one or more common composite manufacturing techniques, and be able to select the appropriate technique for manufacture of fibre-reinforced composite products.
OE-M-305.3. Analyse the elastic properties and simulate the mechanical performance of composite laminates; and understand and predict the failure behaviour of fibre-reinforced composites
OE-M-305.4. Apply knowledge of composite mechanical performance and manufacturing methods to a composite design project
OE-M-305.5. Critique and synthesize literature and apply the knowledge gained from the course in the design and application of fibre-reinforced composites.

Unit-1: Introduction
1.1 Classification and characteristics of Composite materials.
1.2 Advantages and application of composites.
1.3 Functional requirements of reinforcement and matrix.
1.4 Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance

Unit-2: Reinforcements Preparation
2.1 Reinforcements Preparation-layup, curing.
2.2 Properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers.
2.3 Properties and applications of whiskers, particle reinforcements.

Unit-3: Mechanical Behavior of composites
3.1 Rule of mixtures
3.2 Inverse rule of mixtures
3.3 Isostrain and Isostress conditions

Unit-4: Manufacturing of Metal Matrix Composites Casting
4.1 Solid State diffusion technique.
4.2 Cladding – Hot iso static pressing.
4.3 Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering.
4.4 Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications

Unit-5: Manufacturing of Polymer Matrix Composites
5.1 Preparation of Molding compounds.
5.2 Prepregs – hand layup method, Autoclave method , Filament winding method.
5.3 Reaction injection molding and its properties and applications

Unit-6: Strength Laminar Failure Criteria
6.1 Strength ratio, maximum stress criteria, maximum strain criteria.
6.2 Interacting failure criteria, hydrothermal failure.
6.3 Laminate first play failure-insight strength.
6.4 Laminate strength-ply discount truncated maximum strain criterion.
6.5 strength design using caplet plots; stress concentrations

Text Books/ Reference Books:

1. Material Science and Technology Composites, R.W.Cahn, VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007
3. Hand Book of Composite Materials-ed-Lubin. 2. Composite Materials – K.K.Chawla. 3. Composite Materials Science and Applications – Deborah D.L. Chung. 4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O 1	PS O 2
OE-M-305.1	2	2	2	-	1	-	2	-	-
OE-M-305.2	1	2	3	1	1	1	3	-	-
OE-M-305.3	3	3	2	-	2	-	2	-	-
OE-M-305.4	2	2	1	-	-	-	2	-	-
OE-M-305.5	2	2	-	-	-	-	1	-	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

OE-M-306: Waste to Energy

Periods/week	Credits		Max. Marks	: 150
L: 3 T: 0	3		Continuous Evaluation	: 50
Duration of Examination: 3 Hrs			End Sem Examination	: 100

Pre-requisites: Nil

Course Outcomes: The students will be able to-
OE-M-306.1. To enable students to understand of the concept of Waste to Energy.
OE-M-306.2. To link legal, technical and management principles for production of energy from waste.
OE-M-306.3. To learn about the best available technologies for waste to energy.
OE-M-306.4. To analyze case studies for understanding success and failures.
OE-M-306.5. To facilitate the students in developing skills in the decision making process.

Unit-1: Introduction to Energy from Waste
1.1 Classification of waste as fuel
1.2 Agro based, Forest residue
1.3 Industrial waste – MSW
1.4 Conversion devices – Incinerators, gasifiers, digestors

Unit-2: Biomass Pyrolysis
2.1 Pyrolysis – Types, slow fast
2.2 Manufacture of charcoal – Methods, Yields and application
2.4 Manufacture of pyrolytic oils and gases- yields and applications.

Unit-3: Biomass Gasification
3.1 Gasifiers – Fixed bed system
3.2 Downdraft and updraft gasifiers
3.3 Fluidized bed gasifiers – Design,
3.4 construction and operation
3.5 Gasifier burner arrangement for thermal heating
3.6 Gasifier engine arrangement and electrical power
3.7 Equilibrium and kinetic consideration in gasifier operation.

Unit-4: Biomass Combustion
4.1 Biomass stoves – Improved chullahs,
4.2 Types, some exotic designs
4.3 Fixed bed combustors, Types
4.4 inclined grate combustors
4.5 Fluidized bed combustors, Design
4.6 construction and operation
4.7 Operation of all the above biomass combustors

Unit-5: Biogas: Properties of biogas
5.1 Biogas plant technology and status
5.2 Bio energy system
5.3 Design and constructional features

5.4 Biomass resources and their classification
5.5 Types of biogas Plants
5.6 Applications

Unit-6: Biogas Conversion
6.1 Biomass conversion processes
6.2 Thermo chemical conversion
6.3 Direct combustion
6.4 Biomass gasification
6.5 Pyrolysis and liquefaction
6.6 Biochemical conversion - anaerobic digestion
6.7 Alcohol production from biomass
6.8 Bio diesel production
6.9 Urban waste to energy conversion
6.10 Biomass energy programme in India

Text Books/ Reference Books:

1. Non Conventional Energy, Desai, Ashok V., Ist edition., 1995: pearson.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, 1983: Tata McGraw Hill Publishing Co. Ltd.
3. Food, Feed and Fuel from Biomass, Challal, D. S., 1991: IBH Publishing Co. Pvt. Ltd.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan,1 997, John Wiley & Sons

Instructions for paper setting: Eight questions will be set in all by the examiners taking at least one question from each unit. Students will be required to attempt five questions in all.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Evaluation Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Sem Examination.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2
OE-M-306.1	1	2	2	-	-	-	2	-	-
OE-M-306.2	1	2	-	-	1	-	2	-	-
OE-M-306.3	1	2	2	-	-	-	2	-	-
OE-M-306.4	2	2	1	-	-	-	1	-	-
OE-M-306.5	2	3	2	-	-	-	2	-	-

SEMESTER IV

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

CS-M-400: DISSERTATION PHASE – II

Periods/week	Credit	Max marks	: 600
P: 32	16	Continuous Evaluation	: 400
Duration of Examination: 3 Hrs		End Sem Examination	: 200

Pre-requisites: The students must have the knowledge Dissertation Phase-I

Course Outcomes: The students will be able to-
CS-M-400.1. Select the engineering tools/components for solving the identified engineering problem.
CS-M-400.2. Apply the identified concepts and engineering tools to arrive at design solution(s) for the identified engineering problem
CS-M-400.3. Analyze and interpret results of experiments conducted on the designed solution(s) to arrive at valid conclusions
CS-M-400.4 Demonstrate the knowledge, skills and attitudes of a professional engineer.

Course Articulation Matrix:

CO Statement	PO 1	PO 2	PO3	PO 4	PO 5	PO6	PO 7	PSO 1	PSO 2
CS-M-400.1	3	3	1	1	3	1	3	3	3
CS-M-400.2	3	3	1	1	3	1	3	3	3
CS-M-400.3	3	3	1	1	3	1	3	3	3
CS-M-400.4	3	3	1	1	3	1	3	3	3