RV College of Engineering®

Master of Technology (M.Tech)

SOFTWARE ENGINEERING

Scheme And Syllabus of I to IV Semester
(2024 Scheme)

B.E. Programs : AS, BT, CH, CS, CS - AI, CS - CD, CS - CY, CV, EC, EE, ET, IM, IS, ME.
M.Tech (13) MCA, M.Sc. (Engg.)
Ph.D. Programs : All Departments are recognized as Research Centres by VTU Except AI & AS

2024
Edition

99TH
NIRF RANKING IN ENGINEERING (2024)

1501+
Times Higher Education World University Rankings (2024)

601+
Asia University Ranking 2024

EduFuture Excellence Award
Best Private Engineering University (South)
by Zee Digital

1001+
Subject Ranking (Engineering)

801+
Subject Ranking (Computer Science)

IIRF 2024
Engineering Ranking India

NATIONAL RANK - 07
STATE RANK - 02
ZONE RANK - 04

AAA
Rating in NPTEL Local Chapter (Jan - Apr 2024)
State Ranking - 1
National Ranking -16

CURRICULUM STRUCTURE

07 CREDITS PROFESSIONAL CORE COURSE

04 CREDITS BASIC SCIENCE

16 CREDITS INTEGRATED PROFESSIONAL CORE COURSE

24 CREDITS PROJECT WORK

04 CREDITS AEC

19 CREDITS PROFESSIONAL ELECTIVES

06 CREDITS INTERNSHIP

80 CREDITS TOTAL

*ABILITY ENHANCEMENT COURSES (AEC), UNIVERSAL HUMAN VALUES (UHV), INDIAN KNOWLEDGE SYSTEM (IKS), YOGA

17
Centers of Excellence

11
Centers of Competence

1569
Publications On SCI

440
Publications On Web Of Science

2842
Citations
Last 3 Years

70
Patents Filed

40
Patents Granted
Last 3 Years

61
Published Patents

29
Skill Based Laboratories Across Four Semesters

MOUS: 90+WITH INDUSTRIES / ACADEMIC INSTITUTIONS IN INDIA & ABROAD

₹5 crores
Sponsored Projects

₹14 crores
Consultancy Projects

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2024
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Glossary of Abbreviations

1.	AS	Aerospace Engineering
2.	BS	Basic Sciences
3.	BT	Biotechnology
4.	CH	Chemical Engineering
5.	CHY	Chemistry
6.	CIE	Continuous Internal Evaluation
7.	CS	Computer Science & Engineering
8.	CV	Civil Engineering
9.	EC	Electronics & Communication Engineering
10.	EE	Electrical & Electronics Engineering
11.	EI	Electronics & Instrumentation Engineering
12.	ET	Electronics & Telecommunication Engineering
13.	GE	Global Elective
14.	HSS	Humanities and Social Sciences
15.	IM	Industrial Engineering & Management
16.	IS	Information Science & Engineering
17.	L	Laboratory
18.	MA	Mathematics
19.	MBT	M. Tech in Biotechnology
20.	MCE	M. Tech. in Computer Science & Engineering
21.	MCN	M. Tech. in Computer Network Engineering
22.	MCS	M. Tech. in Communication Systems
23.	MDC	M. Tech. in Digital Communication
24.	ME	Mechanical Engineering
25.	MHT	M. Tech. in Highway Technology
26.	MIT	M. Tech. in Information Technology
27.	MMD	M. Tech. in Machine Design
28.	MPD	M. Tech in Product Design & Manufacturing
29.	MPE	M. Tech. in Power Electronics
30.	MSE	M. Tech. in Software Engineering
31.	MST	M. Tech. in Structural Engineering
32.	MVE	M. Tech. in VLSI Design & Embedded Systems
33.	N	Internship
34.	P	Projects (Minor / Major)
35.	PHY	Physics
36.	SDA	Skill Development Activity
37.	SEE	Semester End Examination
38.	T	Theory
39.	TL	Theory Integrated with Laboratory
40.	VTU	Visvesvaraya Technological University

RV Educational Institutions®

POSTGRADUATES PROGRAMS

Sl. No	Core Department	Program	Code
1.	BT	M. Tech in Biotechnology	MBT
2.	CS	M. Tech in Computer Science & Engineering	MCE
3.	CS	M. Tech in Computer Network Engineering	MCN
4.	CV	M. Tech in Structural Engineering	MST
5.	CV	M. Tech in Highway Technology	MHT
6.	EC	M. Tech in VLSI Design & Embedded Systems	MVE
7.	EC	M. Tech in Communication Systems	MCS
8.	EE	M. Tech in Power Electronics	MPE
9.	ET	M. Tech in Digital Communication	MDC
10.	IS	M. Tech in Software Engineering	MSE
11.	IS	M. Tech in Information Technology	MIT
12.	ME	M. Tech in Product Design & Manufacturing	MPD
13.	ME	M. Tech in Machine Design	MMD
14.	MCA	Master of Computer Applications	MCA

RV Educational Institutions®

DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

VISION

To be the hub for innovation in Information Science & Engineering through Teaching, Research, Development and Consultancy; thus make the department a global resource center in advanced, sustainable and inclusive

MISSION

1. To enable students to become responsible professionals, strong in fundamentals of information science and engineering through experiential learning

2. To bring research and entrepreneurship into classrooms by continuous design of innovative solutions through research publications and dynamic development-oriented curriculum.

3. To facilitate continuous interaction with the outside world through student internship, faculty consultancy, workshops, faculty development programs, industry collaboration and association with the professional societies.

4. To create a new generation of entrepreneurial problem solvers for a sustainable future through green technology with an emphasis on ethical practices, inclusive societal concerns, and environment

5. To promote teamwork through interdisciplinary projects, co-curricular and social activities.

PROGRAMME OUTCOMES (PO)

M. Tech in **Software Engineering** graduates will be able to:

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: An ability to develop software in various domains in a systematic way by applying Analytical and Programming skills leading to practical solutions.

PO4: Design, develop and deliver complex, scalable, and cost-effective software systems by applying Software Engineering principles, tools and processes.

PO5: Demonstrate with responsibilities and capabilities of professional software engineer with importance to quality and management issues involved in software construction.

PO6: Demonstrated capability to take up higher studies, Entrepreneurships and self-driven career development in the chosen area of interest.

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I SEMESTER M.Tech												
Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE	SEE Duration (H)	Max Marks SEE
			L	T/SDA	P	Total						
1	MMA211TB	Linear Algebra and Probability Theory	3	1	0	**4**	MA	Theory	1.5	100	3	100
2	MSE412IA	Data Structures and Applications	3	0	1	**4**	IS	Theory+Lab	1.5	100+50	3+3	100+50
3	MIT413IA	IoT Application Development	3	0	1	**4**	IS	Theory+Lab	1.5	100+50	3+3	100+50
4	MXX314AX	Professional Core Courses (Cluster Electives) (Group-A)	3	1	0	**4**	CS/IS	Theory	1.5	100	3	100
5	MSE415DL	Design Thinking Lab (Full Stack MEAN Lab)	0	0	2	**2**	IS	Lab	1.5	50	3	50
6	HSS116EL	Technical English	0	0	1	**1**	HSS	HSS	1.5	50	2	50
Total Credits						**19**						

*Cluster-wise Courses Common to PG Programs

Clusters

CSE Cluster - PG Programs (CSE, CNE, SE, IT)
ECE Cluster - PG Programs (VLSI, CS, PE, DC)
ME Cluster - PG Programs (PDM, MD)
CV Cluster - PG Programs (ST, HT)
BT Cluster - PG Programs (BT)

Code	Professional Core Courses (Cluster Electives) (Group-A)
MCN314A1	Advanced Cloud Computing and Distributed Systems
MCE314A2	Blockchain Technologies and Applications
MSE314A3	Microservices Development and Applications
MIT314A4	Robotic Process Automation

II SEMESTER M.Tech												
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**	**CIE Duration (H)**	**Max Marks CIE**	**SEE Duration (H)**	**Max Marks SEE**
			L	**T/ SDA**	**P**	**Total**						
1	MSE421IA	Software Testing and Automation	3	0	1	**4**	IS	Theory+Lab	1.5	100+50	3+3	100+50
2	MSE422IA	Cloud Native Automation	3	0	1	**4**	IS	Theory +Lab	1.5	100+50	3+3	100+50
3	MXXX23BX	Program Specific Courses (Elective) (Group-B)	3	1	0	**4**	IS	Theory	1.5	100	3	100
4	MXX324CX	Professional Core Courses (Cluster Electives) (Group-C)	3	1	0	**4**	IS	Theory	1.5	100	3	100
5	MXX325DX	Interdisciplinary Courses (Global Electives) (Group-D)	3	0	0	**3**	Resp. BOS	Theory	1.5	100	3	100
6	MIM426RT	Research Methodology (NPTEL)	2	0	0	**2**	IM	NPTEL	--	--	ONLINE	50
7	MIT427SL	Skill Lab (API Development and Integration Lab)	0	0	2	**2**	IS	Lab	1.5	50	3	50
Total Credits						**23**						

*Cluster-wise Courses Common to PG Programs

Clusterss

CSE Cluster - PG Programs (CSE, CNE, SE, IT)
ECE Cluster - PG Programs (VLSI, CS, PE, DC)
ME Cluster - PG Programs (PDM, MD)
CV Cluster - PG Programs (ST, HT)
BT Cluster - PG Programs (BT)

Code	Program Specific Courses (Elective) (Group-B)
MSE223B1	Software Security
MSE223B2	Computer Interaction Design
MSE223B3	Event Driven Architecture Patterns
MIT323B4	Fintech Processes

Code	Professional Core Courses (Cluster Electives) (Group-C)
MCN324C1	Advanced Routing Protocols
MCE324C2	Advances in Computer Vision
MSE324C3	Mobile Commerce and Applications
MIT324C4	Extended Reality

Interdisciplinary Courses (Global Electives) (Group-D)	
MBT325DA	Nature impelled Engineering
MBT325DB	Clinical Data Management
MCN325DC	Cyber Forensics and Cyber Laws
MCV325DD	Industrial Safety and Health
MCV325DE	Advanced Technologies for Transportation Systems
MEC325DF	Design & Implementation of Human-Machine Interface
MEE325DG	Intelligent Control Techniques in Electrical Drives
MET325DH	Electronic Navigation Systems
MET325DJ	Vehicular Communication Ecosystem
MIM325DK	Essentials of Project Management
MIS325DM	User Interface & User Experience
MMA325DN	Mathematical Methods for Data Science
MME325DO	Industry 4.0: The smart Manufacturing
MME325DQ	Industrial Internet of Things (IIoT)

III SEMESTER M.Tech												
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**	**CIE Duration (H)**	**Max Marks CIE**	**SEE Duration (H)**	**Max Marks SEE**
			L	**T/ SDA**	**P**	**Total**						
1	MSE331TA	Agile Software Technologies	3	1	0	**4**	IS	Theory	1.5	100	3	100
2	MXX332EX	Professional Elective Courses (NPTEL) (Group-E)	2	0	0	**2**	CS	NPTEL	--	--	ONLINE	50
3	MSE433P	Minor Project	0	0	6	**6**	IS	PROJECT	1.5	50	3	50
4	MSE434N	Internship	0	0	6	**6**	IS	Internship	1.5	50	3	50
Total Credits						**18**						

Code	Professional Elective Courses (NPTEL) (Group-E)
MCE332E1	Data Mining
MCE332E2	Data Science for Engineers
MCE332E3	Introduction to Soft Computing
MCE332E4	Design and Engineering of Computer Systems

IV SEMESTER M.Tech													
Sl. No.	**Course Code**		**Credit Allocation**				**BoS**	**Category**	**CIE Duration (H)**	**Max Marks CIE**	**SEE Duration (H)**	**Max Marks SEE**
			L	**T/SDA**	**P**	**Total**						
1	MXX341FX	Program Specific Courses (NPTEL-Elective) (Group-F)	2	0	0	**2**	IS	NPTEL	--	--	ONLINE	50
2	MSE442P	Major Project	0	0	18	**18**	IS	PROJECT	--	100	3	100
Total Credits						**20**						

Code	Program Specific Courses (NPTEL-Elective) (Group-F)
MIT341F1	Information Security
MIT341F2	Edge Computing
MSE341F3	Introduction to Reliability Engineering
MSE341F4	Machine Learning

SEMESTER: I						
Course Code	:	MMA211TB	**LINEAR ALGEBRA AND PROBABILITY THEORY**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*Theory: Common to MDC, MCE, MCN, MPE, MSE, MIT*	SEE Marks	:	100
Hours	:	45L+30T+45EL	*(Professional Core Course)*	SEE Duration	:	3 Hours

UNIT – I	**9 Hours**
Vector spaces and Linear Transformations: Vector spaces and subspaces, Linear independence, Basis and dimension, Four fundamental subspaces, Linear transformations, Matrix representation, Rank-nullity theorem.	
UNIT – II	**9 Hours**
Orthogonality and Least square approximations: Orthogonal vectors, orthogonal projections, orthogonal bases, Orthogonal complement subspaces, Gram-Schmidt orthogonalization process, QR factorisation, Least square problems, and application to linear models.	
UNIT – III	**9 Hours**
Symmetric matrices and Quadratic forms: Real symmetric matrices, Eigenvalues and Eigenvectors, Diagonalization, Quadratic forms, constrained optimization, positive definiteness, Singular value decomposition, Principal component analysis.	
UNIT – IV	**9 Hours**
Random variables and Probability Distributions: Random variables-discrete and continuous, probability mass function, probability density function, cumulative distribution function, mean and variance. Discrete distributions - Binomial and Poisson, Continuous distributions – Uniform and Normal.	
UNIT – V	**9 Hours**
Sampling and Inferential statistics: Population and sample, sample mean and sample proportion, central limit theorem, Sampling distributions - Sampling distributions of means, Sampling distributions of proportions. Principles of Statistical Inference, Null and alternative hypothesis, Type I and Type II errors, level of significance, one – tailed and two – tailed tests, z-test, t-test.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Explore the fundamental concepts of linear algebra, random variables, probability distributions, sampling, inferential statistics. **(PO1)**
CO2	:	Apply theoretical concepts of linear algebra, discrete and continuous random variables, probability distributions, sampling, inferential statistics to evaluate the problems of engineering applications. **(PO1, PO4)**
CO3	:	Analyze the solution of the engineering problems solved using appropriate techniques of linear algebra, random variables, probability distributions, sampling theory, inferential statistics. **(PO1, PO4, PO5, PO6)**

CO4	:	Enhance the comprehensive understanding of linear algebra, random variables, probability distributions, sampling theory, inferential statistics gained to demonstrate the problems arising in many practical situations. **(PO1, PO4, PO5, PO6)**

Reference Books

1. Linear Algebra and its Applications, David C. Lay, 3rd Edition, 2002, Pearson Education India, ISBN:13: 978-81-7758-333-5.

2. Linear Algebra and its Applications, Gilbert Strang, Cengage Learning, 4th Edition, 2006, ISBN:97809802327.

3. Introduction to Probability and Statistics for Engineers and Scientists, Sheldon Ross, 5th Edition, 2014, Academic Press, ISBN: 13-978-0123948113.

4. Probability and Statistics for Computer Scientists, Michael Baron, CRC Press, 2nd Edition, 2014, ISBN- 13: 978-1-4822-1410-9.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)

CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**

Sl.No.	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: I						
Course Code	:	MSE412IA	**DATA STRUCTURES AND APPLICATIONS**	CIE Marks	:	150
Credits L-T-P	:	3-0-1		SEE Marks	:	150
Hours	:	45L+ 30P+45EL	(Theory & Practice)	SEE Durations	:	3+3 Hours

UNIT-I	**9 Hrs**
Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method. Amortized Analysis- Aggregate analysis, The accounting method, The potential method.	
UNIT-II	**9 Hrs**
Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for spars graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching. **Polynomials and the FFT:** Representation of polynomials; The DFT and FFT; Efficient implementation of FFT, A*Search	
UNIT-III	**9 Hrs**
Trees: 2-3- tree, 2-3-4 tree, Augmenting Data Structures. **Heaps:** Binary Heap, **Priority Queues:** Leftist Heap, Skew Heap, Binomial Heap, Fibonacci Heap.	
UNIT - IV	**9 Hrs**
Number -Theoretic Algorithms: Elementary notions; GCD; Chinese remainder theorem; Powers of an element; RSA cryptosystem; **String-Matching Algorithms:** Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms.	
UNIT - V	**9 Hrs**
OpenMP for Parallel Programming: Scope of Variables, The Reduction Clause, The parallel for Directive, Caveats, Data dependences, Finding loop-carried dependences, Loops in OpenMP, Scheduling Loops, The schedule clause, The static schedule type, The dynamic and guided schedule types, The runtime schedule type. The atomic directive, Critical sections and locks, Using locks in the message-passing program, critical directives, atomic directives, or locks. **Parallel Algorithms:** The basics of fork-join parallelism, Parallel matrix multiplication, Parallel merge sort, Parallel Dijkstra's shortest paths.	
LABORATORY	**30 Hrs**
Laboratory Programs The following programs will be executed on Java/C/C++/Python any equivalent tool/language by adapting exception handling technique wherever it is suitable **Part-A** 1. Design, develop, and write a program to implement insertion and search operation in a 2-3-4 tree. Determine its complexity. 2. Design develop, and write a program to implement Fibonacci Heap/ Binomial Heap 3. Design, develop, and write a program find the shortest path between source and destination using A* search 4. Design and implement RSA public key to decrypt ciphertext.	

5. Design, develop, and write a program to implement to solve string matching problem using nai approach and the Rabin Karp algorithm and compare their complexity. **Part-B** Design and Implement Realtime applications using the available data structures.

Course Outcomes:
After going through this course, the student will be able to:

CO1	:	Understand the fundamentals of different Data Structures and Algorithms
CO2	:	Apply data structures and algorithms with an emphasis on persistence.
CO3	:	Analyze the impact of Data Structures and algorithms for better performance
CO4	:	Design and implement efficient solutions to real world problems

Reference Books:

1. Introduction to algorithms, Cormen, Thomas H., Leiserson, Charles E., Rivest, Ronald L. and Clifford Stein –4th Edition, MIT Press, 2022, ISBN 9780262046305.

2. Data Structures and Algorithms Analysis in C++, Mark Allan Weiss, 4th Edition, 2014, Pearson, ISBN-13: 9780132847377 Java, 3rd Edition, 2012, ISBN:0-132-57627-9 / 9780132576277.

3. Data structures and algorithms, Aho, Hopcroft and Ullman, 1st Edition, Pearson Education India, 2002, ISBN: 8177588265, 9788177588262.

4. The Algorithm Design Manual, Steven S Skiena, Springer, 2008, ISBN: 9781848000704, 9781848000698.

5. Shameem Akhter and Jason Roberts, Multi-core Programming, Intel Press, 2006, ISBN 0-976432-4-6

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)

CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks]**

Sl.No.	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**

3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	CIE THEORY TOTAL	**100**
RUBRIC FOR CONTINUOUS INTERNAL EVALUATION (CIE-Lab)		
Q.NO.	**CONTENTS**	**MARKS**
1	Conduction of the Experiments & Lab Record	30
2	Open-ended Lab Experiment	10
3	Lab Test	10
	CIE LAB TOTAL	**50**
	MAXIMUM MARKS FOR THE CIE	**150**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	SEE THEORY TOTAL	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Lab)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	10
2	Conduction of the Experiments	30
3	Viva	10
	SEE LAB TOTAL	**50**
	MAXIMUM MARKS FOR THE SEE	**150**

SEMESTER: I						
Course Code	:	MIT413IA	**IOT APPLICATION DEVELOPMENT**	CIE Marks	:	100
Credits L-T-P	:	3:0:1		SEE Marks	:	100
Hours	:	45L+30P+45EL	*(Professional Core Course with Integrated Lab)*	SEE Durations	:	3+3 Hours

UNIT-I	**9 Hrs**
Fundamentals of IoT: Introduction, Physical design of IoT, Logical design of IoT, IoT Enabling technologies, IoT Levels and Deployment Templates, , IoT vs M2M. **IoT Systems - Logical Design using Python:** Installing Python, Python Data Types & Data Structures, Functions. Modules, Python Packages of Interest for IoT: JSON, XML, HTTPLib & URLLib, SMTPLib (Text book 1)	
UNIT-II	**10 Hrs**
Basics of Arduino: Introduction to Arduino, Arduino IDE, Basic Commands for Arduino, Play with LED and Arduino, Play with LCD with Arduino. **Basics of Raspberry Pi:** Introduction to Raspberry pi, Installation of NOOBS on SD Card, Installation of Raspbian on SD Card, Terminal Commands, Installation of Libraries on Raspberry Pi, Getting the static IP address of Raspberry Pi, Run a Program on Raspberry Pi, Installing the Remote Desktop Server. (Text book 2)	
UNIT-III	**9 Hrs**
Programming with Raspberry Pi: Controlling LED with Raspberry Pi , Installation of I2C driver on Raspberry Pi, SPI (serial peripheral interface) with Raspberry Pi, Programming a Raspberry Pi, Play with LED and Raspberry Pi, Reading the digital input, Reading an edge triggered input. (Text book 2)	
UNIT - IV	**8 Hrs**
Case Studies Illustrating IoT Design: Home Automation: Smart Lighting, Home Intrusion Detection, Smart Cities: Smart Parking, Smart Environment: Weather Monitoring System, Weather Reporting Bot, Air Pollution Monitoring, Forest Fire Detection, Smart Agriculture. (Text book 1)	
UNIT - V	**9 Hrs**
Connecting to the Cloud: Smart IoT Systems, DHT11 Data Logger with ThingSpeak Server, Ultrasonic Sensor Data Logger with ThingSpeak Server, Air Quality Monitoring System and Data Logger with ThingSpeak Server, Landslide Detection and Disaster Management System, Smart Motion Detector and Upload Image to gmail.com. (Text book 2)	
LABORATORY	**30 Hours**
PART A: Note: The following programs can be executed in Python language. Prerequisities: Installation of following open source softwares is compulsory: 1. Arduino IDE Latest version 2. Putty software for remote connectivity	

3. Angry IP scanner
4. VNC Viewer and Server softwares for remote connectivity
5. ThingsSpeak open-source cloud sign up for account creation.

Application projects to be developed with prototype model as:

1. Design and develop an AI with IoT system for intrusion monitoring in home/office environments using both arduino and Raspberry Pi boards with appropriate sensors deployed.
2. Design and develop an AI-IoT system for traffic monitoring and air pollution measurement with display unit.
3. Design and develop an IoT system for logistics and zero trust inventory management with day today analysis visualization.
4. Design and develop an intelligent agriculture IoT system for monitoring plant growth, soil moisture, pumping water on/off, light detection, disease detection and data visualization.

PART B: Free MooC IoT certifications to be submitted- Min 1 and Max 2.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand the fundamentals of direct integration of the physical world with computer-based systems
CO2	:	Design & Implement solutions for Internet of Things with Raspberry Pi and Arduino through basic knowledge of programming and interfacing of input/output devices.
CO3	:	Apply and analyse the analog & digital data with advanced interfacing techniques
CO4	:	Create visualizations for IoT data captured through real time systems to help decision making systems

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015, ISBN: 978-81-7371-954-7.
2. Internet Of Things With Raspberry Pi And Arduino, Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, and Mahendra Swain, CRC Press, Taylor & Francis Group, 2020, ISBN: 13: 978-0-367-24821-5
3. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017, ISBN: 13: 978-1-58714-456-1
4. Internet of Things-Architecture & Design Principles, Raj kamal, 2nd edition, Mc Graw Hill India, 2022, ISBN: 9390727383.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks]**

Sl.No.	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	CIE THEORY TOTAL	**100**

RUBRIC FOR CONTINUOUS INTERNAL EVALUATION (CIE-Lab)

Q.NO.	CONTENTS	MARKS
1	Conduction of the Experiments & Lab Record	30
2	Open-ended Lab Experiment	10
3	Lab Test	10
	CIE LAB TOTAL	**50**
	MAXIMUM MARKS FOR THE CIE	**150**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)

Q.NO.	CONTENTS	MARKS
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	SEE THEORY TOTAL	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Lab)

Q.NO.	CONTENTS	MARKS
1	Write Up	10
2	Conduction of the Experiments	30
3	Viva	10
	SEE LAB TOTAL	**50**
	MAXIMUM MARKS FOR THE SEE	**150**

SEMESTER: I						
Course Code	:	MCN314A1	**ADVANCED CLOUD COMPUTING AND DISTRIBUTED SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+30T	*Professional Core Course (Cluster Electives) (Group-A)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**
Distributed System Models & Cloud Computing: Technologies for network-based system, System models for distributed & cloud, Cloud Computing in a Nutshell, System Model for Distributed and Cloud Computing, Roots of Cloud Computing, Grid and Cloud, Layers and Types of Clouds, Desired Features of a Cloud	
UNIT - II	**9 Hours**
Service Oriented Architecture for Distributed Computing: Services & SOA, Message Oriented Middleware, Workflow in SOA. Cloud Programming & Software Environments: Features of Cloud & Grid, Parallel & Distributed programming paradigms, Programming support of Google Cloud, Amazon AWS & Azure	
UNIT - III	**9 Hours**
Virtual Machines and Virtualization: Levels of Virtualization, Virtualization structures/Tools and Mechanism, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resources Management, Virtualization Data-Centre Automation	
UNIT - IV	**9 Hours**
Virtualization of Cluster and Public Cloud Platforms: Virtual Machine Migration Services, VM Provisioning and Migration in Action. PUBLIC CLOUD PLATFORMS: GAE, AWS, AND AZURE: Cloud infrastructure, Architecture and Functional modules.	
UNIT - V	**9 Hours**
Designing Distributed Systems: **GOOGLE CASE STUDY**: Introducing the case study: Google Overall architecture and design philosophy Underlying communication paradigms, Data storage and coordination services Distributed computation services.	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Apply the distributed and cloud computing concepts to solve problems in computing domain.
CO2	:	Analyse various architectures, work flow models and algorithms used to implement cloud and distributed systems.
CO3	:	Design solutions using modern tools to solve applicable problems in cloud and distributed systems.
CO4	:	Demonstrate effective communication , report writing and usage of modern tools for implementing cloud and distributed systems applications

Reference Books
1. Kai Hwang. Geoffrey C. Fox, Jack J. Dongarra, "Distributed and Cloud Computing from parallel processing to the internet of things", Elsevier, 1st Edition, ISBN: 9780123858801-1, 2013
2. Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, "Cloud Computing: principles and Paradigms (Wiley Series on Parallel and Distributed Computing), Wiley Publishing (c) 201, 1st edition, ISBN:978- 470887998, 2013
3. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, DISTRIBUTED SYSTEMS Concepts and Design, Fifth Edition, Addison- Wesley, ISBN:978-0132143011, 2012
4. Cloud Computing Theory and Practice, Dan Marinescu,ISBN: 9780323852777 eBook ISBN: 9780323910477, 3rd Edition 2022

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: I						
Course Code	:	MCE314A2	**BLOCKCHAIN TECHNOLOGIES AND APPLICATIONS**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+30T	*Professional Core Course(Cluster Electives) (Group-A)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**
Introduction to Blockchain Technology: Basic ideas behind block chain, how it is changing the landscape of digitalization, introduction to cryptographic concepts, Hashing, public key cryptosystems, private vs public block chain and use cases, Hash Puzzles Blockchain Fundamentals: Basic architecture of Blockchain, different terminologies associated, Characteristics of Block chain, Types of networks, Introducing Smart contract concept in Blockchain. Components of Blockchain: Core components of Blockchain, Types of Block chains; Blockchain Protocol, Permission & Permission less Block chains	
UNIT - II	**9 Hours**
Smart Contracts: Introduction to Smart Contracts, Structure of Smart Contract, Smart Contract Interaction, Contracts, Patterns and Smart Contracts Examples **Ethereum Blockchain Components:** Introduction to Ethereum Development Tools, Ethereum Clients, Ethereum Languages, Ethereum Wallets, Ethereum Accounts, Ethereum Key pairs, Ethereum Platform	
UNIT - III	**9 Hours**
Bitcoins: Introduction to Bitcoins, Bitcoin : Digital Signature, Digital Keys, Private Keys, Public Keys, Bitcoins Addresses, Bitcoins Transactions, Bitcoins Network, Bitcoins Wallets, Bitcoins Payments, Bitcoins Clients and APIs, Bitcoins Limitation	
UNIT - IV	**9 Hours**
Hyperledgers: Hyperledger Fabric, Saw tooth, Indy, Hyperledger tools Caliper and Hyperledger library Ursa, Blockchain as-a-service deployment model of Hyperledger Cello	
UNIT - V	**9 Hours**
Emerging Trends in Blockchain: Cloud-based block chain, Multi chain, Geth , Stellar , Ripple, R3 Corda, Blockchain API, Blockchain Sandboxes	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Comprehend the foundational concepts of blockchain technology and its impact on digital transformation
CO2	:	Analyze the fundamental architecture of blockchain, its core components, and the concept of smart contracts
CO3	:	Apply knowledge of Ethereum and Bitcoin ecosystems to develop blockchain-based solutions
CO4	:	Evaluate emerging blockchain platforms and technologies for practical deployment in industries

Reference Books
1. Artemis Caro, "Blockchain: The Beginners Guide to Understanding the Technology Behind Bitcoin & Crypto currency".
2. Scott Marks, "Blockchain for Beginners: Guide to Understanding the Foundation and Basics of the Revolutionary Blockchain Technology", Create Space Independent Publishing Platform
3. Arvind Narayanan, Joseph Bonneau, EdwardFelten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in a test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: I						
Course Code	:	MSE314A3	**MICROSERVICES DEVELOPMENT AND APPLICATIONS**	CIE Marks	:	100
Credits L-T-P	:	3:1:0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+30T	*Professional Core Course (Cluster Electives) (Group-A)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**
Toward a Microservices Architecture: What Are Microservices?, Reducing Coordination Costs, Learning by Doing, Decisions, Decisions. Designing a Microservices Operating Model: Why Teams and People Matter, Introducing Team Topologies, Designing a Microservices Team Topology. **Designing Microservices:** The SEED(S) Process: Introducing the Seven Essential Evolutions of Design for Services, Identifying Actors, Identifying Jobs That Actors Have to Do, Discovering Interaction Patterns with Sequence Diagrams, Deriving Actions and Queries from JTBDs, Describing Each Query and Action as a Specification with an Open Standard, Getting Feedback on the API Specification, Implementing Microservices, Microservices Versus APIs.	
UNIT - II	**9 Hours**
Rightsizing Your Microservices: Finding Service Boundaries: Why Boundaries Matter, When They Matter, and How to Find Them, Domain-Driven Design and Microservice Boundaries, Introduction to Event Storming, Introducing the Universal Sizing Formula. Dealing with the Data: Independent Deployability and Data Sharing, Microservices Embed Their Data, Event Sourcing and CQRS, Event Sourcing and CQRS Beyond Microservices.	
UNIT - III	**9 Hours**
Building an Infrastructure Pipeline: DevOps Principles and Practices, Setting Up the IaC Environment, Configuring Amazon Web Services, Building an IaC Pipeline. Building a Microservices Infrastructure: Infrastructure Components, Implementing the Infrastructure.	
UNIT – IV	**9 Hours**
Developer Workspace: Coding Standards and the Developer's Setup, Setting Up a Containerized Environment Locally, Installing Docker, Advanced Local Docker Usage: Installing Cassandra, Installing Kubernetes. Developing Microservices: Designing Microservice Endpoints, Implementing the Data for a Microservice, Implementing Code for a Microservice, Introducing a Second Microservice to the Project, Hooking Services Up with an Umbrella Project.	
UNIT - V	**9 Hours**
Releasing Microservices: Setting Up the Staging Environment, Shipping the Flight Information Container, Deploying the Flights Service Container, Clean Up. Managing Change: Changes in a Microservices System, Considerations for Our Architecture. A Journey's End (and a New Beginning): On Complexity and Simplification Using Microservices, Measuring the Progress of a Microservices Transformation.	

Course Outcomes: After going through this course the student will be able to:		
CO1	:	Comprehend the key concepts of microservices architecture, including the SEED(S) process, microservice boundaries, and event sourcing techniques.
CO2	:	Apply design principles to create microservices, implement endpoints, and develop infrastructure pipelines using tools like Docker, Kubernetes, and AWS for deployment.
CO3	:	Analyze the impact of microservice team structures and topologies on architecture decisions, efficiency of microservices implementation.
CO4	:	Assess the scalability and maintainability of a microservices system, including the management of data and changes across services.

Reference Books

1. Irakli Nadareishvili, "Microservices: Up and Running A Step-by-Step Guide to Building a Microservices Architecture", Shroff Publication, 2020, ISBN: 9789385889608

2. Sam Newman, "Building Microservices: Designing Fine-Grained Systems", O'Reilly Media, 2nd Edition, 2021, ISBN: 978-1492034025

3. Harry Percival, Bob Gregory, "Architecture Patterns with Python", 1st Edition, Shroff Publication, 2020, ISBN: 9352139739

4. John Carnell, "Spring Microservices in Action", Manning, 1st Edition, 2017, ISBN: 978-1617293986

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)

CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**

Sl.No.	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: I						
Course Code	:	MIT314A4	**ROBOTIC PROCESS AUTOMATION**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+30T	*Professional Core Course (Cluster Electives) (Group-A)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**
What is Robotic Process Automation? Scope and Techniques of automation: what should be automated? What can be automated? Techniques of automation Robotic Process Automation: What can RPA do? Benefits of RPA Components of RPA, RPA platforms. About UiPath. The future of automation. Record and Play: UiPath stack, Downloading and Installing UiPath Studio, Learning UiPath Studio, Task Recorder, Emptying trash in Gmail, Emptying Recycle Bin.	
UNIT - II	**9 Hours**
Sequence, Flowchart, and Control Flow: Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, how to use a sequence, how to use a flowchart, step by step example using sequence and control flow. Data Manipulation: Variables and scope, Collections, Arguments-purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example. CSV/Excel to data table and vice versa examples.	
UNIT - III	**9 Hours**
Taking control of the controls : Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls-mouse and keyboard activities, working with UiExplorer, Handling events, Revisit recorder, Screen scraping, When to use OCR, Types of OCR available, How to use OCR, Avoiding typical failure points. Tame that Application with Plugins and Extensions Terminal plugin: SAP automation, Java Plugin, Citrix automation, Mail plugin, PDF plugin, web integration, Excel and Word plugins, Credential management.	
UNIT – IV	**9 Hours**
Handling User Events and Assistant Bots: What are assistant bots? Monitoring system event triggers, Monitoring image and element triggers, Launching an assistant bot on a keyboard event. Exception Handling, Debugging, and Logging Exception handling: Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting.	
UNIT – V	**9 Hours**
Managing and Maintaining the Code: Project Organization, Nesting workflows, Reusability of workflows, commenting techniques, State Machine, When to use Flowcharts, State Machines or sequences, Using config files and examples of a config file. Deploying and Maintaining the Bot: Publishing using publish utility, Overview of Orchestration Server, Using Orchestration Server to control bots, Using Orchestration Server to deploy bots.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply the concept of Robotic Process Automation to automate various applications.

CO2	:	Analyse the usage of appropriate Robotic Process Automation technique for a given application.
CO3	:	Design and implement techniques of Robotic Process Automation.
CO4	:	Evaluate the code for deployment and maintenance.

Reference Books

1. Alok Mani Tripathi, Learning Robotic Process Automation, 1st Edition, Packpub.com, 2018, ISBN: 978-1-78847-094-0
2. Ed Freitas, Robotic Process Automation Succinctly, Succinctly EBook Series, 2020, ISBN: 978-1- 64200-199-0
3. Nividous, Robotic Process Automation, www.nividous.com, 2018
4. Vaibhav Srivastava, Getting started with RPA using Automation Anywhere, BPB Publications, 2021, ISBN: 978-9389898286

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)

CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**

Sl.No.	COMPONENTS	MARKS
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2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)

Q.NO.	CONTENTS	MARKS
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: I						
Course Code	:	MSE415DL	**DESIGN THINKING LAB (FULL STACK MEAN LAB)**	CIE Marks	:	50
Credits L-T-P	:	0-0-2		SEE Marks	:	50
Hours	:	30P		SEE Durations	:	3 Hours

EMPATHIZE: Understanding user needs and contexts through research and observation

Overview of Full Stack Web Development, Introduction to the MEAN stack: MongoDB, Express.js, Angular, and Node.js.
Understanding the role of each component in full stack development, Setting up a MEAN development environment, Introduction to RESTful APIs.

DEFINE: Framing the problem and defining user needs

Angular Basics: Components, Templates, and Directives, TypeScript: Introduction and key features, Data Binding and Event Handling: Two-way data binding in Angular, Routing: Implementing routing in Angular applications, Forms and Validations: Template-driven and reactive forms, HTTP Client: Consuming RESTful APIs with Angular's HTTP client.

IDEATE: Generating potential solutions and brainstorming innovative approaches

Introduction to Node.js: Understanding the event-driven architecture, Express.js: Setting up a basic web server, Middleware in Express: Handling requests, responses, and errors, RESTful API Development: Building and structuring APIs with Express.js, Authentication and Authorization: JWT and session-based authentication, File Handling and Streams: Working with file uploads and streams.

PROTOTYPE: Building tangible representations of the solution

Introduction to MongoDB: NoSQL database concepts, collections, and documents, CRUD Operations: Performing create, read, update, and delete operations, Mongoose: Object Data Modeling (ODM) for MongoDB and Node.js, Aggregation Framework: Query optimization and data aggregation in MongoDB, Relationships: Managing relationships between data using references and embedded documents.

TEST: Evaluating the solution and gathering feedback

Integration: Connecting Angular with the back-end (Node.js and Express).

- Session Management: Managing sessions in a full stack application.
- Security Best Practices: Preventing SQL Injection, XSS, and CSRF attacks.
- Deployment: Deploying MEAN stack applications on platforms like Heroku and AWS.
- Testing and Debugging: Unit testing with Jasmine and Karma (for Angular) and Mocha (for Node.js).

Version Control: Using Git for managing source code.

Course Outcomes:
After going through this course the student will be able to:

CO1		Build dynamic, responsive web applications using Angular.

	:	
CO2	:	Develop server-side applications and RESTful APIs using Node.js and Express.js.
CO3	:	Work with MongoDB to manage data in a NoSQL environment.
CO4	:	Understand and implement the full development cycle of a MEAN stack application.

Reference Books:

Simon Holmes, Clive Harber, Getting MEAN with Mongo, Express, Angular, and Node, Manning Publications, 2nd Edition.

Brad Dayley, Brendan Dayley, Caleb Dayley, Node.Js, Mongodb and Angular Web Development: The Definitive Guide to Using the Mean Stack to Build Web Applications (Developer's Library) , 2nd edition, 2 February 2018, ISBN-100134655532.

Greg Lim, Beginning MEAN Stack (MongoDB, Express, Angular, Node.js), 1st edition, August 2021, ISBN-13-979-8460912742.

Shyam Seshadri, Angular: Up and Running: Learning Angular Step by Step, 1st edition,15 June 2018,O'Reilly Publisher,ISBN-101491999837.

RUBRIC FOR CONTINUOUS INTERNAL EVALUATION (CIE-Lab)

The evaluation of the work will be carried out by the committee appointed by the Head of the department. Student/team should submit a report on the Case Studies solved under the theme.

Evaluation will be carried out in THREE Phases.

Phase	Activity	MARKS
I	Phase I	10
II	Phase II	15
III	Phase III and Draft report	15
	Final report	10
MAXIMUM MARKS FOR THE CIE		**50**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Lab)

The evaluation will be done by Internal and External examiners through Exhibition Mode. The following weightage would be given for the exhibition:

Q.NO.	CONTENTS	MARKS
1	Presentation through posters	15
2	Demonstration of the Prototype	25
3	Vivavoce	10
MAXIMUM MARKS FOR THE SEE		**50**

SEMESTER: I						
Course Code	:	HSS116L	**Technical English (Common to all Programs)**	CIE Marks	:	50
Credits L-T-P	:	0-0-1	Online English Laboratory Course	SEE Marks	:	50
Hours	:	30P	Humanities and Social Sciences	SEE Duration	:	2 Hours

UNIT - I	**10 Hours**
The Basics. Business Documents, Questions, and the Technical Pursuit. Engineering Concepts and Complexity; The Future Tense for Technical Work. White Papers; Modifiers and Qualifiers.	
UNIT - II	**10 Hours**
Making Recommendations; Interpreting Data, Ethical Persuasion for Technical Projects; Cause and Effect; Calls for Proposals. Technical Complexity in Communication. Numbers, Plain English, Jargon, and Technical Terms, Active and Passive Structures.	
UNIT III - Ethical Persuasion for Technical Projects	**6 Hours**
Organization Needs; Seeing the Big Picture; Negotiating. Audience Needs and Assessment; Standards versus White Papers; Objectivity, Communicating within Expected Genres; Identifying Trustworthy Sources or Bias in. A Review of Major Course Takeaways	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Demonstrate clarity and precision in technical communication by structuring information effectively, balancing technical terms with plain English, and adapting to diverse audiences.
CO2	:	Analyze and produce professional documents, such as white papers, business proposals, and reports, while applying ethical persuasion, data interpretation, and evidence-based reasoning.
CO3	:	Evaluate and refine communication strategies by assessing audience needs, recognizing trustworthy sources, and navigating organizational and technical complexities.
CO4	:	Apply critical thinking and negotiation skills to align communication with organizational goals, anticipate future challenges, and support informed decision-making.

References

1. IEEE – EBSCO Technical English for Professionals – Online platform EE – EBSCO Technical English for Professionals – Online platform
2. Valerie Lambert, Elaine Murray, English for Work – Everyday Technical English, Pearson Education, 2003, ISBN- 0 582 53963 3
3. David Bonamy, Christpher Jacques, Technical English – First Course Book, Pearson Education, 2008

<table>
<tr><td colspan="3">4.S Sumant. Technical English I, The McGraw Hill, 2011, ISBN -978 81 8209 3089</td></tr>
<tr><td colspan="3">Assessment and Evaluation Pattern (Online Mode)</td></tr>
<tr><td></td><td>CIE (Online Mode)</td><td>SEE (Online Mode)</td></tr>
<tr><td>Weightage</td><td>50%</td><td>50%</td></tr>
<tr><td>Test – I</td><td rowspan="2">Each test will be conducted for 50 marks adding to 100 marks. Final test marks will be reduced to 40 marks</td><td rowspan="3">Final assessment will be conducted for 50 marks</td></tr>
<tr><td>Test – II</td></tr>
<tr><td>Experiential Learning</td><td rowspan="2">10 Marks</td></tr>
<tr><td>Communication Skills- Activity based test – Script writing, Essay Writing, Role plays. Any other activity that enhances the Communication skills. The students will be assigned with a topic by the faculty handling the batch. The students can either prepare a presentation/write essay/role play etc. for the duration (4-5 minutes per student).
Parameters for evaluation of the Presentation
a. Clarity in the presentation/ Speaking/Presentation skills.
b. Concept / Subject on which the drama is enacted/ scripted</td><td></td></tr>
<tr><td>Maximum Marks</td><td>50 Marks</td><td>50 Marks</td></tr>
<tr><td>Total marks for the course</td><td>50</td><td>50</td></tr>
</table>

SEMESTER: II						
Course Code	:	MSE421IA	**SOFTWARE TESTING AND AUTOMATION** *(Theory & Practice)*	CIE Marks	:	100+50
Credits L-T-P	:	3-0-1		SEE Marks	:	100+50
Hours	:	45L+45EL+30P	*(Professional Core Course with Integrated Lab)*	SEE Durations	:	3+3 Hrs

UNIT-I	9 Hrs

Testing and Designing Tests: Jumping into testing, The impossibility of complete testing, Testing software - an analysis, Data and predictability — the oracle problem.
Fundamental Issues in Tooling and Automation: Technical requirements, No silver bullets - you can't radically fix the test cycle, The minefield regression problem; Coverage model, The Battleships problem – testing, versus checking, The maintenance problem, The money problem Lessons from the fundamental issues.
Programmer-Facing Testing: Technical requirements, The programmer's view, Introducing FizzBuzz, Unit tests, TDD, Unit test and unit code design, Mutation testing, Web APIs from a test perspective, Testing functional and legacy code, A Roman Numerals Kata.

UNIT-II	9 Hrs

Customer-Facing Tests: Technical requirements, A word of warning, Human Or Tooling—is it either/or?, GUI test automation patterns, Designing your own system, Low-code and no-code test automation, Batch- and model-driven test automation, This chapter is completely wrong, Summary.
Specialized Testing: Technical requirements, Understanding load and performance testing, Exploring security testing, Delving into accessibility testing, Internationalization and localization, CI and the pipeline, Regulated testing.
Testing Related Skills: Technical requirements, Finding bugs, Writing bug reports, Planning testing —cases and plans, Metrics and measurement, Project projections, Influencing change.

UNIT-III	9 Hrs

Test Data Management: Technical requirements, The test data problem, The standard data seed, Leveraging production refreshes, Exploring development, test, and production environments, Scriptable users and structure, Exploring synthetic users, Understanding the regulatory issues in test data management.
Delivery Models and Testing: Technical requirements, Waterfall, Extreme Programming (XP), Scrum and SAFe, House-rules software development, Continuous delivery and deployment, DevOps, Platform Engineering, SRE.
The Puzzle Pieces of Good Testing: Technical requirements, Recipes — how to do hard things, Coverage - did we test the right things well enough?, Defects — what is the status of the software? Schedule and risk - too many test ideas, not enough time; Iterative testing, Strategy — what are our risks and priorities? Dashboard — how do we communicate what we know?

UNIT - IV	9 Hrs

Putting Your Test Strategy Together: What are we doing now?, A census of risk, Setting priorities, time management, and scope, Today's strategy versus tomorrow's goals.

Lean Software Testing: Lean software testing defined, The seven wastes, Flow, One-piece flow and CD.

Case Studies and Experience Reports: RCRCRC at scale, Pair and tri-programming, The evolution of the test strategy, Professional pushback — dealing with bullies.

Testing Activities or a Testing Role?: Technical requirements, The cultural conflict with a testing role, Building a risk mitigation team, Faith-based versus empirical test automation, Shift left and shift right (Actually) continuous testing.

UNIT - V	**9 Hrs**

Philosophy and Ethics in Software Testing: Philosophy and why it matters in testing, Ethics and ethical reasoning in testing, Practical ethical issues in testing, Scientific thinking and logical fallacies, How we wind up in hell and how to escape, Put the responsibility in the right place.

Words and Language About Work: Context-driven testing and the other schools, Precise language Words matter, Process versus skill.

Testing Strategy Applied: A mobile test strategy example, Al in software testing, A few thoughts to leave with.

Laboratory Component	**30 Hrs**

Students are expected to choose a relevant case study (Problem Statement) and carryout following steps with proper documentation.

- Test plan preparation
- Test suite creation
- Manual and Automation Testing using specific tools like Selenium.
- Usage of relevant Metrics to measure the attributes
- Metric dysfunction and Project projections

Hands-On Learning:

- Identify and document a test case from a sample application that testers believe should be automated first. Prepare test documentation in a well formatted way.
- Design a test case using the scientific method for a search bar functionality in an e-commerce application. Document the hypothesis, steps, and expected results.
- Create a priority list of test cases for automation and explain the criteria used for prioritization.
- Implement the designed test case in pseudo-code format, explaining how each step aligns with the hypothesis.
- Set up a new Selenium test automation project in relevant IDEs like IntelliJ and VS Code.
- Configure the necessary dependencies for the real-time case study using Selenium, WebDriver, test framework and relevant build tools.
- Plan and create test suit for a real-time application. Perform testing at all levels including unit testing, integration testing and system testing using automated software relevant to the application.
- Explore critical aspects of software fault localization, like multiple bugs, successful and failed test cases, coincidental correctness, faults introduced by missing code.

Course Outcomes: **After going through this course the student will be able to:**		
CO1	:	Comprehend the concepts of different software development methodologies, delivery models and effectiveness of testing roles, processes, and tools in testing environments.
CO2	:	Apply testing techniques, data management strategies and relevant testing tools to ensure comprehensive test coverage to support robust testing in various development contexts.
CO3	:	Analyze testing methodologies, tools, and strategies to align testing efforts with business objectives, customer needs, and software requirements.
CO4	:	Design and Create Ethical and Collaborative Testing Practices for Continuous Improvement to ensure efficient and high-quality delivery.

Reference Books:

1. Matthew Heusser, Michael Larsen, "Software Testing Strategies: A testing guide for the 2020s", Packt Publishing, 2023, ISBN: 9781837638024.

2. Paul C. Jorgensen, Byron DeVries, Software Testing, A Craftsman's Approach, Fifth Edition, Auerbach Publications, 2021, ISBN: 978-0367767624.

3. Aditya P. Mathur, "Foundations of Software Testing", Second edition, Pearson Education. 2013, ISBN: 978-8131794760.

4. K. Naik and P. Tripathy, "Software Testing and Quality Assurance: Theory and Practice", Wiley, 2011, ISBN: 978-0471789116.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks]**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	CIE THEORY TOTAL	**100**

RUBRIC FOR CONTINUOUS INTERNAL EVALUATION (CIE-Lab)		
Q.NO.	**CONTENTS**	**MARKS**
1	Conduction of the Experiments & Lab Record	30
2	Open-ended Lab Experiment	10
3	Lab Test	10
	CIE LAB TOTAL	**50**
	MAXIMUM MARKS FOR THE CIE	**150**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	SEE THEORY TOTAL	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Lab)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	10
2	Conduction of the Experiments	30
3	Viva	10
	SEE LAB TOTAL	**50**
	MAXIMUM MARKS FOR THE SEE	**150**

SEMESTER: II						
Course Code	:	MSE422IA	**CLOUD NATIVE AUTOMATION**	CIE Marks	:	100
Credits L-T-P	:	3:0:1		SEE Marks	:	100
Hours	:	45L+30P+45EL	*(Professional Core Course with Integrated Lab)*	SEE Duration	:	3+3 Hours

UNIT - I	**9 Hours**

Revolution in the cloud: The creation of the cloud, The dawn of DevOps, The Coming of Containers, Conducting the Container Orchestra, Kubernetes, Cloud Native,The Future of Operations. **First Steps with Kubernetes:** Running Your First Container, The Demo Application, Building a Container, Container Registries, Hello Kubernetes, Minikube. Getting Kubernetes : Cluster Architecture, The Costs of Self-Hosting Kubernetes, Managed Kubernetes Services, Kubernetes Installers, Clusterless Container Services.

UNIT - II	**9 Hours**

Working with Kubernetes Objects: Deployments, Pods, ReplicaSets, Maintaining Desired State, The Kubernetes Scheduler, Resource Manifests in YAML Format, Helm: A Kubernetes Package Manager.
Managing Resources: Understanding Resources, Managing the Container Life Cycle, Using Namespaces, Optimizing Cluster Costs.

UNIT - III	**9 Hours**

Operating Clusters: Cluster Sizing and Scaling, Conformance Checking, Chaos Testing. Kubernetes Power Tools: Mastering kubectl, Working with Resources, Working with Containers, Contexts and Namespaces, Kubernetes Shells and Tools Kubernetes IDEs.

UNIT - IV	**9 Hours**

Running Containers: Containers and Pods, Container Manifests, Container Security, Volumes, Restart Policies, Image Pull Secrets, Init Containers. Managing Pods: Labels, Node Affinities, Pod Affinities and Anti-Affinities, Taints and Tolerations, Pod Controllers, Ingress, Service Mesh.

UNIT - V	**9 Hours**

Configuration and Secrets: ConfigMaps, Kubernetes Secrets, Secrets Management Strategies, Encrypting Secrets with Sops, Sealed Secrets. Security, Backups, and Cluster Health: Access Control and Permissions, Cluster Security Scanning, Container Security Scanning, Backups, Monitoring Cluster Status.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understanding the concept of cloud native DevOps to applications.
CO2	:	Apply the usage of cloud, creating a docker image, kubernetes deployment for a given application.
CO3	:	Evaluate the design and implement cloud native applications and deployment.
CO4	:	Create real world applications using DevOps CI/CD deployment.

Reference Books

1. Justin Domingus and John Arundel, Cloud Native DevOps with Kubertnetes, 2nd Edition, O"Rielly, 2022, ISBN: 9789355421944
2. Mitesh Soni, Agile, DevOps and Cloud Computing with Microsoft Azure, BPB Publications, 2019, ISBN: 978-93-88511-902
3. Nicole Forsgren, Jez Humble and Gene Kim, The Science of Lean Software and DevOps, ACCELERATE, IT Revolution Press, 2018, ISBN: 978-1942788331
4. IBM,IBM Cloud DevOps Field Guide, IBM Corporation, 2021, https://ac-gm-static-files-server.lahgrqm5xee.ausyd.codeengine.appdomain.cloud/cloud/architecture/files/devops-field-guide.pdf

LABORATORY COMPONENT

PART A:

1. Introduction to Lab:
   Introduction to Source Control like (Git, Gitlab, Code Review, Pull request, etc)

   Docker Fundamentals (Image, Container, volumes, networking)
   Kubernetes (Introduction, Deployment platform)
   Continuous Integration(CI) and Continuous Deployment(CD).
   Hands on working with CI/CD Devops toolchains.
2. Design and develop an web application which has to be run in docker, kubernetes and then host in cloud.
3. Complete the Docker video workshop with following steps in the link as:
   https://docs.docker.com/get-started/workshop/10_what_next/

- Docker overview and installation- https://www.youtube.com/watch?v=gAGEar5HQoU
- Pull, run, and explore containers- https://www.youtube.com/watch?v=gAGEar5HQoU&t=1400s
- Build a container image- https://www.youtube.com/watch?v=gAGEar5HQoU&t=3185s
- Containerize an app- https://www.youtube.com/watch?v=gAGEar5HQoU&t=4683s
- Connect a DB and set up a bind mount- https://www.youtube.com/watch?v=gAGEar5HQoU&t=6305s
- Deploy a container to the cloud- https://www.youtube.com/watch?v=gAGEar5HQoU&t=8280s

4. For Application 2 dockerised, apply the Kubernetes deployment as follows:
- Kubernetes deployment YAML with multiple replicas
- Kubernetes deployment YAML with resource limits
- Kubernetes deployment YAML with health checks

5. Know about Devops in following link and apply concept for application 2 developed:
   https://www.youtube.com/watch?v=vwkBBjS0l3E

PART B: DevOps free two MooC certifications to be submitted.

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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	CIE THEORY TOTAL	**100**
RUBRIC FOR CONTINUOUS INTERNAL EVALUATION (CIE-Lab)		
Q.NO.	**CONTENTS**	**MARKS**
1	Conduction of the Experiments & Lab Record	30
2	Open-ended Lab Experiment	10
3	Lab Test	10
	CIE LAB TOTAL	**50**
	MAXIMUM MARKS FOR THE CIE	**150**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	SEE THEORY TOTAL	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Lab)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	10
2	Conduction of the Experiments	30
3	Viva	10
	SEE LAB TOTAL	**50**
	MAXIMUM MARKS FOR THE SEE	**150**

SEMESTER: II						
Course Code	:	MSE223B1	**SOFTWARE SECURITY**	CIE Marks	:	100
Credits L-T-P	:	3-1-0		SEE Marks	:	100
Hours	:	45L+45EL+ 30T	*Program Specific Course (Elective) (Group-B)*	SEE Durations	:	3 Hrs

UNIT-I	**9 Hrs**
Software Security: Vulnerabilities, Attacks, and Countermeasures, Set-UID and vulnerabilities. **Environment Variables and Attacks:** Environment Variables, Attack Surface, Attacks via Dynamic Linker, Case Study. Attack via External Program, Case Study.	
UNIT-II	**9 Hrs**
Buffer Over flow Attack: Stack and Function Invocation, Stack Buffer-Overflow Attack, Countermeasures. **Format String Vulnerability:** Exploiting the Format String Vulnerability, Code Injection Attack, Countermeasures. Race Condition Vulnerability: Exploiting Race Condition Vulnerabilities, Countermeasures.	
UNIT-III	**9 Hrs**
Race Condition Vulnerability: Exploiting Race Condition Vulnerabilities, Counter measures. **Dirty COW:** The Dirty COW Vulnerability. **Web Security:** The Web Architecture, Web Browser, Web Server, Browser-Server Communication.	
UNIT - IV	**9 Hrs**
Cross Site Request Forgery: CSRF Attacks, Countermeasures. Cross-Site Scripting Attack, **SQL Injection Attack:** SQL Injection Attacks, The Fundamental Cause, Counter measures.	
UNIT - V	**9 Hrs**
Hardware Security: Introduction and Analogy, Side Channel Attacks via CPU Cache, **The Room Holding Secret:** The Kernel, The Meltdown Attack, Countermeasures.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Explain how various security mechanisms work, and correlate these security mechanisms with security principles
CO2	:	Apply security principles to solve problems
CO3	:	Design and implement basic security mechanisms to protect computer systems
CO4	:	Analyze and evaluate software systems for its security properties

Reference Books:

1. Computer Security,AHands-on Approach By Wenliang Du, 3rd Edition ISBN: 978-17330039-5-7
2. Introduction to Network Security By Douglas Jacobson, Publisher: CRC Press , Published: November 2008, ISBN: 9781420010695
3. Software security : building security in By Gary McGraw, Publisher: Addison- Wesley, Published: 2006, ISBN: 9780321356703
4. Cryptography and Network Security Principles and Practices, Fourth Edition By William Stallings, Publisher: Prentice Hall Pub Date: November 16, 2005 Print ISBN-10: 0-13-187316-4 Print ISBN-13: 978-0-13-187316-2 eText ISBN-10: 0-13-187319-9 eText ISBN-13: 978-0-13-187319-3

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
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Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MSE223B2	**COMPUTER INTERACTION DESIGN**	CIE Marks	:	100
Credits L-T-P	:	3-1-0		SEE Marks	:	100
Hours	:	45L+45EL+ 30T	*Program Specific Course (Elective) (Group-B)*	SEE Durations	:	3 Hrs

UNIT-I	**9 Hrs**
Usability of Interactive Systems: Introduction, Usability goals and Measures, Usability Motivations, Universal Usability, Goals for Our Profession. Guidelines, Principles, and Theories: Introduction, Guidelines, Principles, and Theories.	
UNIT-II	**9 Hrs**
Managing Design Processes: Introduction, Organizational Design to Support Usability, The Four Pillars of Design, Development Methodologies, Ethnographic Observation, Participatory Design, Scenario Development, Social Impact Statement for Early Design Review, Legal Issues. **Evaluating Interface Designs:** Introduction, Expert Reviews, and Usability Testing and Laboratories, Survey Instruments, Acceptance Tests, Evaluation During Active Use Controlled Psychologically Oriented Experiments.	
UNIT-III	**9 Hrs**
Direct Manipulation and Virtual Environment: Introduction Examples of Direct Manipulation, Discussion of Direct Manipulation, 3D Interfaces Teleoperation, Virtual and Augmented Reality. **Menu Selection, Form Fill-in, and Dialog Boxes:** Introduction, Task-Related Menu Organization, Single Menus, Combinations of Multiple Menus, Content Organization Fast Movement through Menus, Data Entry with Menus: Form Fill-in, Dialog Boxes and Alternatives, Audio Menus and Menus for Small Displays	
UNIT - IV	**9 Hrs**
Design Models and Theories: Cognitive models, goal and task hierarchies, Linguistic models, physical and device models, cognitive architectures, socio-organizational issues and stake holder requirements, organizational issues, capturing requirements.	
UNIT - V	**9 Hrs**
Task Analysis: Difference between task analysis and other techniques, Task decomposition, Knowledge based analysis, Entity-relationship based techniques. Sources of information and data collection. Uses of task analysis. **Ubiquitous computing and augmented Realities:**Ubiquitous computing applications research, virtual and augmented reality, information and data visualization. Case studies.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Enumerate the basic concepts of human, computer interactions
CO2	:	Apply and analyze HCI design principles and guidelines in the software process.
CO3	:	Analyze and identify user models, user support, socio-organizational issues and stake holder requirements of HCI systems.
CO4	:	Design prototypes and come up with methods and criteria for evaluation of the design

Reference Books:
1. Ben Shneiderman and Catherine Plaisant, "Designing the User Interface: Techniques for Effective Human-Computer Interaction", Pearson Publications, 6th Edition, 2016, ISBN: 9780123822291.
2. Human-Computer Interaction by Alan Dix, Janet Finlay, G D Abowd, R Beale., 3rd Edition, Pearson Publishers, 2008, ISBN:978-0-13-046109-4.
3. Designing with the Mind in Mind: Simple Guide to Understanding User by Jeff Johnson, Morgan Kaufmann publisher, 2010, ISBN:978-0-12-375030-3.
4. Prece, Rogers, Sharps, "Interaction Design", Wiley, 3rd Edition, 2011, ISBN: 978-1-119-02075-2

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
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1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MSE223B3	**EVENT DRIVEN ARCHITECTURE PATTERNS**	CIE Marks	:	100
Credits L-T-P	:	3-1-0		SEE Marks	:	100
Hours	:	45L+45EL+ 30T	*Program Specific Course (Elective) (Group-B)*	SEE Durations	:	3 Hrs

UNIT-I	**9 Hrs**
Envisioning Architecture: The Architecture Business Cycle, What is Software Architecture, Architectural patterns, reference models, reference architectures, architectural structures and views. Creating an Architecture, Quality Attributes, Achieving qualities, Architectural styles and patterns, designing the Architecture, Documenting software architectures, Reconstructing Software Architecture.	
UNIT-II	**9 Hrs**
Enterprise Applications : Enterprise Applications, Kinds of Enterprise Application, Performance, Patterns, The Structure of the Patterns, Limitations of Patterns, Layering, The Evolution of Layers in Enterprise Applications, The Three Principal Layers, Choosing Layers. Organizing Domain Logic, Making a Choice, Service Layer.	
UNIT-III	**9 Hrs**
Mapping to Relational Databases: Architectural Patterns, The Behavioral Problem, Reading in Data, Structural Mapping Patterns, Mapping, Inheritance, Building the Mapping, Double Mapping, Using Metadata, Database connections, Web Presentation: View Patterns, Input control patterns.	
UNIT - IV	**9 Hrs**
Concurrency and Session State: Concurrency, Concurrency Problems, Execution Contexts, Isolation and Immutability, Optimistic and Pessimistic Concurrency Control. Preventing Inconsistent Reads, Deadlocks, Transactions ACID, Transactional Resources, Reducing Transaction Isolation for Liveness, Business and System transactions, Patterns of the concurrency control, Application server concurrency **Session state:** Value of statelessness, Session state, Ways to store session state.	
UNIT - V	**9 Hrs**
Distributed Objects: The Allure of Distributed Objects, Remote and Local Interfaces, Where You Have to Distribute, Working with the Distribution Boundary, Interfaces for Distribution, Layers all together: Domain Layer, Data Source Layer, Data Source for Transaction Script, Data Source Table Module, Data Source for Domain Model, The Presentation Layer, Other Layering schemes.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Comprehend the concepts of software architecture pattern to solve real world problems.
CO2	:	Apply the knowledge to create an architecture for given application
CO3	:	Analyze software architecture patterns in distributed applications
CO4	:	Design the application by mapping software architecture pattern to all the layers

Reference Books:
1. Martin Fowler, With Contributions from David Rice, Matthew Foemmel, Edward Hieatt, Robert Mee and Randy Stafford, Patterns of Enterprise Application Architecture, 1st Edition, Addison-Wesley Publication, Reprint Version – 2023, ISBN 0-321-12742-0
2. Satheesha B. Nanjappa, Senthil K. Nallasamy, Veerakumar Esakimuthu Anubhav Pradhan, Raising Enterprise Applications: A Software Engineering Perspective, 1st Edition, 2021 Reprint, Wiley-India Publication, ISBN: 9788126519460
3. Eric A. Marks, Michael Bell, Service-Oriented Architecture: A Planning and Implementation Guide for Business and Technology, 1st Edition, Wiley Publication, 2008, ISBN: 978-0-471-76894-4
4. Pallab Saha, A systematic perspective to managing complexity with enterprise architecture, 1st Edition, 2013, ISBN:9781466645189

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1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MIT323B4	**FINTECH PROCESSES**	CIE Marks	:	100
Credits L-T-P	:	3-1-0		SEE Marks	:	100
Hours	:	45L+45EL+ 30T	*Program Specific Courses (Elective) (Group-B)*	SEE Durations	:	3 Hrs

UNIT-I	**9 Hrs**

Introduction; Banking and the E-Book Moment; Why We're so Excited About FinTech; Current Trends in Financial Technology

FinTech Themes; Banks Need to Think Collaboration Rather Than Competition; Global Compliance is Key; Lending (Capital) in the 21st Century; The Next Big Innovation in FinTech - Identity, Tech Giants Becoming Non-Bank Banks; Design is No Longer an Option-User Experience (UX) in FinTech;

UNIT-II	**9 Hrs**

FinTech Solutions: Rewiring the Deal - The Path Forward for B2B Supply Chains; Payments and Point of Sales (POS) Innovation; Predictive Algorithms – Building Innovative Online Banking Solutions; Big Data is the Cornerstone of Regulatory Compliance Systems; FinTech Solutions in Complex Contracts Optimization; Behavioural Biometrics – A New Era of Security; Ultra-Fast Text Analytics in Trading Strategies; Regulated Crowdfunding Ecosystems; Remittances – International FX Payments at Low Cost; FinTech Solutions for Small Businesses; Payment Solutions Including Apple Pay; FinTech Solutions Benefiting other Sectors; FinTech Innovation for Wearables

UNIT-III	**9 Hrs**

Technologies That Can Create the New ABC of Fintech; A for Artificial intelligence, Algorithms, Anomaly and Autonomous, B for Big Data, Blockchain and Bitcoin, C for Cloud, Crypto (Ethereum, Smart contracts) and Cybersecurity

Crypto-currencies and Blockchains, FinTech + Digital Currency – Convergence or Collision?, Blockchain and Crypto-currencies

UNIT - IV	**9 Hrs**

The Future of FinTech: How Emerging Technologies Will Change Financial Services, The Future of Financial Services, Banking on Innovation Through Data, Why FinTech Banks Will Rule the World, The FinTech Supermarket – The Bank is Dead, Long Live the Bank!, Banks Partnering with FinTech Start-ups to Create an Integrated Customer Experience, The Rise of BankTech – The Beauty of a Hybrid Model for Banks, FinTech Impact on Retail Banking – From a Universal Banking Model to Banking Verticalization, Embracing the Connected API Economy, Banking Like Water, Eliminating Friction in Customers' Financial Lives, FinTech is the Future Itself, A Future Without Money, Ethics in FinTech

UNIT - V	**9 Hrs**

Cybersecurity Vulnerabilities in FinTech: General Cybersecurity Vulnerabilities in Fintech, Specific Cybersecurity Vulnerabilities in Fintech, Assessing the Fintech Cybersecurity Vulnerabilities, General Policies to mitigate Fintech Cybersecurity Vulnerabilities

Emerging Markets and Social Impact; FinTech – The Not So Little Engine That Can; Why Am I Not Gonna Be Able to Enter a Bank?; The Rise of the Rest in FinTech; Smartphones, FinTech, and Education – Helping the Unbanked Reach Financial Inclusion, The Social Impact of FinTech in Nigeria, India and the Pyramid of Opportunity.

Course Outcomes: **After going through this course the student will be able to:**		
CO1	:	Explain the interplay of finance and technology and how the two universes inevitably are colliding into one another
CO2	:	How big data technology can make risk and compliance information systems easier to implement
CO3	:	Understand the role of emerging technologies in securing and leveraging banking services
CO4	:	Analyse the impact of applying trending technologies to financial institutions through real time case studies

Reference Books:

1. Susanne Chishti and Janos Barberis, The FinTech Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley, 2016, ISBN: 978-1-119-21887-6

2. Gurdip Kaur, Ziba Habibi Lashkari, Arash Habibi Lashkari, Understanding Cybersecurity Management in FinTech, Springer, 2021, ISBN 978-3-030-79914-4

3. Sanjay Phadke, FinTech Future, SAGE, 2020, ISBN: 9789353882488

4.Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services, First Edition, De Gruyter, 2018, ISBN: 978-1547417087

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)

CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**

Sl.No.	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MCN324C1	**ADVANCED ROUTING PROTOCOLS (THEORY)**	CIE Marks	:	100
Credits L-T-P	:	3-1-0		SEE Marks	:	100
Hours	:	45L+45EL+30T	*Professional Core Courses (Cluster Electives) (Group-C)*	SEE Durations	:	3 Hours

UNIT-I	**9 Hrs**
Internet Protocol Traffic Engineering: Routing Protocols, Routing Classification and Routing Table, Traffic, Stochasticity, Delay and Utilization, Traffic and Performance Measures, Characterizing Traffic, Average Delay in a single link system, Nonstationary of traffic, Applications View, An Architectural Framework, Traffic Engineering, a Four-Node Illustration, IGP Metric, Determining IGP Link Weights via Duality of MCNF Problems, Illustration of Link Weight Determination Through Duality, Link Weight Determination, Link weight determination Large Networks.	
UNIT-II	**9 Hrs**
Hierarchical and Dynamic Call Routing in the Telephone Network: Hierarchical Call Routing, Overall Hierarchical Routing Architecture, The Road to Dynamic Routing, Limitations of Hierarchical Routing, Call Control and Crankback, Trunk Reservation, Mixing of OCC and PCC, Dynamic Non-hierarchical Routing, Dynamically Controlled Routing, Dynamic Alternate Routing, Real-Time Network Routing, Classification of Dynamic Call Routing Maximum Allowable Residual Capacity Routing, Dynamic Routing and Its Relation to Other Routing.	
UNIT-III	**9 Hrs**
Traffic Engineering in the Voice Telephone Network: Traffic Engineering, Traffic Load and Blocking, Computing Erlang-B Loss Formula, Grade-of-Service and Trunk Occupancy, Centi-Call Seconds and Determining Based Load, Economic CCS Method Network Controls for Traffic Engineering, Guidelines on Detection of Congestion Examples of Controls, Communication of Congestion Control Information, Congestion Manifestation, State-Dependent Call Routing, Three-Node Network, N-Node Symmetric Network, N-Node Symmetric Network with Trunk Reservation, Illustration Without and with Trunk Reservation, Qualiy of Service(QoS), QoS Routing Classification, QoS Attributes.	
UNIT - IV	**9 Hrs**
IP Packet Filtering and Classification: Importance of Packet Classification, Packet Classification Problem, Expressing Rules, Performance Metrics, Packet Classification Algorithms, Naïve Solutions, Two-Dimensional Solutions and its types, Approaches for d Dimensions, Extending Two-Dimensional Solutions Divide and Conquer Approaches-Lucent Bit Vector, Aggregated Bit Vector, Tuple Space Approaches, Decision Tree Approaches-Hierarchical Intelligent Cuttings, Hardware-Based Solutions Ternary Content Addressable Memory (TCAM).	
UNIT - V	**9 Hrs**
VoIP Routing: Interoperability Through IP and PSTN: Traffic Engineering of IP/MPLS Networks, VPN Traffic Engineering, PSTN Call Routing Using the Internet, PSTN Call Routing: Managed IP Approach, IP-PSTN Interworking for VoIP, IP Multimedia Subsystem, Multiple Heterogeneous Providers Environment, All-IP Environment of VoIP Services	

Course Outcomes: **After going through this course the student will be able to:**		
CO1	:	Explore different types of traffic engineering adopted in an Internet based services and Telephone networks
CO2	:	Apply call routing and voice routing approaches used to optimize the routing in different types of networks.
CO3	:	Analyze the performance issues related to routing in an IP traffic engineering networks
CO4	:	Examine the various algorithms of routing in VoIP call services, Traffic Engineering and Telephone networks.

Reference Books:

1. Deepak Medhi, Karthik Ramasamy, and Network Routing: Algorithms, Principles and Architectures, Second Edition, Morgan Kaufmann publications, 2018, ISBN: 978-0-12-800737-2.

2. Ravi Malhotra, IP Routing, First Edition, Oreilly Publication, 2002, ISBN: 81-7366-337-8

3. Kevin Dooley, Designing Large-Scale LANs, First Edition, Oreilly Publication, 2002, ISBN: 81-7366-337-2.

4. Technical and Research Papers on VPN, Call Routing,Traffic Engineering, VoIP, PSTN and Hierarchical Routing

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MCE324C2	**ADVANCES IN COMPUTER VISION**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+30T	*Professional Core Courses (Cluster Electives) (Group-C)*	SEE Duration	:	3 Hours

UNIT - I	**10 Hours**

Introduction to Digital Image Fundamentals: Digital Image Processing concepts: The origin of Digital Image processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sampling and Quantization, Some Basic Relationships between Pixels.

Histogram Processing: Histogram Equalization, Histogram Matching (Specification Local Histogram Processing. Fundamentals Of Spatial Filtering the Mechanics of Linear Spatial Filtering, Spatial Correlation and Convolution, Separable Filter Kernels.

UNIT - II	**9 Hours**

Image Segmentation: Fundamentals, Thresholding: The Basics of Intensity Thresholding, The Role of Noise in Image Thresholding, The Role of Illumination and Reflectance in Image Thresholding. Basic Global Thresholding Optimum Global Thresholding Using Otsu's Method Segmentation by Region Growing and By Region Splitting and Merging Region Growing Region Splitting and Merging.

UNIT - III	**9 Hours**

Region Segmentation Using Clustering and Super pixels: **R**egion Segmentation Using K-Means Clustering, Region Segmentation Using Super pixels, Slic Superpixel Algorithm.

Object Recognition: Image Pattern Classification: Priori by A Human Designer, Patterns and Pattern Classes, Pattern Vectors, Structural Patterns, Pattern Classification by Prototype Matching.

UNIT - IV	**9 Hours**

Object Recognition: Minimum-Distance Classifier Using Correlation for 2-D Prototype Matching Sift Feature Matching Structural Prototypes.

Tracking: Tracking as an Abstract Inference Problem, Independence Assumptions, Tracking as Inference. Data Association: Choosing the Nearest- Global Nearest Neighbours, Gating and Probabilistic Data Association, Applications and Examples, Vehicle Tracking, Finding and Tracking People.

UNIT - V	**8 Hours**

Applications: Finding Faces Using Frame Invariance, Multilocal Visual Events, finding: Annotation and segmentation, Template matching, Shape and correspondence, Video Image-Based Rendering: Constructing 3D Models from Image Sequences, Scene Modelling from Registered Images, Scene Modelling from Unregistered Images Transfer-Based Approaches to Image-Based Rendering Affine View Synthesis.

Course Outcomes: After going through this course the student will be able to:		
CO1	:	Analyze the difficulties of the pattern recognition problems which include classification techniques, Feature detection and Histogram equalization process in feature extraction methods, which help identify meaningful patterns and structures in images.
CO2	:	Apply appropriate image processing methods for image filtering, image restoration, image reconstruction, segmentation, classification and representation
CO3	:	Designing and implement a Computer Vision system as part of an experiential learning initiative in teams to solve societal and environmental problems using pattern recognition in images and videos
CO4	:	Evaluation of the performances of different CV algorithms and its limitation, study of ethical issues related to CV applications including privacy concerns and bias in algorithms

Reference Books

1. David Forsyth and Jean Ponce, "Computer Vision: A Modern Approach", Prime student, 2nd edition, ISBN-13: 978-0136085928

2. Rafael C. Gonzalez, Richard E. Woods;" Digital Image Processing"; Pearson Education; 3rd Edition; 2012; ISBN 978-93-325-7032-0.

3. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision". 3rd edition, CL Engineering, ISBN-13: 978-0495082521

4. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag : http://szeliski.org/Book/.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**

	MAXIMUM MARKS FOR THE CIE	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER II						
Course Code	:	MSE324C3	**MOBILE COMMERCE AND APPLICATIONS**	CIE Marks	:	100
Credits L-T-P	:	3-1-0		SEE Marks	:	100
Hours	:	45L+45EL+ 30T	*Professional Core Courses (Cluster Electives) (Group-C)*	SEE Durations	:	3 Hours

UNIT-I	**9 Hrs**
Introduction to Mobile commerce: Mobile commerce, Mobile commerce framework, Mobile commerce business models, M commerce applications, E commerce vs M commerce. Mobile commerce services: Types of M commerce services, Mobile portal, Applications of mobile commerce in industry, Mobile application development.	
UNIT-II	**9 Hrs**
Wireless and Mobile Communication: communication systems, wireless communication, satellite communication, mobile communication systems. Digital cellular Technology: Cellular communications, cellular networks, mobile phone cellular networks. Mobile access technology: Mobile communication standards, Evolution of mobile communication systems, 2G and 3G systems.	
UNIT-III	**9 Hrs**
4G and 5G systems: 4G features, 4G technologies, IPv6 support, LTE advanced, 4G objectives and Goals, 4G deployment plans, 5G systems, 5G features, 5G technologies, Cloud based systems, (IoT) Internet of Things systems, Artificial intelligence and Mobile Edge computing, Mobile Devices: Types of Mobile Devices, mobile computers, Mobile Internet Device (MID), Personal Digital Assistant (PDA), Handheld game console, portable media player, pager, Personal Navigation Device, Tablet, Mobile service providers: Mobile network operators, Mobile Virtual network operators, satellite based mobile operators. **Case Study:** Mobile Shopping, Mobile Business Intelligence.	
UNIT - IV	**9 Hrs**
Mobile Banking: Bank in your mobile , Mobile banking business models, mobile banking technologies, mobile banking services, advantages and challenges of mobile banking , mobile banking applications, SMS banking, Tickets on mobile : Mobile ticketing, applications of mobile tickets, advantages of mobile tickets, privacy and security issues, mobile ticketing Apps, mobile ticket providers, Mobile Payment: characteristics of mobile payment systems, mobile payment models, types of mobile payments, security issues.	
UNIT - V	**9 Hrs**
Mobile computing : Ubiquitous computing, applications of mobile computing , challenges of mobile computing , mobile computing software platforms, Business applications of mobile computing, Mobile computing software platforms, Mobile business intelligence, Security and privacy issues: mobile security concepts, mobile security mechanism, Mobile network security, mobile information security, mobile device security, mobile device security arrangements, mobile application security, mobile security management, Legal aspects: mobile device related laws, cell phone freedom act 2010, information technology act 2000 of India, Privacy and Electronic Communication Regulations act 2003. **Case Study:** Mobile Cloud Computing, Mobile Education.	
Course Outcomes: After going through this course the student will be able to:	

CO1	:	Describe the value-added attributes, benefits, and fundamental drivers of m-commerce
CO2	:	Apply the mobile computing infrastructure that supports m-commerce (devices, software, and services)
CO3	:	Differentiate m-commerce applications in banking and financial services
CO4	:	Analyze consumer and personal applications of m-commerce, including entertainment, ubiquitous computing and sensory networks

Reference Books:

1. Karabi Bandyopadhyay, Mobile commerce,1st edition , PHI Learning, 2013, ISBN-978-81-203-4805-9

2.Nikhilesh Dholakia , Morten Rask, Ruby Roy Dholakia, M-commerce : global experiences and perspectives, 2nd edition Hershey PA : Idea Group Pub., 2006, ISBN-978-1591403159

3.Paul May, Mobile Commerce: Opportunities Applications And Technologies Of Wireless Business, South Asia Edition, CAMBRIDGE UNIVERSITY PRESS 2015,ISBN:9781316509968

4. Shiney Chib, M-Commerce, 1st edition, Himalaya Publishing House, 2017,ISBN: 978-93-5024-914-7

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)

CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**

Sl.No.	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)

Q.NO.	CONTENTS	MARKS
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MIT324C4	**EXTENDED REALITY**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+30T	*Professional Core Courses (Cluster Electives) (Group-C)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**
Introduction: Virtual Reality, Augmented Reality, Mixed Reality, Extended Reality applications. **Birds-eye view :** Hardware, Software, Human Physiology and perception, History of VR and AR **Programming with Unity:** Unity Basics, Manipulating the Scene, Code blocks and Methods, Debugging Conditional and looping statements.	
UNIT - II	**9 Hours**
Programming with Unity: Working with objects, Working with Scripts, Player movement, Camera Movement, Menu and UI, Advanced 3D movement Further Learning for Unity: The Asset Store **Mouse-Aimed camera:** First Person Controller, Third Person Controller **Further Learning for Unity**: The Asset Store	
UNIT - III	**9 Hours**
Augmented Reality: Types of tracking, Marker-based tracking, Marker-less tracking, Build and Run-Vuforia. **Modeling Tools:** An introduction to different modeling tools, Blender, Modeling of an object, Sculpting objects, Importing from Blender to Unity, Animation. Visual Scripting, Digital Twining	
UNIT - IV	**9 Hours**
XR Market, applications,**Introduction to WebXR:** Entering VR through WebXR, Life cycle of WebXR application, Creating an XR session through WebXR. Creating an AR website with WebXR: Object creation, spatial tracking, start AR session.	
UNIT - V	**9 Hours**
Extended Reality and Artificial Intelligence: XR and Artificial Intelligence, Future Research Agenda and Roadmap. **XR and Metaverse Software Platforms:** Enabling Platforms, Content Platforms, Human-Centered Platforms, Utility Platforms, Application Platforms.	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Understand the concepts of AR/VR/XR and its Applications
CO2	:	Identify, examine and develop application that reflects techniques for the design and deployment of VR/AR/XR experiences
CO3	:	Demonstrate a VR/AR/XR environment to captivate its experiences
CO4	:	Analyze the technology for unimodal/multimodal interaction

Reference Books
1."Virtual Reality", Steven M. LaValle, Copyright Steven M. LaValle 2017 Available for downloading at http://vr.cs .uiuc.edu/
2. "Roadmapping Extended Reality Fundamentals and Applications" , Mariano Alcañiz, Marco Sacco, Jolanda G. Tromp, 2022, Published by Wiley, ISBN 978-1-119-86514-8
3. "Blender 3D: Designing Objects" , Romain Caudron, Pierre-Armand Nicq, Enrico Valenza, 2016, Packt Publishing Ltd, ISBN 978-1-78712-719-7
4. Sanni Siltanen, Theory and applications of marker-based augmented reality, Julkaisija – Utgivare – publisher, ISBN 978-951-38-7449-0 (soft back ed.), ISSN 2242-119X (soft backed).
5.AR and VR Using the WebXR API, Rakesh Baruah , 2021, ISBN-13 : 978-1-4842-6317- 4 ISBN-13 : 978-1-4842-6318-1 https://doi.org/10.1007/978-1-4842-6318-1

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MBT325DA	**NATURE IMPELLED ENGINEERING**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**
Bio-Inspired designs-biomimetics: Termites; Sustainable buildings, Insect foot adaptations for adhesion. Bees and Honeycomb Structure. Namib Desert Beetle; Harvesting desert fog-Nature's water filter. Biopolymers, Bio-steel, Bio-composites, multi-functional biological materials. Antireflection and photo-thermal biomaterials, Invasive and non-invasive thermal detection inspired by skin.	
UNIT - II	**9 Hours**
Plant inspired Technologies: Photosynthesis and Photovoltaic cells, Bionic/Artificial leaf. Lotus leaf effect for super hydrophobic surfaces. Flectofin®, a new façade-shading system inspired by flower of the Bird-of-Paradise (Strelitzia reginae). Robotic Solutions Inspired by Plant Root.	
UNIT - III	**9 Hours**
Bio-Inspired technologies for medical applications: Organ system- Circulatory- artificial blood, artificial heart, pacemaker. Respiratory- artificial lungs. Excretory- Artificial kidney and skin. Artificial Support and replacement of human organs: artificial liver and pancreas. Total joint replacements- artificial limbs. Visual prosthesis -artificial / bionic eye.	
UNIT - IV	**9 Hours**
Bio-Inspired driven technologies for industrial applications: Biosensors: Artificial tongue and nose. Biomimetic echolation. Insect foot adaptations for adhesion. Thermal insulation and storage materials. Bio-robotics.	
UNIT - V	**9 Hours**
Bio-inspired computing: Cellular automata, neural networks, evolutionary computing, swarm intelligence, artificial life, and complex networks. Genetic Algorithms, Artificial Neural Networks. Artificial intelligence and MEMS.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Contemplate a deep understanding of biological systems, mimetics structures, and functions that inspire engineering innovations for adaptability and sustainability.
CO2	:	Endeavor biological principles from nature driven techniques to design engineering systems for solving real-world challenges
CO3	:	Appraise the bioinspired materials for their advanced applications in the domain of health, energy and environmental sustainability.
CO4	:	Paraphrase biomimicry and ethics in bioinspired engineering designs, ensuring that their solutions are environmentally responsible and socially conscious

Reference Books
1. Yoseph Bar-Cohen. Biomimetics: Biologically Inspired Technologies D. Floreano and C. Mattiussi, "Bio-Inspired Artificial Intelligence", CRC Press, 2018. ISBN: 1420037714, 9781420037715.
2. Guang Yang, Lin Xiao, and Lallepak Lamboni. Bioinspired Materials Science and Engineering. John Wiley, 2018. ISBN: 978-1-119-390336.
3. M.A. Meyers and P.Y. Chen. Biological Materials, Bioinspired Materials, and Biomaterials Cambridge University Press, 2014 ISBN 978-1-107-01045.
4. Tao Deng. Bioinspired Engineering of Thermal Materials. Wiley-VCH Press, 2018. ISBN: 978-3-527-33834-4.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MBT325DB	**CLINICAL DATA MANAGEMENT**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

Fundamentals of Healthcare Data and Analytics: Overview, importance, and evolution of health informatics in the digital age, Healthcare Data Types: Structured vs. unstructured data, clinical vs. operational data, and sources of healthcare data, Data Conversion and Integration: Data standardization, integration into clinical data warehouses, and data cleaning. Data Analytics: Introduction to descriptive, predictive, and prescriptive analytics in healthcare. Use of AI and machine learning for improved outcomes, Challenges and Future Trends: Data privacy, interoperability issues, the role of informatics in personalized medicine, and the future of digital health.

UNIT - II	**9 Hours**

Electronic Health Records (EHRs) and Digital Health: Overview of EHRs: Key components, data capture mechanisms, and the shift towards integrated EHR systems. Scope and Adoption: Role of EHRs in enhancing patient care, interoperability, and data sharing between healthcare providers. Implementation Process: Steps for selecting, deploying, and optimizing EHR systems, including vendor selection and compliance with healthcare regulations. Challenges in EHRs: Usability issues, data quality, resistance to adoption, and strategies for overcoming these barriers. Digital Health Innovations: Impact of telemedicine, remote patient monitoring, and digital therapeutics on EHR integration.

UNIT - III	**9 Hours**

Data Standards, Interoperability, and Medical Coding: Introduction to Standards: Need for data standards in health informatics, and their role in ensuring interoperability. Terminology and Content Standards: Deep dive into ICD, SNOMED CT, LOINC, and HL7 FHIR. Data Exchange and Transport Standards: HL7, DICOM, CDA, and emerging standards for seamless data exchange. Medical Coding Systems: Role of medical coding in billing, clinical documentation, and outcome measurement. Overview of CPT, ICD-10, and DRG codes. Emerging Trends: Role of AI in medical coding and billing, and the shift towards real-time data standardization.

UNIT - IV	**9 Hours**

Health Informatics Ecosystem: Introduction to the ecosystem, including hospitals, clinics, insurance providers, and regulatory bodies. Key Players and Stakeholders: Role of informatics professionals, data scientists, clinicians, and IT staff in healthcare. Challenges and Barriers: Addressing technical, organizational, and regulatory challenges in health informatics. Career Opportunities: Overview of roles like clinical informatics specialist, health data analyst, and telehealth coordinator. Resources and Professional Development: Important certifications, online resources, and organizations (e.g., HIMSS, AMIA).

UNIT - V	9 Hours

Health Information Privacy, Security, and Ethics: Introduction to Privacy and Security: Core principles of data privacy, HIPAA, and GDPR in healthcare. Security Principles: Confidentiality, integrity, availability, encryption methods, and access control mechanisms. Authentication and Identity Management: Role of biometric authentication, two-factor authentication, and secure access protocols. Data Security in the Cloud: Cloud computing in healthcare, managing risks in cloud-based data storage, and hybrid cloud models. Ethics in the use of AI in healthcare, managing bias in algorithms, and ensuring equitable access to digital health technologies.

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Understand the key principles and challenges of health informatics, and apply them to real-world scenarios.
CO2	:	Effectively manage the process of data capture, conversion, and analysis to generate actionable insights.
CO3	:	Apply knowledge of medical coding, data standards, and interoperability to improve data sharing and clinical workflows.
CO4	:	Implement robust security measures to protect patient data, and navigate ethical issues in health informatics.

Reference Books

1. Robert E. Hoyt Ann K. Yoshihashi, Health Informatics, Practical guide for Healthcare and Information Technology
Professionals, 6th edition, Informatics Education, 2014, ISBN: 978-0-9887529-2-4

2. Kathryn J. Hannah Marion J. Ball, Health Informatics, Springer Series edition, Springer, 2005, ISBN: 1-85233-826-1

3. William R Hersh, Health Informatics, a Practical guide, 8th edition. 2022, ISBN 978-1-387-85475-2

4. Pentti Nieminen. Medical informatics and data analysis 1st edition, MDPI AG, 2021, ISBN-13 : 978-3036500980

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)

CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**

Sl.No.	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating,	**40**

	and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MCN325DC	**CYBER FORENSICS AND CYBER LAWS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**
Computer Forensics in Today's World : Introduction to Computer Forensics and Digital Evidence, the Role of the Forensic Investigator, Understanding Forensic Readiness. Legal Issues and Considerations, Types of Computer Forensic Investigations, Forensic Investigation Process.	
UNIT - II	**9 Hours**
Investigation Process: Computer Forensics Investigation Methodology, Handling Digital Evidence, Chain of Custody and Documentation, Evidence Preservation: Hashing and Imaging, Investigation Planning and Legal Approval, Searching and Seizing Computers: Search and Seizure Procedures, Obtaining a Search Warrant, Securing the Crime Scene	
UNIT - III	**8 Hours**
Digital Evidence: Types of Digital Evidence (Physical, Logical, Latent), Collecting and Preserving Digital Evidence, Writing Reports on Digital Evidence, Identifying Evidence Sources: Hard Drives, Network Logs, Databases, Evidence Recovery Techniques, First Responder Procedures: First Responder Role in Digital Investigations, Protecting and Securing Evidence, Best Practices for Incident Response	
UNIT - IV	**8 Hours**
Jurisdiction of Cyberspace: Information Technology Law Literature and Glossary, Information Technology Law Concepts, Jurisdictional Issues in Cyber Space, scope of I.T. laws, **Law and the Internet:** Domain issues in Internet, Regulatory body, ICANN regulations	
UNIT - V	**8 Hours**
Security Governance Objectives: Security Architecture, Risk Management Objective, Developing A Security Strategy, Sample Strategy Development	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Gain a comprehensive understanding of Cyberfornsic and Investigation
CO2	:	Apply cyber forensics measures, tools, and techniques to protect systems, networks, and information.
CO3	:	Analyse the Legal Frameworks governing the internet
CO4	:	Exploration of Security Frameworks in the Cyber space.

Reference Books
1. EC-Council CHFI Course Outline: https://www.eccouncil.org/programs/computer-hacking-forensic-investigator-chfi/
2. Guide to Computer Forensics and Investigations" by Bill Nelson, Amelia Phillips, and Christopher Steuart, 6th Edition (latest), Cengage Learning, February 15, 2018, 978-1337568944
3. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics" by John Sammons, Edition: 2nd Edition (latest) Syngress (an imprint of Elsevier), June 30, 2014, ISBN-10:012801653

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MCV325DD	**INDUSTRIAL SAFETY AND HEALTH**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure. National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of trade union safety representatives. Occupational health and safety:

Introduction: Health, Occupational health: definition, Interaction between work and health, Health hazards, workplace, economy and sustainable development. Development of accident prevention programs and development of safety organizations.

UNIT - II	**9 Hours**

Work as a factor in health promotion. Potential health hazards: Air contaminants, Chemical hazards, Biological hazards, Physical hazards, Ergonomic hazards, Psychosocial factors, Evaluation of health hazards: Exposure measurement techniques, Interpretation of findings, recommended exposure limits. Controlling hazards: Engineering controls, Work practice controls, Administrative controls. Occupational diseases: Definition, Characteristics of occupational diseases, Prevention of occupational diseases.

UNIT - III	**9 Hours**

Hazardous Materials characteristics and effects on health: Introduction, Chemical Agents, Organic Liquids, Gases, Metals and Metallic Compounds, Particulates and Fibers, Alkalies and Oxidizers, General Manufacturing Materials, Chemical Substitutes, Allergens, Carcinogens, Mutagens, Reproductive Hazards, Sensitizers and Teratogens, Recommended Chemical Exposure Limits. Physical Agents, Noise and Vibration, Temperature and Pressure, Carcinogenicity, Mutagenicity and Teratogenicity. Ergonomic Stresses: Stress-Related Health Incidents, Eyestrain, Repetitive Motion, Lower Back Pain, Video Display Terminals.

UNIT - IV	**9 Hours**

Occupational safety and Health act.: Occupational Safety and Health Administration, right to know Laws, Accident Causation, Correcting Missing Skills, Investigator Tendencies and Characteristics, Theories of accident causation: Domino theory, Human Factors theory, Accident/Incident theory, Epidemiological theory and systems theory of accident causation.GD

UNIT - V	**9 Hours**

Environmental Health And Safety Management: Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies.

Occupational Health and Safety Considerations: Water and wastewater treatment plants, Construction material manufacturing industries like cement plants, RMC Plants, precast plants and construction sites, Municipal solid waste management.

Course Outcomes:		
After going through this course the student will be able to:		
CO1	:	Explain the Industrial and Occupational health and safety and its importance.
CO2	:	Demonstrate the exposure of different materials, occupational environment to which the employee can expose in the industries.
CO3	:	Exposure to the onset of regulatory acts and accident causation models.
CO4	:	Demonstrate the significance of safety policy, models and safety management practices.

Reference Books

1. Industrial Health and Safety Acts and Amendments, by Ministry of Labor and Employment, Government of India.
2. Fundamentals of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012.
3. Goetsch, D. L. (2011). Occupational Safety and Health for Technologists, Engineers and Managers 3rd edition. Prentice hall.
4. David. A. Calling - Industrial Safety Management and Technology, Prentice Hall, New Delhi.
5. Environmental and Health and Safety Management by Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995.
6. ISO 45001:2018 Occupational health and safety management systems – Requirements with guidance for use, International Organisation for Standardisation, 2018.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)

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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MCV325DE	**ADVANCED TECHNOLOGIES FOR TRANSPORTATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

Introduction to Intelligent Transportation Systems (ITS): Definition, objectives, Historical Background, Benefits of ITS –ITS. ITS User Services. ITS Applications. Strategic Needs Assessment and Deployment. Regional ITS Architecture Development Process. ITS Standards. ITS Evaluation. ITS Challenges and Opportunities.

UNIT - II	**9 Hours**

Data collection techniques : Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.
Telecommunications in ITS: Information Management, Traffic Management Centres (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centres; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts.

UNIT - III	**9 Hours**

Traffic Engineering - Fundamental relations of traffic flow, Traffic Stream models - , Shock wave, Car following models, Lane changing models, Vehicle arrival models, PCU values, Interrupted and Uninterrupted flow. Signalized intersection design and Analysis based on IRC, HCM and Indo –HCM. Numerical Problems. Traffic Simulation. Numerical Problems. Application of IOT, Machine learning in traffic management.

UNIT - IV	**9 Hours**

Transportation Network Analysis – Basic Introduction to Travel demand modelling, Trip generation, Distribution, Modal Split and Trip Assignment. Transit Capacity, ITS functional areas: Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS)

UNIT - V	**9 Hours**

ITS applications: Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing. Parking Management; Transportation network operations; commercial vehicle operations; public transportation applications; Automated Highway Systems- Vehicles in Platoons –ITS in World – Overview of ITS implementations in developed countries, ITS in developing countries. Case Studies

Course Outcomes: After going through this course the student will be able to:		
CO1	:	Identify and apply ITS applications at different levels
CO2	:	Illustrate ITS architecture for planning process
CO3	:	Examine the significance of ITS for various levels
CO4	:	Compose the importance of ITS in implementations

Reference Books

1. Pradip Kumar Sarkar and Amit Kumar Jain, "Intelligent Transport Systems", PHI Learning Private Limited, Delhi,2018, ISBN-9789387472068

2. Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House publishers (31 March 2003); ISBN-10: 1580531601

3. Bob Williams, "Intelligent transportation systems standards", Artech House, London, 2008. ISBN-13: 978-1-59693-291-3

4. Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García Zuazola "Intelligent Transport Systems: Technologies and Applications" Wiley Publishing ©2015, ISBN:1118894782 9781118894781

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MEC325DF	**DESIGN AND IMPLEMENTATION OF HUMAN-MACHINE INTERFACE** Industry Assisted Elective-Bosch	CIE Marks	:	100
Credits L-T-P	:	3:0:0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**8 Hours**

Foundations Of HMI: The Human: History of User Interface Designing, I/O channels, Hardware, Software and Operating environments, The Psychopathology of everyday Things, Psychology of everyday actions, Reasoning and problem solving. The computer: Devices, Memory, processing and networks. Interaction: Models, frameworks, Ergonomics, styles, elements, interactivity, Paradigms.

Introduction to HMI and domains: Automotive, Industrial, CE, Medical, ECUs within car and their functionalities. Interaction between ECUs. Communication protocols for ECUs(CAN, LIN, Most, FlexRay, Ethernet etc)

UNIT - II	**8 Hours**

Automotive Human-Machine Interfaces: Automotive infotainment system - Evolution road map, Feature sets, System architecture, Trends, Human factors and ergonomics in automotive design, Automotive User Experience (UX) Design Principles, In-Vehicle Information Systems (IVIS), Driver-Assistance Systems (DAS) Interfaces, HMI design for adaptive cruise control, Voice and Gesture Recognition in Automotive HMIs, Touchscreen Interfaces and Controls, Usability Testing and Evaluation in Automotive HMIs, Safety Considerations and Regulations in Automotive HMIs, Emerging Technologies in Automotive HMIs, Human-Machine Interfaces for Autonomous Vehicles

UNIT - III	**8 Hours**

UX and Guidelines: Introduction to UX design - stages, theory, Design thinking, UX Study, Interaction concepts, Graphic design tools - Adobe Photoshop, Adobe XD, Blender, GIMP, Asset Design - Overview , Guidelines and norms, 2D/3D rendering, OpenGL, OSG.

UNIT - IV	**8 Hours**

HMI User Interface: User-centered HMI development process, Basics of Web-Server. Web-based HMI: Basics of TwinCAT and HTML, CSS, JavaScript.
HMI on Mobile: Four Principles of Mobile UI Design, Benefits of Mobile HMIs, Mobile HMI Development Suites.

UNIT - V	**8 Hours**

HMI Control Systems: Introduction to Voice-Based HMI, Gesture-Based HMI, Sensor-Based UI controls.
Haptics in Automotive HMI: Kinesthetic Feedback Systems, Tactile Feedback Systems, Haptics in Multimodal HMI, Automotive Use-Cases
HMI Testing: Limitations of Traditional Test Solutions, Case - Study: Bosch's HMI validation tool - Graphics Test Systems (GTS).
UI analytics: Usage patterns, Debugging, Performance Profiling, Use Cases.

Course Outcomes:		
After going through this course the student will be able to:		
CO1	:	Explain the application of HMIs in various domain
CO2	:	Differentiate various communication protocols used in HMI development.
CO3	:	Describe car multimedia system and hardware and software evolution.
CO4	:	Use various graphic tools and advanced techniques to create UIs

Reference Books

1. Shuo gao, Shuo Yan, Hang Zhao, Arokia Nathan " Touch based HMI; Principles and Applications" Springer Nature Switzerland AG, 1st Edition.
2. Robert Wells, " Unity 2020 by Example: A Project based guide to building 2D, 3D augumented reality and Virtual reality games from sratch" Packt Publishing ltd , edition 2020
3. Ryan Cohen, Tao Wang, "GUI Design and Android Apps" Apress, Berkley, CA,2014

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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MEE325DG	**INTELLIGENT CONTROL TECHNIQUES IN ELECTRICAL DRIVES**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**
Fuzzy Logic Systems: Introduction to fuzzy logic, fuzzy Vs crisp set, linguistic variables, membership functions, fuzzy sets and operations on crisp sets and fuzzy sets, Fuzzy relations, operations on fuzzy relation, Cartesian Product of Relation. linguistic variables, fuzzy if then rules, compositional rule of inference, Fuzzy Rule Base and Approximate Reasoning	
UNIT - II	**9 Hours**
Fuzzy Logic Control: Basic concept of fuzzy logic control, relationship to PI, PD and PID control, design of FLC: determination of linguistic values, construction of knowledge base, inference engine, tuning, fuzzification, De-fuzzification methods. Fuzzy Inference Systems (FIS), Construction and Working Principle of FIS, Mamdani FIS models, Takagi-Sugeno-Kang (TSK) fuzzy models and concept of Adaptive Fuzzy control, Examples applicable to Drives.	
UNIT - III	**9 Hours**
Neural network: Fundamental Concept, history and development of neural network principles, Biological Neural Network, Comparison Between Biological Neuron and Artificial Neuron, Important Terminologies of ANN. Basic Models and Advantages of Neural Networks. **Learning methods:** types of learning, supervised, unsupervised, reinforced learning, knowledge representation and acquisition **Theory, architecture and learning algorithm of neural network models:** McCulloc model, Hopfield model, Perceptron Network, Back propagation network.	
UNIT - IV	**9 Hours**
Neural Networks for feedback Control: Identification of system models using neural networks, Model predictive control, feedback linearization and model reference control using neural networks, Neural Network Reinforcement Learning Controller, Radial basis function neural networks, Basic learning laws in REF nets, Recurrent back propagation, CMAC networks and ART networks, Kmeans clustering algorithm. Kohnen's feature maps, pattern recognition & mapping, Examples applicable to Drives.	
UNIT - V	**9 Hours**
Hybrid algorithms: Neuro-fuzzy systems, ANFIS and extreme-ANFIS, derivative free optimization methods. **Genetic algorithms:** introduction, principle of natural selection, Flow chart of simple genetic algorithm, GA operators and parameters. Particle swarm optimization, Solution of typical control problems. Case studies on Application to Electrical Drives.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Explain the concepts ANN and Fuzzy Logic.
CO2	:	Analyze the techniques involved in ANN and fuzzy logic applications.

CO3	:	Design and model hybrid system with ANN and FL or independent system.
CO4	:	Apply techniques in modern industrial drives and power electronics system.

Reference Books

1. Dr. S. N. Sivanandam and Dr. S. N. Deepa, "Principles of Soft Computing", WILEY publication, 2nd Edition, 2008, ISBN: 9788126527410.
2. John Yen and Reza Langari, "Fuzzy Logic – Intelligence, Control and Information", Pearson Education Inc, 3rd Edition, 2009, ISBN 978-81-317-0534-6.
3. Simon Haykin, "Neural Networks – A Comprehensive Foundation", PH Publisher, 2nd Edition, 1998, ISBN:978-81-203-2373-5.
4. Timothy J. Ross., "Fuzzy Logic with Engineering Applications", John Wiley and Sons, 3rd Edition, 2011, ISBN: 978-0-470-74376-8.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MET325DH	**ELECTRONIC NAVIGATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*(Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**
An Introduction to Radar: Basic Radar, The simple form of the Radar Equation, Radar Block Diagram, Radar Frequencies, Application of radar, Types of Radars. Detection of signals in Noise, Receiver Noise and the Signal-to Noise Ratio, Probability of Detection and False alarm, Introduction to Doppler, MTI, UWB Radars	
UNIT - II	**9 Hours**
Terrestrial Network based positioning and navigation: General Issues of wireless positions location, Fundamentals, positioning in cellular networks, positioning in WLANs, Positioning in Wireless sensor networks.	
UNIT - III	**9 Hours**
Satellite-based navigation systems: Global Navigation satellite systems (GNSS), GNSS receivers.	
UNIT - IV	**9 Hours**
LiDAR: Introduction to LiDAR, context and conceptual discussion of LiDAR, Types of LiDARS, LiDARS Detection modes, Flash LiDAR versus Scanning LiDAR, Monostatic versus Bistatic LiDAR, Major Devices in a LiDAR, LiDAR remote sensing, Basic components and physical principles of LiDAR, LiDAR accuracy and data formats.	
UNIT - V	**9 Hours**
SONAR: Underwater acoustics, applications, comparison with radar, submarine detection and warfare, overcoming the effects of the ocean, sonar and information processing.Transmission of the acoustic signal: Introduction, detection contrast and detection index, transmission equation, equation of passive and active sonar.	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Understand the concepts of Radar, LiDAR, Sonar, terrestrial and satellite based navigation system.
CO2	:	Apply the concepts of radars, LiDAR, Sonar, cellular networks, WLAN, sensor networks and satellites in determining the user position and navigation.
CO3	:	Analyze the different parameters of satellite and terrestrial networks for navigation systems.
CO4	:	Evaluate the Radar, LiDAR, Sonar systems and satellite and terrestrial network based navigation and tracking systems.

Reference Books
1.M. L Skolnik,Introduction to RADAR Systems,3rd edition, 2017,TATA Mcgraw-Hill, ISBN: 978- 0070445338
2.Mark A Richards, James A Scheer, William A Holam,Principles of Modern Radar Basic Principles, 2010, 1st edition,SciTech Publishing Inc, ISBN:978-1891121524 .
3. Davide dardari, Emanuela Falletti, Marco Luise, Satellite and Terrestrial Radio Positioning techniques- A signal processing perspective, 1st Edition, 2012, Elsevier Academic Press, ISBN: 978-0-12-382084-6.
4. Paul McManamon,LiDAR Technologies and Systems, SPIE press, 2019.
5. Pinliang Dong and Qi Chen,LiDAR Remote Sensing and Applications, CRC Press, 2018, ISBN: 978-1- 4822-4301-7
6. Jean-Paul Marage, Yvon Mori, Sonar and Underwater Acoustics, Wiley, 2013, ISBN: 9781118600658

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MET325DJ	**VEHICULAR COMMUNICATION ECOSYSTEM**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

Introduction: Basic Principles and Challenges, Past and Ongoing VANET Activities
Standards and Regulations of DSRC : Introduction, Layered Architecture for VANETs, DSRC Regulations, DSRC Physical Layer Standard, DSRC Data Link Layer Standard (MAC and LLC), DSRC Middle Layers.

UNIT - II	**9 Hours**

Physical Layer Considerations for Vehicular Communications: Standards Overview, Wireless Propagation Theory, Channel Metrics, Measurement Theory, Empirical Channel Characterization at 5.9 GHz.
MAC Layer and Scalability Aspects of Vehicular Communication Networks: Challenges and Requirements. MAC Approaches for VANETs, Communication Based on IEEE 802.11p.

UNIT - III	**9 Hours**

MAC Layer and Scalability Aspects of Vehicular Communication Networks Performance Evaluation and Modeling, Aspects of congestion control.
Data Security in Vehicular Communication Networks: Challenges of Data Security in Vehicular Networks, Network, Applications, and Adversarial Model, Security Infrastructure, Cryptographic Protocols.

UNIT - IV	**9 Hours**

Intra-vehicle communication:-In-vehicle networks, Automotive bus systems, In-vehicle Ethernet, Wireless in-vehicle networks
Inter-vehicle communication: Applications, Requirements and components, Concepts for inter-vehicle communication, Fundamental limit.

UNIT - V	**9 Hours**

Cooperative Vehicular Safety Applications: Introduction, Enabling technologies, Cooperative system architecture, Mapping for safety applications.
VANET-enabled Active Safety Applications: Infrastructure-to-vehicle applications, Vehicle-to-vehicle applications, Pedestrian-to-vehicle applications.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Illustrate fundamentals of wireless vehicular networks.
CO2	:	Design of Physical & MAC layer and routing protocols for vehicular networks.
CO3	:	Analyse the security issues and energy management in vehicular networks.
CO4	:	Evaluate the performance of vehicular networks in different use cases.

Reference Books
1. Hannes Hartenstein and Kenneth Laberteaux (eds.), VANET Vehicular Applications and Inter-networking Technologies, John Wiley & Sons, 2009.
2. Christophe Sommer and Falko Dressler, Vehicular Networking, Cambridge University Press, 2014.
3. Claudia Campolo, AntonellaMolinaro and Riccardo Scopigno, Vehicular ad hoc Networks: Standards, Solutions, and Research, Springer, 2015.
4. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005.
5. Hannes Hartenstein and Kenneth Laberteaux (eds.), VANET Vehicular Applications and Inter-networking Technologies, John Wiley & Sons, 2009.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MIM325DK	**ESSENTIALS OF PROJECT MANAGEMENT**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*(Interdisciplinary Elective)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**
Introduction: Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS), Introduction to Agile Methodology.	
UNIT - II	**9 Hours**
Capital Budgeting: Capital Investments: Importance and Difficulties, phases of capital budgeting, levels of decision making, facets of project analysis, feasibility study – a schematic diagram, objectives of capital budgeting	
UNIT - III	**9 Hours**
Project Costing: Cost of Project, Means of Finance, Cost of Production, Working Capital Requirement and its Financing, Profitability Projections, Projected Cash Flow Statement, Projected Balance Sheet, Multi-year Projections, Financial Modeling, Social Cost Benefit Analysis	
UNIT - IV	**9 Hours**
Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Techniques (PERT) Critical Path Method (CPM), Computerized project management.	
UNIT - V	**9 Hours**
Project Management and Certification: An introduction to SEI, CMMI and project management institute USA – importance of the same for the industry and practitioners. PMBOK 6 - Introduction to Agile Methodology, hemes / Epics / Stories, Implementing Agile. Domain Specific Case Studies on Project Management: Case studies covering project planning, scheduling, use of tools & techniques, performance measurement.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Explain project planning activities that accurately forecast project costs, timelines, and quality.
CO2	:	Evaluate the budget and cost analysis of project feasibility.
CO3	:	Analyze the concepts, tools and techniques for managing projects.
CO4	:	Illustrate project management practices to meet the needs of Domain specific stakeholders from multiple sectors of the economy (i.e. consulting, government, arts, media, and charity organizations).

Reference Books

1. Prasanna Chandra, Project Planning Analysis Selection Financing Implementation & Review, Tata McGraw Hill Publication, 9th Edition, 2017, ISBN: 978-9332902572.
2. Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK Guide), 5th Edition, 2013, ISBN: 978-1-935589-67-9
3. Harold Kerzner, Project Management A System approach to Planning Scheduling & Controlling, John Wiley & Sons Inc., 11th Edition, 2013, ISBN 978-1-118-02227-6.
4. Rory Burke, Project Management – Planning and Controlling Techniques, John Wiley & Sons, 4th Edition, 2004, ISBN: 978-0470851241

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MIS325DM	**USER INTERFACE AND USER EXPERIENCE**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*(Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**
What's a UI Pattern?: How Users Interact With Design Patterns, Following Universal Design Conventions, Applying Empathy to UI Design Patterns. Why Use UI Patterns?: Why Patterns Work, Expectations Reinforce Themselves, Deadline-Busting Communication, Why not use patterns?. The Importance of Prototyping First: Got a Pattern? Plan it Out, Thinking Through the Process, Patterns Take Guesswork Off of Developers' Plates.	
UNIT - II	**9 Hours**
User Testing: Insights You Can't Ignore. Prototyping UI Patterns: Explaining the Gray Box, Pattern Libraries Are Prototyping Shortcuts, Reusable elements, Patterns and Prototypes Work Together, Applying UI Design Patterns: Building a Pattern Library, Riffing on Design Patterns, Tweaking Pattern Styles, Going forward, Useful UI Pattern Examples, Formatting Data, Getting input, Navigation, Teasers.	
UNIT - III	**9 Hours**
Design for Usefulness: Painkillers & Vitamins, Embracing Goal-Centered Design, Test for Relevancy With an MVP, A Quick MVP Case Study: Buffer. Designing for Usability: Forgiving, Satisfying, The 6-Step Process to Improve Usability. Designing for Desirability: Desirable Products Are More Usable, Desire Is Relative to Users, Elements of Desirable Design.	
UNIT - IV	**9 Hours**
Designing for Findability: Building the Right Information Architecture, 5 IA Layouts for the Web, 5 Navigational Menu Patterns, Testing Findability. Designing for Accessibility: Universal Design, What Accessibility Means for UX Design, Benefits of Accessibility, Accessibility Best Practices.	
UNIT - V	**9 Hours**
The Core of Desirable Design: The Habit Loop, A Quick Case Study, Quick Case Study: Apple.com. Designing for Credibility: First Impressions Matter, Quick Case Study: Chase, Building a Credible Product Interface, Selling the Product Through Social Proof, Persuading Through Transparency.	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Apply the concept of User Interface and User Experience to increase look and feel various applications.
CO2	:	Analyse the usability, accesssibility, availability and other factors of User Interface design patterns.
CO3	:	Design and implement techniques of implementing design patterns.
CO4	:	Evaluate the design patetrns and elements of user experience.

Reference Books
1. Ben Gremillion, Jerry Cao, Kamil, Tactical UI Design Patterns, The Handbook to faster Design, UXPin Inc., 2015.
2. Jerry Cao, Kamil, Matt Ellis, The Elements of Successful UX Design, Best Practices of Meaningful products, UXPin Inc., 2015.
3. User Friendly- How the Hidden Rules of Design Are Changing the Way We Live, Work, and Play, Cliff Kuang, Picador Paper; Reprint edition, 2020, ISBN: 1250758203
4. Jenifer Tidwel, Designing Interfaces: Patterns for Effective Interaction Design, 3rd Edition, O'Reilly, 2020, ISBN: 1492051969

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MMA325DN	**MATHEMATICAL METHODS FOR DATA SCIENCE**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

Parameter Estimation: Introduction to probability models of univariate random variables, Discrete distribution (Bernoulli, Binomial, Poisson), Continuous distributions (Uniform, Exponential, Normal), Estimation - Criteria for good estimates - unbiasedness, consistency, efficiency and sufficiency, Variance of a point estimator, Parameter estimation via maximum likelihood, Method of moments, Bayesian estimation of parameters.

UNIT - II	**9 Hours**

Optimization I: Introduction and formulation, Optimality conditions, Review of local maxima, and local minima along with first and second order conditions. Taylor series and local function approximation, automatic differentiation, One dimensional Search Methods - Sequential search method, Fibonacci search method, Golden section search method.

UNIT - III	**9 Hours**

Optimization II: Constrained and Unconstrained optimization, Gradient vector, Hessian matrix, optimization using Hessian matrix, Gradient descent method, Step size selection and convergence, Newton method, Stochastic gradient descent (SGD), Convex optimization, Duality - weak and strong duality, Optimization using duality.

UNIT - IV	**9 Hours**

Fuzzy Optimization: Basic concepts of fuzzy sets - Operations on fuzzy sets, Fuzzy relation equations, Fuzzy logic control, Fuzzification, Defuzzification, Decision making logic, Membership functions.

Artificial Neural Networks: Introduction - Neuron model, Multilayer perceptions - Back propagation algorithm and its variants, Loss functions in artificial neural networks.

UNIT - V	**9 Hours**

Machine Learning Algorithms: Unsupervised learning, Supervised learning, Linear regression, Multiple Linear Regression, Overfitting, Naïve Bayes classifier. Clustering methods, k-means clustering, Linear support vector machine, Kernel functions and Nonlinear support vector machine.

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Explore fundamental concepts of estimation, optimization, and machine learning applied in various branches of engineering. **(PO1, PO4, PO6)**
CO2	:	Apply theoretical concepts of estimation and optimization to model problems using a machine learning approach on model requirements and to evaluate solutions within given constraints effectively. **(PO1, PO2, PO4, PO6)**

CO3	:	Analyze and solve the modern engineering problems using appropriate techniques of statistical and mathematical learning to the real-world problems arising in many practical situations. **(PO1, PO3, PO4, PO6)**
CO4	:	Develop and implement algorithms for constrained and unconstrained optimization, utilizing estimation techniques to classify, predict, and optimize solutions for practical applications, emphasizing model accuracy and performance and also engage in lifelong learning. **(PO1, PO2, PO3, PO4, PO6)**

Reference Books

1. 1. Jorge Nocedal Stephen J. Wright, Numerical Optimization, Springer, 2nd Edition, 2006, ISBN-10: 0-387-30303-0 ISBN-13: 978-0387-30303-1.

2. Mykel J. Kochenderfer, Tim A. Wheeler, Algorithms for Optimization, MIT Press, Illustrated Edition, 2019, ISBN-13 978-0262039420.

3. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 1st Edition, 2006, ISBN-10: 0-387-31073-8 ISBN-13: 978-0387-31073-2.

4. 4. Shai Shalev-Shwartz and Shai Ben-David "Understanding Machine Learning: From Theory to Algorithms", 1st Edition, Cambridge University Press, 2014, ISBN: 978-1-107-05713-

5.George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications**,** 1st Edition, Prentice Hall PTR, 1995, ISBN 0-13-101171-5.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)		
CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**		
Sl.No.	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MME325DO	**INDUSTRY 4.0: THE SMART MANUFACTURING**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**
Fundamentals of Industry 4.0- Introduction, Key Components of Industry 4.0, RAMI 4.0, Cyber-Physical Systems. **Servitization and Product-Service Systems** - Integrated Overview, Examples Across Sectors. Industry 4.0 Across Sectors- Introduction, Smart Manufacturing, Transportation 4.0, Multimodal Transportation Systems, Rail 4.0, Logistics 4.0 and Implications. **Future Trends and Challenges**- Emerging Applications, Risks and Barriers to Implementation	
UNIT - II	**9 Hours**
The Concept of IIoT- Introduction to IIoT, Key Features and Applications **Modern Communication Protocols**- Overview, TCP/IP, Wireless Communication, Technologies. **API**- A Technical Perspective, Importance in IIoT, Examples and Applications, **Middleware Architecture**- Role in IIoT, Integration and Data Flow Management. **Emerging Trends in IIoT**- Industrial IoT Standards and Frameworks, Edge Computing in IIoT.	
UNIT - III	**9 Hours**
Data Analytics in Manufacturing: Energy Efficiency in Manufacturing, Anomaly Detection in Air Conditioning Systems, Smart Remote Machinery Maintenance Systems with Komatsu, Quality Prediction in Steel Manufacturing, Predictive Maintenance with Data Analytics **Internet of Things and New Value Proposition**: IoT in Manufacturing, Value Creation Barriers: Standards, security, and privacy concerns. **Advances in Robotics in the Era of Industry 4.0**: Recent Technological Components of Robots, Advanced Sensor Technologies, Artificial Intelligence in Robotics, Collaborative Robots, Internet of Robotic Things, Cloud Robotics, Digital Twin Technology	
UNIT - IV	**9 Hours**
Additive Manufacturing Technologies and Applications: Additive Manufacturing Technologies Overview, Stereo lithography, 3D Printing, Fused Deposition Modeling, Selective Laser Sintering, Laser Engineered Net Shaping, Manufacturing in Industry 4.0, Hybrid Manufacturing Processes. **Advances in Virtual Factory Research and Applications**: The State of Art, The Virtual Factory Software	
UNIT - V	**9 Hours**
Cybersecurity and Resilience in Industry 4.0: Introduction to Cybersecurity in Industry 4.0, Industrial IoT security, Edge and Cloud Security, Digital Twin Security, AI and Machine Learning for Cybersecurity, Standards and Frameworks for Industry 4.0 Cybersecurity, Resilience Strategies for Industry 4.0, Future Trends in Cybersecurity for Industry 4.0	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand the opportunities, challenges brought about by Industry 4.0 for benefits of organizations and individuals
CO2	:	Analyze the effectiveness of Smart Factories, Smart cities, Smart products and Smart services
CO3	:	Apply the Industrial 4.0 concepts in a manufacturing plant to improve productivity and profits
CO4	:	Evaluate the effectiveness of Cloud Computing in a networked economy

Reference Books

1. 1.Alasdair Gilchrist, Industry 4.0 The Industrial Internet Of Things, Apress Publisher, ISBN-13 (pbk): 978-1-4842-2046-7
2. Alp Ustundag, Emre Cevikcan, Industry 4.0: Managing The Digital Transformation, Springer, 2018 ISBN 978-3-319-57869-9
3. Ovidiu Vermesan and Peer Friess, Designing the industry - Internet of things connecting the physical, digital and virtual worlds, Rivers Publishers, 2016 ISBN 978-87-93379-81-7
4. Christoph Jan Bartodziej, The concept Industry 4.0- An Empirical Analysis of Technologies and Applications in Production Logistics, Springer Gabler, 2017 ISBN 978-3-6581-6502-4

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (CIE-Theory)

CIE will consist of TWO Quizzes (Q), TWO Tests (T), and ONE Experiential Learning (EL) component **[20 (Q) + 40 (T) + 40 (EL) = 100 marks)**

Sl.No.	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & each Quiz will be evaluated for 10 marks, and Final Quiz marks adding up to 20 marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SMESTER: II						
Course Code	:	MME325DQ	**INDUSTRIAL INTERNET OF THINGS (IIOT)**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*Interdisciplinary Courses (Global Electives) (Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

Introduction: IoT vs IIoT, challenges in deployment, building blocks of business model and architecture, layers, sensing for manufacturing process, processing, communication and networking. Applications – Factories and assembly lines, inventory management and quality control, facility management.

Industrial Control Systems: Process Industries versus Discrete Manufacturing Industries – Levels, variables and parameters, Continuous Control Systems, Discrete Control Systems, Computer Process Control - Control Requirements, Capabilities of Computer Control, Forms of Computer Process Control.

UNIT - II	**9 Hours**

Sensors in IIoT applications: Temperature sensor interfacing, accelerometer sensor interfacing, MoS Gas sensor, magneto strictive sensors, speed sensor, ultrasonic sensor, smart sensors.

Automatic identification and data Capture : Overview Of Automatic Identification Methods, Linear (One-Dimensional) Bar Code, Two-Dimensional Bar Codes, Radio Frequency Identification, Magnetic Stripes, Optical Character Recognition, Machine Vision

UNIT - III	**9 Hours**

Group Technology and Cellular Manufacturing: Part Family, Intuitive Grouping, Parts Classification and Coding, Production Flow Analysis, cellular manufacturing - Composite Part Concept, Machine Cell Design, applications of group technology, Opitz Part Coding System, Machine Cell Organization and Design Rank-Order Clustering - Numericals

UNIT - IV	**9 Hours**

Industrial Networking: Introduction, Hierarchy of Industrial Networks, Network Topologies, Data Flow Management, Transmission Hardware, Network Backbones, Network Communication Standards, Fieldbus Networks

Simulating Industrial Processes: Queues and Queueing – waiting time, service time, machine utilisation, Modelling an Industrial Process Designing a Process Simulation, managing resource utilisation, product mixes, Queuing network models.

UNIT - V	**9 Hours**

Clustering: Similarity measures, hierarchical clustering – single linkage, complete linkage, average linkage Non heirerchial clustering – Numericals, multidimensional scaling correspondence analysis - Numericals

Prediction Models: K- Nearest neighbour, RMS Error and Mean Absolute Error, Mean Absolute Percentage Error, Coefficient of Determination, Underfitting and Overfitting, Cross-Validation, multiple regression – Numericals.

Course Outcomes:		
After going through this course the student will be able to:		
CO1	:	***Analyze*** the differences between IoT and IIoT, and evaluate the challenges, architectures, and sensing layers involved in the deployment of IIoT for manufacturing and industrial applications.
CO2	:	***Demonstrate*** the ability to interface sensors in IIoT systems, and apply automatic identification techniques for process automation.
CO3	:	***Design*** machine cells using group technology principles, and implement cellular manufacturing systems for optimized production workflows.
CO4	:	***Develop*** simulation models for industrial processes, and predict outcomes to optimize industrial system performance.

Reference Books

1. Jeschke, S., Brecher, C., Song, H., & Rawat, D. B. (Eds.). (2017). Industrial Internet of Things: Cyber manufacturing Systems. Springer. ISBN: 978-3-319-42559-7.

2. Groover, M. P. (2018). Automation, Production Systems, and Computer-Integrated Manufacturing (5th ed.). Pearson. ISBN: 978-0134605463.

3. Johnson, R. A., & Wichern, D. W. (2007). Applied Multivariate Statistical Analysis (6th ed.). Pearson Prentice Hall. ISBN: 978-0131877153.

4.Hill, R., & Berry, S. (2021). Guide to Industrial Analytics: Solving Data Science Problems for Manufacturing and the Internet of Things. Springer. ISBN: 978-3-030-79103-2

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2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)		
Q.NO.	**CONTENTS**	**MARKS**
1 & 2	Unit 1: Question 1 or 2	20
3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: II						
Course Code	:	MIM426RT	**RESEARCH METHODOLOGY**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Online Course)*	SEE Marks	:	50
Hours	:	16L	*(Common Course to all M.Tech Programs)*	SEE Duration	:	2 Hrs

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Duration of the ONLINE Course - 8 Weeks

Week 1: A group discussion on what is research; Overview of research
Week 2: Literature survey, Experimental skills
Week 3: Data analysis, Modelling skills
Week 4: Technical writing; Technical Presentations; Creativity in Research
Week 5: Creativity in Research; Group discussion on Ethics in Research
Week 6: Design of Experiments
Week 7: Intellectual Property
Week 8: Department specific research discussions

Reference Books

1. Krishnaswami, K.N., Sivakumar, A. I. and Mathirajan, M., Management Research Methodology, Integration of Principles, Methods and Techniques, 17th Impression, Pearson India Education Services Pvt. Ltd, 2018. ISBN: 978-81-7758-563-6
2. William M. K. Trochim, James P. Donnelly, The Research Methods Knowledge Base, 3rd Edition, Atomic Dog Publishing, 2006, ISBN: 978-1592602919
3. Kothari C.R., Research Methodology Methods and Techniques, 4th Edition, New Age International Publishers, 2019, ISBN: 978-93-86649-22-5.
4. Levin, R.I. and Rubin, D.S., Statistics for Management, 8th Edition, Pearson Education: New Delhi, 2017, ISBN-13- 978-8184957495.

GENERAL GUIDELINES

1. NPTEL is an acronym for National Programme on Technology Enhanced Learning which is an initiative by seven Indian Institutes of Technology (IIT Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras and Roorkee) and Indian Institute of Science (IISc) for creating course contents in engineering and science.
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7. Exam is conducted by NPTEL.

SEMESTER: II						
Course Code	:	MIT427SL	**SKILL LAB (API DEVELOPMENT AND INTEGRATION LAB)**	CIE Marks	:	50
Credits L-T-P	:	0-0-2		SEE Marks	:	50
Hours/Week	:	5	*Common Course (MIT,MSE)*	SEE Duration	:	3 Hrs
LABORATORY						**30 Hours**

Students are expected to choose a relevant case study (Problem Statement) and carryout following steps with proper documentation.

Module-1

Analyse problems related to building relevant APIs.

Design and develop Java-based RESTful APIs using Spring MVC and Spring Boot frameworks. Cover key principles and best practices for: Versioning, Security, Documentation, Error handling, Paging and sorting

Module- 2:

Develop skills to build advanced REST applications using Spring technologies, Focus on creating robust, scalable, and maintainable REST applications,

Module-3:

Hands-On Learning: Build Java-based microservices, native cloud, or any applications using Spring REST, Employ Spring MVC and RESTful Spring, • Build a GraphQL application example

Module-4:

Document REST services, as well as versioning, paging, and sorting, Test, handle errors and secure your application

Examples of API Integration Use Cases: Connect Cloud Apps, Creation of Custom APIs Multiple Services Management, Building an Application with Spring Boot/Any other technology

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Comprehend and apply the key API concepts/tools such as REST, SOAP, and GraphQL, and describe how they differ in terms of design and usage for various application needs.
CO2	:	Analyse the API integration mechanisms within applications to effectively manage authentication, testing, handle errors to ensure proper functionality and reliability.
CO3	:	Design and Document functional APIs based on best practices and create detailed documentation using tools like OpenAPI, ensuring clarity and completeness for developers and users.
CO4	:	Evaluate and implement security protocols such as API keys, OAuth, and rate limiting to safeguard APIs against unauthorized access and potential attacks, ensuring secure and efficient API operation.

Reference Books:		
1. Sanjit Engle, "The Complete 2023 Web Development Guide", 2023, Kindle edition.		
2. Sourabh Sharma, "Modern API Development with Spring and Spring Boot: Design highly scalable and maintainable APIs with REST, gRPC, GraphQL, and the reactive paradigm", Packt Publishing , 2021, Kindle Edition.		
3.Dinesh Rajput, " Mastering Spring Boot 2.0: Build modern, cloud-native, and distributed systems using Spring Boot", Packt Publishing, 2018, ISBN: 978-1787127562.		
4. Harihara Subramanian, Pethuru Raj, "Hands-On RESTful API Design Patterns and Best Practices", 1st Edition, Packt Publishing, 2019, ISBN: 978-1788992664.		
RUBRIC FOR CONTINUOUS INTERNAL EVALUATION (CIE-Lab)		
Q.NO.	**CONTENTS**	**MARKS**
1	Conduction of the Experiments relavant to modules & Report	15
2	Design and testing of the Prototype / Projects / Modules	20
3	Final presentation and report	15
	CIE LAB TOTAL	**50**
	MAXIMUM MARKS FOR THE CIE	**50**
RUBRIC FOR SEMESTER END EXAMINATION (SEE-Lab) The evaluation will be carried out by Internal and External examiners through Exhibition Mode. The following weightage would be given for the exhibition.		
Sl.NO.	**CONTENTS**	**MARKS**
1	Presentation through posters	15
2	Demonstration of the Prototype / Projects / Modules	25
3	Viva Voce	10
	SEE LAB TOTAL	**50**
	MAXIMUM MARKS FOR THE SEE	**50**

SEMESTER: III						
Course Code	:	MSE331TA	**AGILE SOFTWARE TECHNOLOGIES (Theory)**	CIE Marks	:	100
Credits L-T-P	:	3-1-0		SEE Marks	:	100
Hours	:	45L+45EL+30T	*(Professional Coure Course)*	SEE Duration	:	3 Hours

UNIT-I	**9 Hrs**
An Introduction to Agile: Definable Work vs. High-Uncertainty Work, The Agile Manifesto and Mindset, Lean and the Kanban Method, Uncertainty, Risk, and Life Cycle Selection. Life Cycle Selection: Characteristics of Project Life Cycles, Mixing Agile Approaches, Project Factors That Influence Tailoring. Implementing Agile: Creating an Agile Environment: Start with an Agile Mindset, Servant Leadership Empowers the Team, Team Composition. Implementing Agile: Delivering in an Agile Environment: Charter the Project and the Team, Common Agile Practices, Troubleshooting Agile Project Challenges, Measurements in Agile Projects.	
UNIT-II	**9 Hrs**
Organizational Considerations for Project Agility: Organizational Change Management, Organizational Culture, Procurement and Contracts, Business Practices, Multiteam Coordination and Dependencies (Scaling), Agile and the Project Management Office (PMO), Organizational Structure, Evolving the Organization. The Purpose of Planning, Why Planning Fails, An Agile Approach.	
UNIT-III	**9 Hrs**
Estimating Size with Story Points: Estimating in Ideal Days, Techniques for Estimating, Re-Estimating, Choosing between Story Points and Ideal Days. Prioritizing Themes, Financial Prioritization, Prioritizing Desirability, Splitting User Stories, Release Planning Essentials, Iteration Planning, Selecting an Iteration Length.	
UNIT - IV	**9 Hrs**
Estimating Velocity: Use Historical Values, Run an Iteration, Make a Forecast, Which Approach Should I Use?. Buffering Plans for Uncertainty: Feature Buffers, Schedule Buffers, Combining Buffers, A Schedule Buffer Is Not Padding, Some Caveats. Planning the Multiple-Team Project: Establishing a Common Basis for Estimates, Adding Detail to User Stories Sooner, Lookahead Planning, Incorporating Feeding Buffers into the Plan. Monitoring the Release Plan, Monitoring the Iteration Plan, Communicating about Plans.	
UNIT - V	**9 Hrs**
Why Agile Planning Works: Replanning Occurs Frequently, Estimates of Size and Duration Are Separated, Plans Are Made at Different Levels, Plans Are Based on Features, Not Tasks, Small Stories Keep Work Flowing, Work in Process Is Eliminated Every Iteration, Tracking Is at the Team Level, Uncertainty Is Acknowledged and Planned For, A Dozen Guidelines for Agile Estimating and Planning. A Case Study: Bomb Shelter Studios.	

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Comprehend the Agile Planning Principles & Framework and choose between techniques based on project context and accurately re-estimate as necessary.

CO2	:	Apply Prioritization and Planning Techniques to manage uncertainty, risk, and life cycle selection in projects.
CO3	:	Analyze different project life cycles, compare Agile approaches, and assess factors influencing life cycle selection and tailoring to fit specific project needs and environments.
CO4	:	Determine the progress using release and iteration plans and communicate adjustments effectively to manage uncertainty in multi-team projects.

Reference Books:

1.Project Management Institute, "Agile Practice Guide", Project Management Institute, 2017, ISBN: 9781628253993

2. Mike Cohn, "Agile Estimating and Planning", Pearson, 2021 (Revised), ISBN: 9780131479418

3. James Shore, Shane Warden, "The Art of Agile Development", 2nd Edition, O'Reilly Media, Inc., 2021, ISBN: 9781492080695

4. Joel McCune, "Agile Unscrum-bled: Decoding Agile Jargon in 2023", Kindle Edition, 2023, ISBN: 979-8859678914

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RUBRIC FOR SEMESTER END EXAMINATION (SEE-Theory)

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3 & 4	Unit 2: Question 3 or 4	20
5 & 6	Unit 3: Question 5 or 6	20
7 & 8	Unit 4: Question 7 or 8	20
9 & 10	Unit 5: Question 9 or 10	20
	MAXIMUM MARKS FOR THE SEE	**100**

SEMESTER: III						
Course Code	:	MCE332E1	**DATA MINING**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Course online)*	SEE Marks	:	50
Hours	:	16L	*Professional Elective Course (NPTEL) (Group-E)*	SEE Duration	:	2 Hours

This course is indicative only and it is subject to change based on the courses running at that time by NPTEL

Duration of the ONLINE Course - 8 Weeks

Week 1: Introduction, Data Preprocessing
Week 2: Association Rule Mining, Classification Basics
Week 3: Decision Tree, Bayes Classifier, K nearest neighbor
Week 4: Support Vector Machine, Kernel Machine
Week 5: Clustering, Outlier detection
Week 6: Sequence mining
Week 7: Evaluation, Visualization.
Week 8: Case studies

Reference Books:

1. Steinbach and Vipin Kumar, Introduction to Data Mining, Tan, Pearson Education, 2016, ISBN: 978-9332571402

2. Pei, Han and Kamber , Data Mining: Concepts and Techniques, Elsevier, 2011, ISBN: 978-0-12-811760-6

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SEMESTER: III						
Course Code	:	MCE332E2	**DATA SCIENCE FOR ENGINEERS**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Course online)*	SEE Marks	:	50
Hours	:	16L	*Professional Elective Course (NPTEL) (Group-E)*	SEE Duration	:	2 Hours

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Duration of the ONLINE Course - 8 Weeks

Week 1: Course philosophy and introduction to R
Week 2: Linear algebra for data science
1. Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse)
2. Geometric view - vectors, distance, projections, eigenvalue decomposition

Week 3: Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates)
Week 4: Optimization
Week 5:
1. Optimization
2. Typology of data science problems and a solution framework

Week 6:
1. Simple linear regression and verifying assumptions used in linear regression
2. Multivariate linear regression, model assessment, assessing importance of different variables, subset selection

Week 7: Classification using logistic regression
Week 8: Classification using kNN and k-means clustering

Reference Books:

1.Gilbert Strang ,Introduction to Linear Algebra , Sixth Edition (2023),ISBN : 978-17331466-7-8

2.Douglas Montgomery, Applied statistics and probability for engineers, Fifth Edition (2022), ISBN:13: 978-0-470-05304-1

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SEMESTER: III						
Course Code	:	MCE332E3	**INTRODUCTION TO SOFT COMPUTING**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Course online)*	SEE Marks	:	50
Hours	:	16L	*Professional Elective Course (NPTEL) (Group-E)*	SEE Duration	:	2 Hours

This course is indicative only and it is subject to change based on the courses running at that time by NPTEL

Duration of the ONLINE Course - 8 Weeks

Week 1: Introduction to Soft Computing, Introduction to Fuzzy logic,Fuzzy membership functions,Operations on Fuzzy sets

Week 2: Fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inferences

Week 3: Defuzzyfication Techniques-I, Defuzzyfication Techniques-II, Fuzzy logic controller-I, Fuzzy logic controller-II

Week 4: Solving optimization problems, Concept of GA, GA Operators: Encoding,GA Operators: Selection-I

Week 5: GA Operators: Selection-II, GA Operators: Crossover-I, GA Operators: Crossover-II, GA Operators: Mutation

Week 6: Introduction to EC-I, Introduction to EC-II, MOEA Approaches: Non-Pareto, MOEA Approaches: Pareto-I

Week 7: MOEA Approaches: Pareto-II, Introduction to ANN, ANN Architecture

Week 8: ANN Training-I, ANN Training-II, ANN Training-III, Applications of ANN

Reference Books:

1. Melanic Mitchell, An Introduction to Genetic Algorithm, MIT Press, ISBN: 9780262631853

2. Collelo, Lament, Veldhnizer, Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Springer, ISBN: 978-8184893694

3. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley,

4. Simon Haykin, Neural Networks and Learning Machines, PHI, ISBN: 978-93-3257-031-3

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6. Exam is conducted by NPTEL for this or equivalent course for the same

SEMESTER: III						
Course Code	:	MCE332E4	**DESIGN AND ENGINEERING OF COMPUTER SYSTEMS**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Course online)*	SEE Marks	:	50
Hours	:	16L	*Professional Elective Course (NPTEL) (Group-E)*	SEE Duration	:	2 Hours

This course is indicative only and it is subject to change based on the courses running at that time by NPTEL

Duration of the ONLINE Course - 8 Weeks

Week 1 - Introduction to computer systems.
• Introduction and overview of the course
• Principles for designing computer systems
• Overview of computer system hardware and software
Week 2 - Process management and CPU virtualization
• Process abstraction and process management in operating systems
• Threads and concurrency
• Virtual machines and containers
Week 3 - Memory management
• Memory management in operating systems
• Virtual memory and paging
• Optimizing memory access in user programs
Week 4 - Disk and network I/O
• Filesystem data structures and implementation
• Synchronous and event-driven APIs for socket-based network communication
• Network I/O subsystem in operating systems
Week 5 - Computer networking
• Architecture of the Internet
• Internet routing, transport and applications
• Network security
Week 6 - End-to-end application design
• Inter-process and inter-thread synchronization
• Architecture of multi-tier applications
• Case studies and examples of systems design
Week 7 - Performance engineering
• Performance measurement and analysis
• Techniques to improve performance of computer systems
• Caching, horizontal and vertical scaling, load balancing
Week 8 - Reliability engineering
• Techniques for fault tolerance in computer systems
• Replication, consistency, and atomicity
• Case studies of designing reliable computer systems

Reference Books:

1. Remzi Arpaci-Dusseau, Andrea Arpaci-Dusseau, Operating Systems: Three Easy Pieces

2. https://www.cse.iitb.ac.in/~mythili/os/
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SEMESTER: III						
Course Code	:	MSE433P	**MINOR PROJECT**	CIE Marks	:	50
Credits L-T-P	:	0-0-6		SEE Marks	:	50
Hours/Week	:	12		SEE Duration	:	3 Hours

Guidelines

1. Student can form group of two to execute the Minor Project.
2. Students are required to select topics related to their PG Program Specialization after extensive Literature Survey and analyzing the Research gaps.
3. Students will be assigned to guides in accordance with the expertise of the faculty.
4. Minor project topics could also be aligned to be implemented/executed based on any of the 16 Centre of Excellence (CoE)/ 06 Center of Competence (CoC) domain. The details of these could be obtained by visiting the website https://rvce.edu.in/rvce-center-excellence
5. Minor project has to be implemented/executed in-house, using the resources available in the department/college/CoE/CoC.
6. Students have to note the periodic progress in the Minor Project Diary and report the work carried to their respective guides.
7. Students have to present the Minor project work to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final Minor project report.
8. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be softbound in Ivory/White color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Analyze the research gaps, formulate the problem definition, conceptualize the objectives and design solution to cater to specific problems.
CO2	:	Apply higher order thinking skills and develop skill competencies specific to program specialization to implement real world problems with professional ethical standards.
CO3	:	Demonstrate the skill and knowledge by applying appropriate tools and techniques specific to their domain.
CO4	:	Communicate, work in teams and demonstrate the learning through oral presentations and report writing.

Scheme of Continuous Internal Evaluation (CIE):
The evaluation committee shall consist of Guide, Professor, Associate Professor/Assistant Professor. The committee shall assess and evaluate the presentation and the progress reports.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
I	Approval of the selected topic, formulation of Problem Statement and Objectives along with Synopsis submission	10%
II	Demonstrate the skill and knowledge by applying appropriate tools/techniques to design solution specific to the problem.	30%
III	Demonstrates the work carried out through experimental results, analysis and testing. Exhibits writing and communication skills through presentations and report writing.	60%

Scheme for Semester End Evaluation (SEE):
The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner. Evaluation shall be done in batches, not exceeding 6 students per batch.

RUBRICS FOR SEMESTER END EXAMINATION

The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner.

Q.NO.	CONTENTS	MARKS
1	Write Up	**20%**
2	Demonstration of Minor Project Work	**60%**
3	Viva voce	**20%**

SEMESTER: III						
Course Code	:	MSE434N	**INTERNSHIP**	CIE Marks	:	50
Credits L-T-P	:	0-0-6		SEE Marks	:	50
Hours/Week	:	12		SEE Duration	:	3 Hours

Guidelines

1. Students can opt for undergoing internship at the industry or research organizations like BEL, DRDO, ISRO, NAL, etc.
2. Students must submit letter from the industry/research organizations clearly specifying the candidate's name and the duration of the internship on the company letter head with authorized signature.
3. The duration of the internship shall be for a period of 6 weeks on full time basis after II semester final exams and before the commencement of III semester.
4. RVCE hosts around 16 Centre of Excellence (CoE) in various domains and around 06 Center of Competence (CoC). The details of these could be obtained by visiting the website https://rvce.edu.in/rvce-center-excellence
5. Students can approach the CoE/CoC for registering and working on relevant domain for training/internship at the CoE/CoC.
6. Internship must be related to the field of specialization of the respective PG program in which the student has enrolled.
7. Students undergoing internship training are advised to report their progress and submit periodic progress reports/diary to their respective guides.
8. Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report.
9. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be softbound in Ivory/White color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Explore the workplace, operating procedures of the department/company and its products, and other organizational concepts.
CO2	:	Learn and improve writing and communication skills, research and technology, work in a team, and develop leadership skills.
CO3	:	Apply higher order thinking skills - critical thinking, analysis, synthesis and evaluate complex problems to solve real world problems with professional ethical standards.
CO4	:	Develop and demonstrate skill competencies and knowledge specific to program specialization by applying appropriate tools and techniques.

Scheme of Continuous Internal Evaluation (CIE):
The evaluation committee shall consist of Guide, Professor, Associate Professor/Assistant Professor. The committee shall assess and evaluate the presentation and the progress reports.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
I	Ability to comprehend the functioning/operating procedures of the Organization/Departments. Application of Engineering knowledge, Critical thinking and analysis to solve problems.	40%
II	Demonstrates skill competencies, Resource Management and Sustainability. Exhibits writing and communication skills through presentations and report writing.	60%

Scheme for Semester End Evaluation (SEE):
The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner. Evaluation shall be done in batches, not exceeding 6 students per batch.

RUBRICS FOR SEMESTER END EXAMINATION

The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner.

Q.NO.	CONTENTS	MARKS
1	Write Up	**20%**
2	Demonstration of Internship Work	**60%**
3	Viva	**20%**

SEMESTER: IV						
Course Code	:	MIT341F1	**Information Security**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Course online)*	SEE Marks	:	50
Hours	:	16L	*Program Specific Course (NPTEL-Elective) (Group-F)*	SEE Duration	:	2 Hours

This course is indicative only and it is subject to change based on the courses running at that time by NPTEL

Duration of the ONLINE Course - 8 Weeks

Week 1 : Introduction / gdb / buffer overflow
Week 2 : Preventing buffer overflow based malware
Week 3 : Integer overflow and buffer overread and heap overflow
Week 4 : More on heap overflow; Access Control
Week 5 : Confinement
Week 6 : SGX and Trustzone
Week 7 : Micro-architectural Attacks
Week 8 : Hardware Security.

Reference Books:

1. Whitman, Michael E. Herbert J. Mattord ,Principles of Information Security, Seventh Edition, Cengage Learning, ISBN: 978-0357506431

GENERAL GUIDELINES

1. NPTEL is an acronym for National Programme on Technology Enhanced Learning which is an initiative by seven Indian Institutes of Technology (IIT Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras and Roorkee) and Indian Institute of Science (IISc) for creating course contents in engineering and science.
2. NPTEL is offering online certification courses through its portal - https://swayam.gov.in/nc_details/NPTEL
3. Enrollment to courses and exam registration can be done in ONLINE mode only. The link is available on NPTEL website http://nptel.ac.in/
4. Students need to enroll for the NPTEL course and clear the exam.
5. In case students fail to get the certificate, they need to enroll for the same course once again, in the subsequent NPTEL semester and clear the exam.
6. If the same course is not offered by NPTEL (i.e. if the same course is not re-run) in the subsequent semester by NPTEL, the students need to write letter seeking permission from the Counsellor, HoD and Dean Academics with further approval from BoS Committee to take alternative course from the list announced by NPTEL.
7. Exam is conducted by NPTEL for this or equivalent course for the same.

SEMESTER: IV						
Course Code	:	MIT341F2	**Edge Computing**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Course online)*	SEE Marks	:	50
Hours	:	16L	*Program Specific Course (NPTEL-Elective) (Group-F)*	SEE Duration	:	2 Hours

This course is indicative only and it is subject to change based on the courses running at that time by NPTEL

Duration of the ONLINE Course - 8 Weeks

Week 1 - Introduction to Cloud and its limitations to support low latency and RTT. From Cloud to Edge computing: Waves of innovation
Week 2 : Introduction to Edge Computing Architectures
Week 3 : Edge Computing to support User Applications (5G-Slicing, self-driving cars and more)
Week 4 : Concepts of distributed systems in edge computing such as time ordering and clock synchronization, distributed snapshot, etc.
Week 5 : Introduction to Edge Data Center, Lightweight Edge Clouds and its services provided by different service providers.
Week 6 : Introduction to docker container and Kubernetes in edge computing. Design of edge storage systems like key-value stores
Week 7 : Introduction to MQTT and Kafka for end-to-end edge pipeline. Edge analytics topologies for M2M and WSN network (MQTT)
Week 8 : Use cases of machine learning for edge sensor data in predictive maintenance, image classifier and self-driving cars. Deep Learning On-Device inference at the edge to support latency-based application

Reference Books:

1. Rajkumar Buyya (Editor), Satish Narayana Srirama (Editor), "Fog and Edge Computing: Principles and Paradigms", Wiley, 2019, ISBN 9781119524984

2. Rajkumar Buyya, James Broberg,Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms", Wiley, 2011, ISBN 978-0-470-88799-8

1. 3. Rajiv Misra, Yashwant Patel, Cloud and Distributed Computing: Algorithms and Systems", Wiley 2020, ISBN: 978-8126520275

GENERAL GUIDELINES

1. NPTEL is an acronym for National Programme on Technology Enhanced Learning which is an initiative by seven Indian Institutes of Technology (IIT Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras and Roorkee) and Indian Institute of Science (IISc) for creating course contents in engineering and science.
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4. Students need to enroll for the NPTEL course and clear the exam.
5. In case students fail to get the certificate, they need to enroll for the same course once again, in the subsequent NPTEL semester and clear the exam.

6. If the same course is not offered by NPTEL (i.e. if the same course is not re-run) in the subsequent semester by NPTEL, the students need to write letter seeking permission from the Counsellor, HoD and Dean Academics with further approval from BoS Committee to take alternative course from the list announced by NPTEL.
7. Exam is conducted by NPTEL for this or equivalent course for the same

SEMESTER: IV						
Course Code	:	MIT341F3	**Introduction to Reliability Engineering**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Course online)*	SEE Marks	:	50
Hours	:	16L	*Program Specific Course (NPTEL-Elective) (Group-F)*	SEE Duration	:	2 Hours

This course is indicative only and it is subject to change based on the courses running at that time by NPTEL

Duration of the ONLINE Course - 8 Weeks

Week 1: Introduction and Definitions
Week 2: Constant Failure Rates Models
Week 3: Time Dependent Failure Rate Models
Week 4: System Reliability Modeling: Series, parallel, series-parallel, and k-out-of-m modeling.
Week 5: Markov Modeling: standby, shared systems etc.
Week 6: Reliability Estimation (Non-Parametric)
Week 7: Reliability Estimation (Distribution Fitting)
Week 8: Maintainability and Availability Analysis

Reference Books:

1. Charles E. Ebeling (2019) “An Introduction to Reliability and Maintainability Engineering”, 3rd edition, Publisher: McGraw Hill Education.

2. Patrick D. T. O’Connor, Andre Kleyner (2012) “Practical Reliability Engineering”, 5th edition, Publisher: Wiley.

3. Roy Billinton, Ronald N. Allan (1992) “Reliability Evaluation of Engineering Systems: Concepts and Techniques”, 2nd edition, Publisher: Springer

4. Mohammad Modarres, Mark P. Kaminskiy, VasiliyKrivtsov (2016) “Reliability Engineering and Risk Analysis: A practical guide”, 3rd edition, Publisher: CRC Press.

GENERAL GUIDELINES

1. NPTEL is an acronym for National Programme on Technology Enhanced Learning which is an initiative by seven Indian Institutes of Technology (IIT Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras and Roorkee) and Indian Institute of Science (IISc) for creating course contents in engineering and science.
2. NPTEL is offering online certification courses through its portal - https://swayam.gov.in/nc_details/NPTEL
3. Enrollment to courses and exam registration can be done in ONLINE mode only. The link is available on NPTEL website http://nptel.ac.in/
4. Students need to enroll for the NPTEL course and clear the exam.
5. In case students fail to get the certificate, they need to enroll for the same course once again, in the subsequent NPTEL semester and clear the exam.
6. If the same course is not offered by NPTEL (i.e. if the same course is not re-run) in the subsequent semester by NPTEL, the students need to write letter seeking permission from the Counsellor, HoD and Dean Academics with further approval from BoS Committee to take alternative course from the list announced by NPTEL.
7. Exam is conducted by NPTEL for this or equivalent course for the same

SEMESTER: IV						
Course Code	:	MIT341F4	**Machine Learning**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Course online)*	SEE Marks	:	50
Hours	:	16L	*Program Specific Course (NPTEL-Elective) (Group-F)*	SEE Duration	:	2 Hours

This course is indicative only and it is subject to change based on the courses running at that time by NPTEL

Duration of the ONLINE Course - 8 Weeks

Week 1 : Introduction to the Machine Learning course
Week 2 : Characterization of Learning Problems
Week 3 : Forms of Representation
Week 4 : Inductive Learning based on Symbolic Representations and Weak Theories
Week 5 : Learning enabled by Prior Theories
Week 6 : Machine Learning based Artificial Neural Networks
Week 7 : Tools and Resources + Cognitive Science influences
Week 8 : Examples, demos and exam preparations

Reference Books:

1.Deisenroth, Faisal and Ong ,Mathematics for Machine Learning, Cambridge University Press, ISBN:978-1-108-47004-9

GENERAL GUIDELINES

1. NPTEL is an acronym for National Programme on Technology Enhanced Learning which is an initiative by seven Indian Institutes of Technology (IIT Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras and Roorkee) and Indian Institute of Science (IISc) for creating course contents in engineering and science.
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5. In case students fail to get the certificate, they need to enroll for the same course once again, in the subsequent NPTEL semester and clear the exam.
6. If the same course is not offered by NPTEL (i.e. if the same course is not re-run) in the subsequent semester by NPTEL, the students need to write letter seeking permission from the Counsellor, HoD and Dean Academics with further approval from BoS Committee to take alternative course from the list announced by NPTEL.
7. Exam is conducted by NPTEL for this or equivalent course for the same

SEMESTER: IV						
Course Code	:	MSE442P	**MAJOR PROJECT**	CIE Marks	:	100
Credits L-T-P	:	0-0-18		SEE Marks	:	100
Hours/Week	:	36		SEE Duration	:	3 Hours

Guidelines

1. Major Project is to be carried out for a duration of 18 weeks
2. Student have to implement the Major Project individually.
3. Students are required to select topics related to their PG Program Specialization after extensive Literature Survey and analyzing the Research gaps.
4. Students will be assigned to guides in accordance with the expertise of the faculty.
5. Major project topics could also be chosen to be implemented/executed based on any of the 16 Centre of Excellence (CoE)/ 06 Center of Competence (CoC) domain. The details of these could be obtained by visiting the website https://rvce.edu.in/rvce-center-excellence
6. Major Project could be implemented in Industry/Research organizations after providing the letter of approval. Students can also implement Major Project, in-house using the resources available in the department/college/CoE/CoC.
7. Students have to adhere to the Project Presentation Schedule note the periodic progress in the Major Project Diary and report the work carried to their respective guides.
8.It is mandatory for the students to present/publish their project work in National/International Conferences/Journals
9. Students have to present the Major Project work to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final Major Project report.
10. Major Project report has to be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be softbound in Ivory/White color for PG circuit Programs and Light Blue for Non-Circuit Programs.

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Analyze the research gaps, formulate the problem definition, conceptualize the objectives and design solution to cater to specific problems.
CO2	:	Apply higher order thinking skills and develop skill competencies specific to program specialization to implement real world problems with professional ethical standards.
CO3	:	Demonstrate the skill and knowledge by applying appropriate tools and techniques specific to their domain.
CO4	:	Communicate, work in teams and demonstrate the learning through oral presentations and report writing.

Scheme of Continuous Internal Evaluation (CIE):
The evaluation committee shall consist of Guide, Professor, Associate Professor/Assistant Professor. The committee shall assess and evaluate the presentation and the progress reports.

The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
I	Approval of the selected topic, formulation of Problem Statement and Objectives along with Synopsis submission	10%
II	Demonstrate the skill and knowledge by applying appropriate tools/techniques to design solution specific to the problem.	30%
III	Demonstrates the work carried out through experimental results, analysis and testing. Exhibits writing and communication skills through presentations, report writing and paper publication.	60%

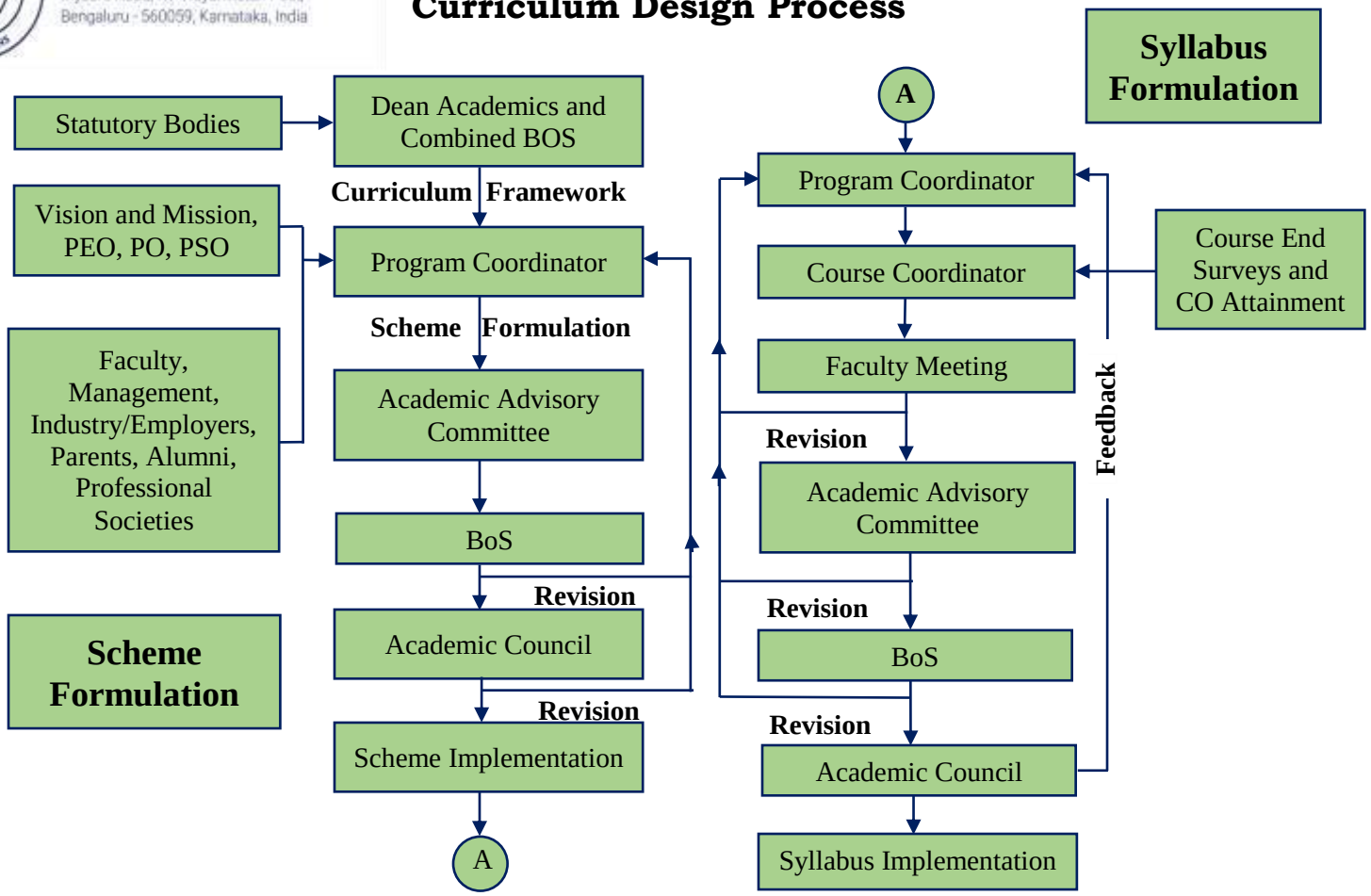
Scheme for Semester End Evaluation (SEE):
Major Project SEE evaluation shall be conducted in two stages. This is initiated after fulfilment of submission of Project Report and CIE marks.
Stage-1 Report Evaluation: Evaluation of Project Report shall be done by the Guide and an External examiner.
Stage-2 Project Viva-voce: Major Project Viva-voce examination is conducted after receipt of evaluation reports from Guide and External examiner.

RUBRICS FOR SEMESTER END EXAMINATION

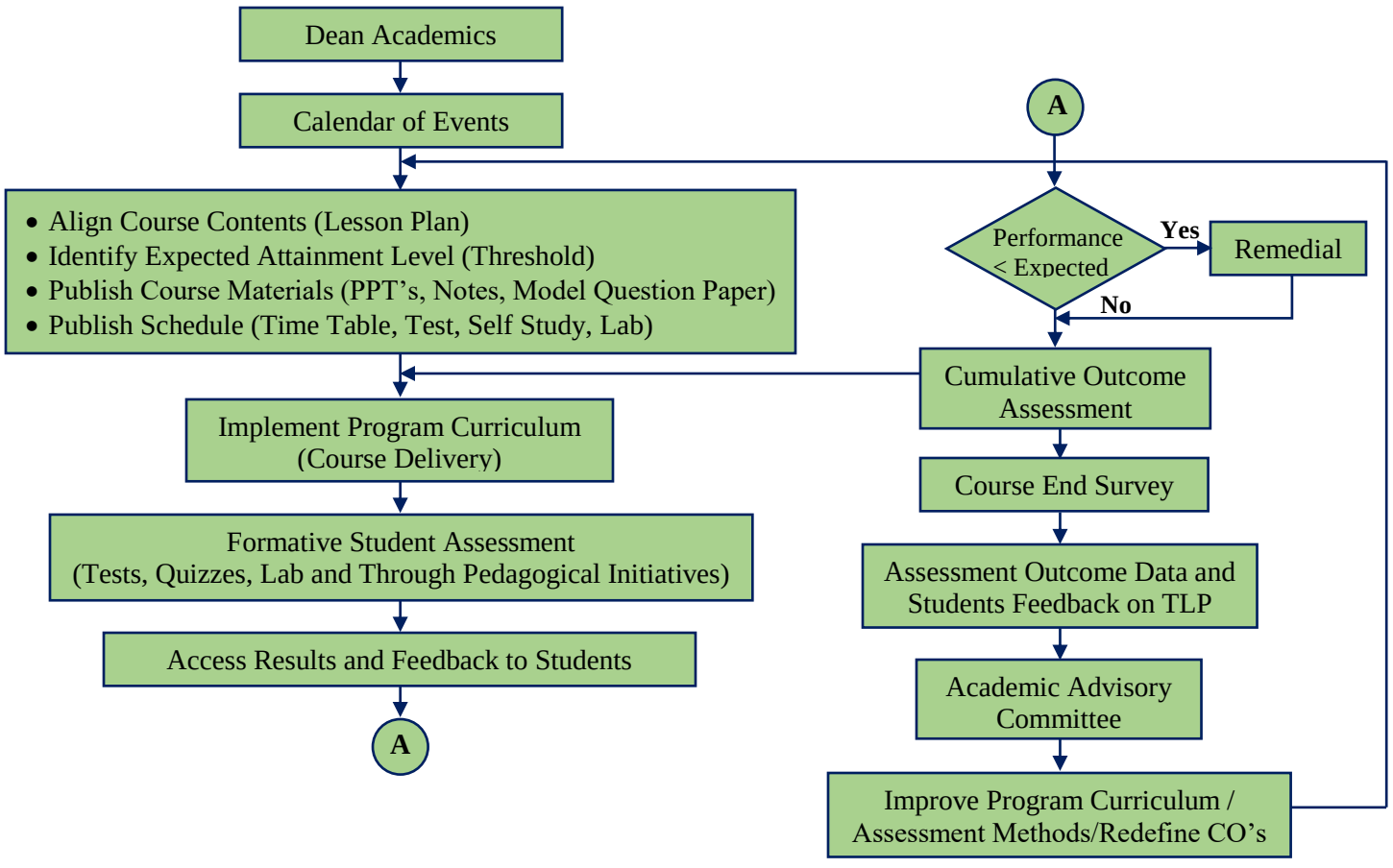
SEE procedure is as follows:

Report Evaluation	Internal Examiner: 100 Marks **(A)**	**Report Evaluation**
	External Examiner: 100 Marks **(B)**	**(A) + (B) = 200/2 = 100 (C)**
Viva-Voce	Jointly evaluated by Internal Guide & External Examiner	**100 (D)**
Total Marks = **(C+D)/2** = 200/2 =100		**100 Marks**

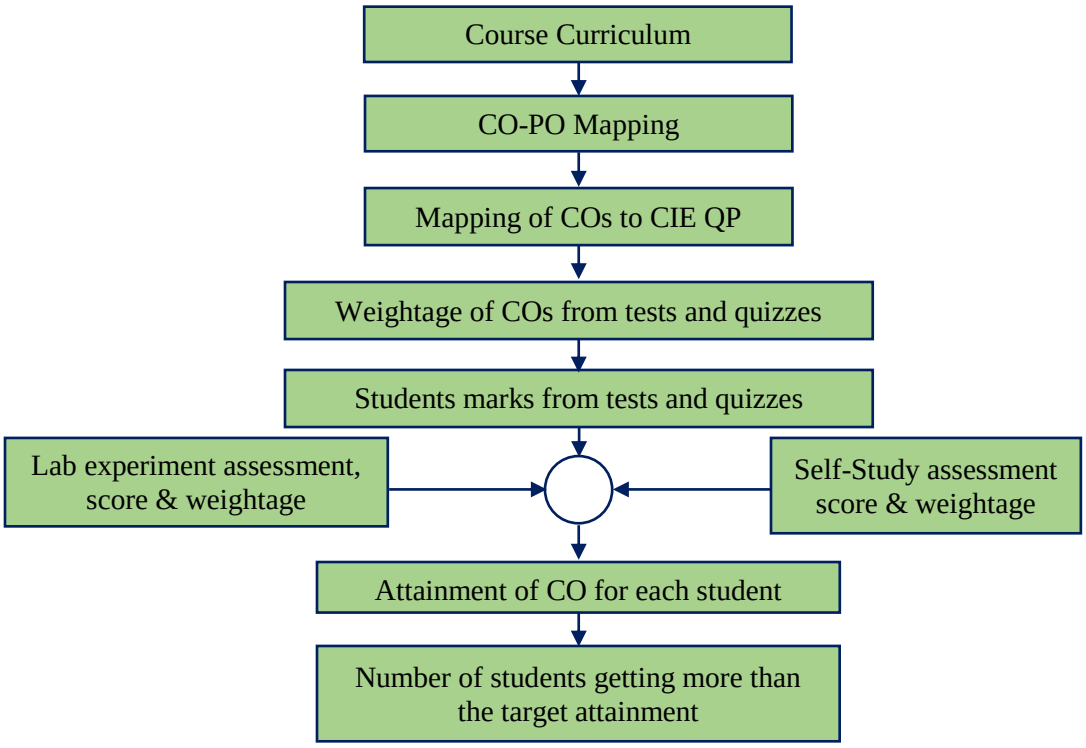
Curriculum Design Process



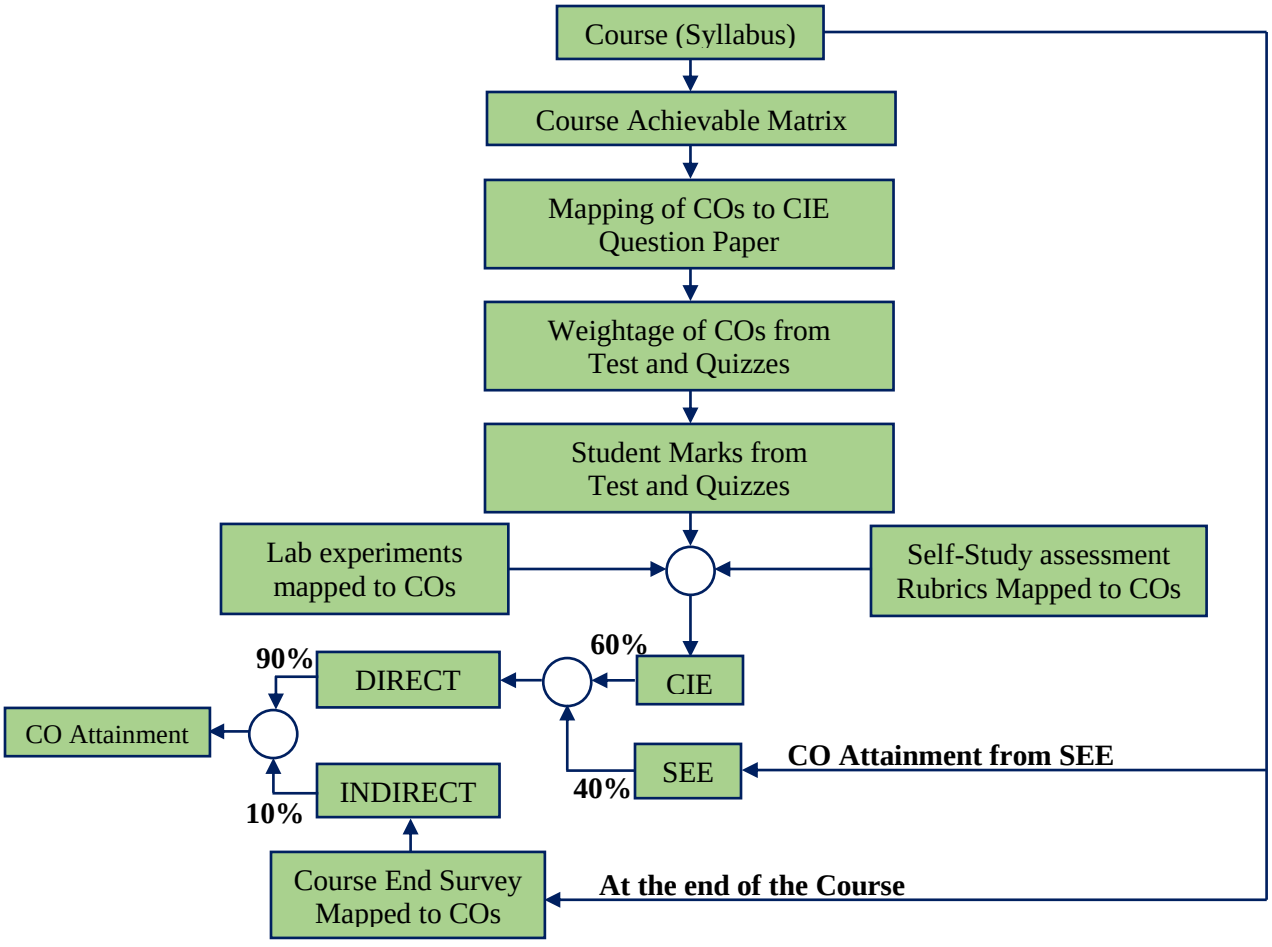
Academic Planning and Implementation



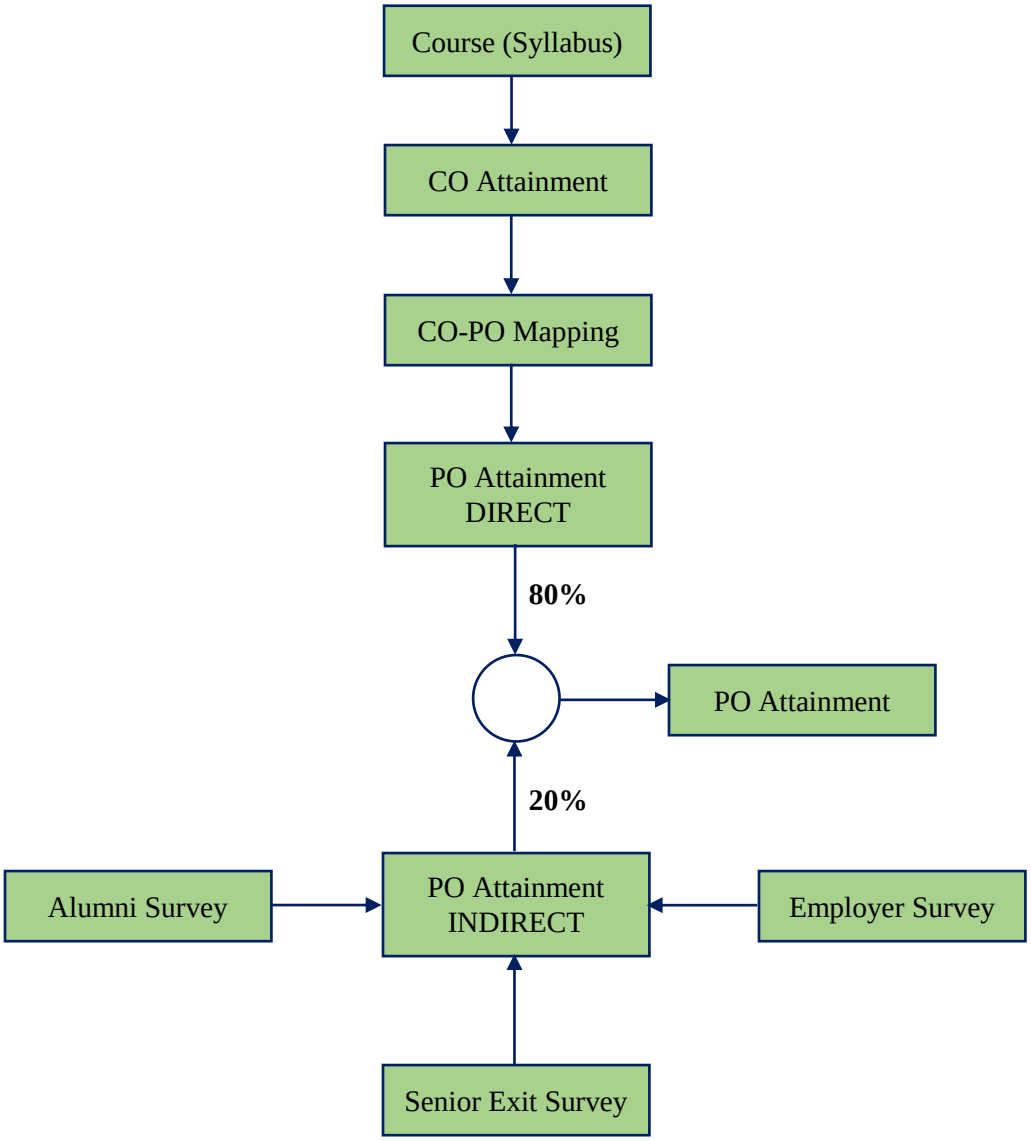
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



RV College of Engineering®
Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

KNOWLEDGE & ATTITUDE PROFILE

- **WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
- **WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
- **WK3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
- **WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
- **WK5:** Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
- **WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
- **WK7:** Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
- **WK8:** Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
- **WK9:** Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

INNOVATIVE TEAMS OF RVCE

Ashwa Mobility Foundation (AMF): Designs and fabricates Formula-themed race cars and mobility solutions to address urban transportation issues.

Astra Robotics Team: Focuses on designing and building application-specific robots.

Coding Club: Helps students gain coding skills and succeed in competitions like GSoC and ACM-ICPC.

Entrepreneurship Development Cell (E-Cell): Promotes entrepreneurship through workshops, speaker sessions, and mentoring for startups.

Frequency Club Team: Works on software and hardware, emphasizing AI and Machine Learning.

Team Garuda: Develops a supermileage urban concept electric car and E-mobility products.

Team Jatayu: Builds low-cost UAVs with autonomous capabilities for various tasks.

Solar Car Team: Aims to create a solar electric vehicle for sustainable transportation.

Team Antariksh: Focuses on space technology and the development of operational rockets.

Team Chimera: Builds a Formula Electric Car through R&D in E-Mobility.

Helios Racing Team: Designs and tests All-Terrain Vehicles, participating in SAE's BAJA competitions.

Team Hydra: Develops autonomous underwater vehicles for tasks like water purification.

Team Krushi: Creates low-cost farming equipment to assist farmers in cultivation and harvesting.

Team Vyoma: Designs and tests radio-controlled aircraft and UAVs.

Team Dhruva: Engages in astronomy-related activities and collaborates on projects with organizations like ICTS and IIA.

Ham Club: Promotes Amateur Radio and explores technical innovations in communications, especially for disaster response.

Cultural Activity Teams

1. AALAP (Music club)
2. DEBSOC (Debating society)
3. CARV (Dramatics club)
4. FOOTPRINTS (Dance club)
5. QUIZCORP (Quizzing society)
6. ROTARACT (Social welfare club)
7. RAAG (Youth club)
8. EVOKE (Fashion team)
9. f/6.3 (Photography club)
10. CARV ACCESS (Film-making

NSS of RVCE

NCC of RVCE

VISION

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology

MISSION

- To deliver outcome based Quality education, emphasizing on experientiallearning with the state of the art infrastructure.
- To create a conducive environment for interdisciplinary research and innovation.
- To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
- To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
- To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation