RV College of Engineering®

Master of Technology (M.Tech)

POWER ELECTRONICS

Scheme And Syllabus Of I & 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
Indian Institutional Ranking Framework

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

RV College of Engineering®

Master of Technology (M.Tech)

POWER ELECTRONICS

Scheme And Syllabus Of I & 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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS

VISION

Attain technical excellence in Electrical and Electronics Engineering through graduate programs and interdisciplinary research to sustainability in power, energy and allied fields

MISSION

1. To provide technical education that combines rigorous academic study and the excitement of innovation enabling the graduates to engage in lifelong learning which is essential to improve performance continuously and excel in their career.
2. To establish center of Excellence in sustainable electrical energy, smart grids and systems.
3. To establish tie-ups with industries and institutions of national and international repute and to foster building up of a wide knowledge base to keep in tune with upcoming technologies
4. To motivate commitment of faculty and students to collate, nogenerate, disseminate, preserve knowledge and to work for the benefit of society.
5. To develop simple, appropriate and cost effective inclusive technologies which are instrumental in the upliftmennt of rural society

PROGRAMME OUTCOMES (PO)

M. Tech in **Power Electronics** graduates will be able to:

PO1: Independently carry out research /investigation and development work to solve practical problems in Power Electronics.

PO2: Write and present a substantial technical report/document.

PO3: Demonstrate a degree of mastery over Power Electronics at a level higher than the requirements in bachelor program of Electrical Engineering.

PO4: Demonstrate the modern engineering tools and techniques for Modelling and Development of Power Electronic Systems.

PO5: Apply the Knowledge of Power Electronics for the development of solutions to problems pertaining to Smart grid, Renewable energy systems, Electric Vehicles and Modern Power and Control Systems.

PO6: Demonstrate Professional Integrity, Ethics, Teamwork, Soft Skills for lifelong learning and sustainable development in the field of Power Electronics.

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

POSTGRADUATE 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

INDEX

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	MPE212IA	Power Electronic Converters - I	3	0	1	**4**	EE	Theory+Lab	1.5	100+50	3+3	100+50
3	MPE213IA	Analysis and control of Electrical Drives	3	0	1	**4**	EE	Theory+Lab	1.5	100+50	3+3	100+50
4	MXX214AX	Professional Core Courses (Cluster Electives) **(Group-A)**	3	1	0	**4**	Res. BoS	Theory	1.5	100	3	100
5	MPE415DL	Design Thinking Lab	0	0	2	**2**	EE	Lab	1.5	50	3	50
6	HSS116EL	Technical English	0	0	1	**1**	HSS	Lab (ONLINE)	1.5	50	02	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)
MCS214A1	Programming, Data Structures and Algorithms using Python
MDC214A2	Multimedia Communications
MPE214A3	Electric and Hybrid Vehicles
MVE214A4	Digital System Design with FPGA

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	MPE221IA	Power Electronic Converters - II	3	0	1	**4**	EE	Theory+Lab	1.5	100+50	3+3	100+50
2	MPE322IA	Power Electronics in Renewable Energy Integration	3	0	1	**4**	EE	Theory+Lab	1.5	100+50	3+3	100+50
3	MPEX23BX	Program Specific Courses (Elective) **(Group-B)**	3	1	0	**4**	EE	Theory	1.5	100	3	100
4	MXX324CX	Professional Core Courses (Cluster Electives) **(Group-C)**	3	1	0	**4**	Res. BoS	Theory	1.5	100	3	100
5	XXX325DX	Interdisciplinary Courses (Global Electives) **(Group-D)**	3	0	0	**3**	Res. BoS	Theory	1.5	100	3	100
6	MIM426RT	Research Methodology (NPTEL)	2	0	0	**2**	IM	NPTEL	--	--	ONLINE	100
7	MPE427SL	Skill Lab	0	0	2	**2**	EE	Lab	1.5	50	3	50
Total Credits						**23**						

Code	Program Specific Courses (Elective) (Group-B)
MPE223B1	PWM Techniques in Power Electronic Circuits
MPE223B2	HVDC Transmission
MPE223B3	Smart Grid Technologies and IoT Applications
MPE223B4	AI in Power Electronics

Code	Professional Core Courses (Cluster Electives) (Group-C)
MCS324C1	Computer Vision with DL
MDC324C2	Adhoc Networks
MPE324C3	Intelligent Control Techniques in Electrical Drives
MVE324C4	Semiconductor Manufacturing

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

****Open to all PG programs**

*Cluster-wise Courses Common to PG Programs

Clusters

CSE Cluster - PG Programs (CSE, NE, 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)

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	MPE331TA	Modelling and Design of Power ELectronic Circuits	3	1	0	**4**	EE	Theory	1.5	100	3	100
2	MPEX32EX	Professional Elective Courses (NPTEL) **(Group-E)**	2	0	0	**2**	EE	NPTEL	--	--	ONLINE	100
3	MPE433P	Minor Project	0	0	6	**6**	EE	Project	***	50	3	50
4	MPE434N	Internship*	0	0	6	**6**	EE	Internship	***	50	3	50
Total Credits						**18**						

***To be undertaken after completion of 2nd sem and before commencement of 3rd semester (6 weeks duration)**

Code	Professional Elective Courses (NPTEL) (Group-E)
MPE232E1	Electromagnetic Compatibility
MPE232E2	Introduction To Operating systems
MPE232E3	Machine Learning
MVE232E4	Sensor Technologies: Physics, Fabrication and Circuits

IV 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	MPE341FX	Program Specific Courses (NPTEL Elective) – **(Group-F)**	2	0	0	**2**	EE	NPTEL	--	--	ONLINE	100
2	MPE442P	Major Project	0	0	18	**18**	EE	Project	--	100	3	100
Total Credits						**20**						

Code	Program Specific Courses (NPTEL Elective) – (Group-F)
MPE341F1	Embedded Systems Design
MPE341F2	Power Quality Improvement Techniques
MPE341F3	FACTS Devices
MPE341F4	Optimal Control

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+45EL+ 30T	*(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 factorization, Least Square problems, application to linear models.

UNIT - III	9 Hours

Symmetric matrices and Quadratic forms:
Real symmetric matrices, Eigen values and Eigen vectors, 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	:	MPE212IA	**POWER ELECTRONIC CONVERTERS - I**	CIE Marks	:	100 + 50
Credits L-T-P	:	3-0-1	*(Theory & Practice)*	SEE Marks	:	100 + 50
Hours	:	45L+45EL+30P	*(Professional Core Course with Integrated Lab) -1*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

Introduction To Power Semiconductor Devices:

Power Diodes, BJT, Thyristor, Power MOSFET, IGBT and GTOs – Device structure and theory of operation, characteristics, rating and specifications, gate drive requirement circuits, protection circuits and applications.

UNIT - II	**9 Hours**

Line Commutated Converters:

Analysis of Three phase semi controlled & fully controlled converter continuous and discontinuous mode of operation. Performance parameter Evaluation with Harmonic Analysis. Analysis of 12-pulse converter.

Single-phase and Three-phase Dual converters and effect of source inductance, Controlled rectifier with power factor improvement methods.

UNIT - III	**9 Hours**

DC/DC Converters:

Introduction to Switch mode converters, Comparison of linear and switch mode converters, types. Design and Analysis of Non-Isolated DC-DC converters: Buck, Boost, Buck-Boost, Cuk and SEPIC – continuous and discontinuous mode of operation. Design of inductors.

UNIT - IV	**9 Hours**

Inverters:

Single-Phase Inverter, Harmonic analysis of PWM based inverter, Bipolar and Unipolar Switching with Sinusoidal Pulse Width Modulation.

Three Phase Inverters -Three Phase Square Wave /Stepped Wave Inverters. Three Phase SPWM Inverters. Choice of Carrier Frequency in Three Phase SPWM Inverters. Multi-Level Inverters - Diode Clamped Type, Flying Capacitor Type and cascaded H-bridge.

UNIT - V	**9 Hours**

AC Voltage Controllers:

Principle of on-off control, phase control: single and 3 phase controllers – Design and analysis with R and R-L loads.

Thermal design of power electronic device- Component Temperature Control and Heat Sinks. EMI and EMC issues and mitigation in power electronic systems.

LABORATORY	**30 Hours**

1. Simulation and hardware circuit analysis of 3-phase semi-controlled converters with R and RL loads.
2. Simulation and hardware circuit analysis of 3-phase fully-controlled converters with R and RL loads.
3. Simulation and hardware circuit analysis of Buck, Boost and Buck-boost converter.
4. Simulation and hardware circuit analysis of Cuk and SEPIC Converter.
5. Simulation and hardware circuit analysis of single-phase Dual converter.
6. Simulation and hardware circuit analysis of single-phase bridge inverter for R load with

different PWM techniques.

7. Simulation and hardware circuit analysis of 3 phase bridge inverter R and RL load.
8. Simulation of Cascaded H-Bridge multi-level inverter.
9. Simulation and hardware circuit analysis of Diode-clamped multi-level inverter.

Experiential Learning:

1. Development of Bi-directional converter.
2. Simulation of 12-pulse converter.

Course Outcomes:

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

CO1	:	Analyse the operation switching devices and various power converter circuits.
CO2	:	Design power electronic converter circuit for specific application.
CO3	:	Evaluate the performance parameters, harmonic analysis of power converters.
CO4	:	Selection of power devices and implementation of power converters to meet the requirements of specific application.

Reference Books

1. Fundamentals of Power Semiconductor Devices, B. Jayant Baliga, 1st Edition, 1995, International Thompson Computer Press, ISBN:9780387473130.
2. Power Electronics Converters, Applications, and Design, Ned Mohan, Tore M. Undeland, William P. Robbins, 3rd Edition, 2011, Wiley India Pvt Ltd, ISBN: 978-0-471-22693-2.
3. Power Electronics, Circuit Devices and Applications, M. H. Rashid, 3rd Edition, 2003, Prentice Hall Publisher, ISBN-10: 0131011405.
4. Power Electronics, M D Singh, K B Khanchandani, 2nd Edition, 2012, Mc. Graw Hill, ISBN 978007058389.

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	:	MPE213IA	**ANALYSIS AND CONTROL OF ELECTRICAL DRIVES**	CIE Marks	:	100 + 50
Credits L-T-P	:	3-0-1	*(Theory & Practice)*	SEE Marks	:	100 + 50
Hours	:	45L+45EL+30P	*(Professional Core Course with Integrated Lab) -2*	SEE Duration	:	3 Hours

UNIT - I	9 Hours

Dynamics of Electric drives: Fundamentals of torque equations, speed torque conventions and multi-quadrant operations, drive parameters, components of load torque, classification of load torques, steady state stability, and load equalization.

Selection of motor power ratings: Thermal model of motor for heating and cooling, classes of motor duty, determination of moto ratings, Electrical drives: advantages, parts of electric drives, choice of electrical drives, and status of DC AC drives.

UNIT - II	9 Hours

Electric Braking: Types of Braking, braking of dc motors during lowering of loads, braking while stopping, Electric braking of Induction motors, Braking of Synchronous motors.

Controlled rectified DC motor Drive: Analysis of series and separately excited DC motor with single phase and three phase converters operating in different modes and configurations. Single phase Dual converter (armature control of DC separately excited motor)

Chopper Control of DC Drives: Analysis of series and separately excited DC motors fed from different choppers for both time ratio control and current limit control, four quadrant control.

UNIT - III	9 Hours

Scalar control of AC machines:

Induction motor drive: Stator Voltage control, Stator Frequency control, Stator Variable Voltage and Variable Frequency control (VVVF), Stator current control, Static rotor-resistance control, Slip-power recovery- Static Kramer drive and Scherbius Drive.

Synchronous Motor Drive: Cylindrical Rotor Motors, Salient-pole motors, Reluctance motors, Permanent-magnet motors.

UNIT - IV	9 Hours

Generalized mathematical modelling: dynamic d-q model of Induction and Synchronous motor.

Vector or Field-Oriented Control: DC drive Analogy, Equivalent Circuit and Phasor Diagram, Principle of Vector control, Flux vector estimation-Voltage model, Indirect or Feedforward Vector control, Direct Torque and Flux control (DTC).

UNIT - V	9 Hours

Electric drive for Electric Vehicles

Switched Reluctance Motor Drive-Basic Magnetic structure, Torque production, SRM Drive converter, modes of operation, sensorless control-phase flux linkage-based method

Vernier Permanent magnet motor drive: structure, principle

Case Studies: Industrial application of electrical drives.

LABORATORY	30 Hours

1. To simulate and study Dynamic braking of Separately excited DC Motor drive using MATLAB/Simulink.
2. To simulate and study implement DC Dynamic braking of Induction motor using MATLAB/Simulink.
3. To implement speed control of DC separately excited electric drive using single-phase controlled rectifier.
4. To implement speed control of DC separately excited electric drive in I and II Quadrant

Chopper control below base speed using H-Bridge.

5. To implement speed control of single-phase induction motor using Triac-based phase control method.
6. To implement speed control of induction motor using PWM inverter by changing the stator voltage.
7. To simulate and study speed control of induction motor using PWM inverter by changing the stator frequency below rated speed using MATLAB/Simulink.
8. To implement V/f control of three-phase induction motor under base speed.
9. To implement speed control of Switched Reluctance Motor Drive.
10. To implement speed control of Permanent Magnet Synchronous motor drive for Electric Vehicle application.
11. Simulate the closed loop Speed control of DC-Separately excited motor with constant speed and variation in load torque.
12. Simulate the speed control of Induction motor by using vector-controlled method with step change in reference speed.

Course Outcomes:

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

CO1	:	Analyse the requirements and select drive system for a given application.
CO2	:	Evaluate the issues related to effect of harmonics and external disturbances of electric drives.
CO3	:	Analyse the control modules for closed loop operation of an electric drive system.
CO4	:	Design the electric drive system as per given specifications.

Reference Books

1. Fundamentals of Electric drives, Gopal K Dubey, 2nd Edition, 2010, Narosa publisher, ISBN: 978-81-7319-428-3.
2. Modern Power electronics and AC Drives, Bimal K Bose, 1st Edition, 2001, PHI publication, ISBN13: 978-0130167439.
3. Power Electronics converters, Applications, and design, Ned Mohan, T M Undeland, W P Biobbins, 3rd Edition, 2012, Wiley publication, ISBN: 978-81-265-1090-0.
4. Generalized Theory of Electrical Machines, PS Bhimbra, 7th edition, 2021, Khanna Book Publishing Co. P Ltd

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]**

SI. 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	:	MCS214A1	**PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+ 30T	*Professional Core Courses (Cluster Electives) (Group-A)*	SEE Duration	:	3 Hours

UNIT - I	9 Hours

Introduction to data structures: Introduction to oops concepts. Introduction to data representation, Linear Lists, Linked Representation

Algorithm Analysis: Mathematical Background, Model, What to Analyze, Running Time Calculations.

UNIT - II	9 Hours

Stack and queue: Stack and queue implementation using linear list and linked list. Stack application- Parenthesis matching, Queue application-railroad car rearrangement.

Hashing: Hash table representation- ideal hashing, hashing with linear open addressing, hash tables with chains

UNIT - III	9 Hours

Binary and other Trees: Trees, Binary Trees, Properties and Representation of Binary Trees-Formula Based Representation, Linked Representation, Common Binary Tree Operations.

Binary Search Tree (BST). Organizing data in a BST. Inserting and deleting items in a BST.

UNIT - IV	9 Hours

Priority Queues (Heaps): Model, Simple Implementations, Binary Heap, Leftist Heaps.

Graph Algorithms: Definitions, Properties of graphs, Representation of Graphs, Shortest-Path Algorithms, Network Flow Problems, Minimum Spanning Tree, Depth-First Search, Breadth-First Search, Introduction to NP-Completeness

UNIT - V	9 Hours

Searching and Sorting Techniques:

Sorting Techniques: Bubble sort, Merge sort, Selection sort', Heap sort, Insertion Sort. Searching Techniques: Sequential Searching, Binary Searching, Search Trees.

Algorithm Design Techniques:

Greedy Algorithms, Divide and Conquer, Dynamic Programming, Randomized Algorithms, Backtracking Algorithms.

Course Outcomes:

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

CO1	:	Illustrate the fundamental concepts of various technologies in data structures which are used in computer programs
CO2	:	Derive the solution by applying the acquired knowledge of classic data structures: array lists, linked lists, stacks, queues, heaps, binary trees, hash tables.
CO3	:	Evaluate the solution of the problems using graph algorithms to the real-world problems arising in many practical situations
CO4	:	Design and development of various algorithms built using different data structures knowledge to apply and engage in life–long learning.

Reference Books

1. Data Structures and Algorithm Analysis in C++, M. A. Weiss. 3rd Edition, Addison-Wesley, ISBN-10: 032144146X & ISBN-13: 9780321441461

2. Data structures, Algorithms and applications in C++, Sartaj Sahani, 1st Edition, McGraw

Hill; 2000, ISBN: 10:007236226X
3. Data Structures Using C++, D.S. Malik, 2nd Edition, 2009, Cengage Learning, ISBN- 13: 978-0-324- 78201-1
4. Data Structures & Algorithms in Java, Goodrich, Goldwasser, 6th Edition, Wiley Publications, ISBN: 978-1-118-77133-4

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: I						
Course Code	:	MDC214A2	**MULTIMEDIA COMMUNICATION**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+30T	*Professional Core Courses (Cluster Electives) (Group-A)*	SEE Duration	:	3 Hours

UNIT - I	9 Hours
Multimedia Communications: Multimedia information representation, multimedia networks, multimedia applications, network QoS and application QoS.	
UNIT - II	**9 Hours**
Standards and Protocols: JPEG (image compression), JPEG 2000 compression standard – development process, features, architecture, bit stream, Audio coding standards for Multimedia: Dolby, AA3, Vorbis. MPEG – 21 multimedia frame work, Protocols - RTP, RTCP, RTSP, RSVP.	
UNIT - III	**9 Hours**
Video compression: Video compression principles, video compression standards: H.261, H.263, MPEG 1, MPEG 2, and MPEG 4. DivX, Flash Video, Avi, WMV.	
UNIT - IV	**9 Hours**
Multimedia Entertainment Networks: Introduction, Cable TV networks, Satellite TV networks, Terrestrial TV networks. High speed PSTN access Technologies.	
UNIT - V	**9 Hours**
Digital Video Broadcasting: DVB Interoperabilities, DVB System, Baseband processing, Digital Television, Services over IP-based networks, Services, Authentication, Authorization. DVB and Internet: IP Multicast, Audio/Video streaming.	

Course Outcomes:

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

CO1	:	Explain multimedia information representation, networks and compression techniques
CO2	:	Analyze applications like interpersonal communication, interactive communication over the internet and entertainment networks.
CO3	:	Apply various coding methods and compression techniques.
CO4	:	Analyze and explain the various broadcasting systems.

Reference Books

1. Multimedia Communications, Fred Halsall, 2001, Pearson education, ISBN: 978-81-317-0994-8.
2. Introduction to Multimedia Communications, K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, 2014, Wiley, ISBN 13 978-0-471-46742-7.
3. Multimedia Communication Systems, K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, 2004, Pearson education, ISBN: 013031398X.
4. Data Communications and Networking, Behrouz A Forouzan, 2015, 4 th Edition, Mc Graw Hill publication, ISBN-13:978-0-07-063414-5.

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: I						
Course Code	:	MPE214A3	**ELECTRIC AND HYBRID VEHICLES (Theory)**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+ 30T	*Professional Core Courses (Cluster Electives) (Group-A)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

Introduction to EV & HEV: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive -trains on energy supplies.
Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.
EV Drive train: Basic concepts & components,
HEV Drive trains hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT - II	**9 Hours**

Electric Traction unit: Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT - III	**9 Hours**

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.
Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

UNIT - IV	**9 Hours**

Traction Motors: Design, Sizing, Thermal Analysis and Modeling.
Series and Parallel Hybrid Drive Train Design: Operation Patterns, Control Strategies, Sizing of the Major Components, Power Rating Design of the Traction Motor, Power Rating Design of the Engine/Generator, Design of PPS, Design Example.

UNIT - V	**9 Hours**

Design of DC-DC Converters for EV-HEV Applications: Multi-input DC-DC Converters, Multi-input converter Using High/Low Voltage Sources, Flux Additive DC-DC Converter, Bidirectional DC-DC Converters.
Case studies: Typical converters for EV and HEV Applications.

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

CO1	:	Analyse the configuration and propulsion systems of EV and HEV.
CO2	:	Analyse the performance EV and HEV drive trains.
CO3	:	Design the structure of EV and HEV.
CO4	:	Evaluate the PE converters performance to EV and HEV applications.

Reference Books

1. Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, “Modern Electric, Hybrid Electric

and Fuel cell vehicles: Fundamentals, Theory and Design", CRC Press, 3rd Edition, 2004, ISBN: 978-1498761772.
2. Iqbal Husain, "Electric and Hybrid Vehicles- Design Fundamentals" CRC Press, 2nd Edition, 2011, ISBN:978-1439811757.
3. Zhang Xi, Mi Chris, "Vehicle Power Management Modeling, Control and Optimization" Springer, 1st Edition, 2011, ISBN: 978-0-85729-735-8.
4. Mi Chris, Masrur A., and Gao D.W, "Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives", Wiley Publisher, 1st Edition, 2011, ISBN:0-824-77653-5.

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: I						
Course Code	:	MVE214A4	**DIGITAL SYSTEM DESIGN WITH FPGA**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+30T	*Professional Core Courses (Cluster Electives) (Group-A)*	SEE Duration	:	3 Hours

UNIT - I	9 Hours

Introduction to Verilog and Design Methodology: Verilog IEEE standards, Verilog Data Types: Net, Register and Constant. Verilog Operators, Number representation and Verilog ports, Simulation and Synthesis, Test-benches. Verilog Primitives. Logic Simulation, Design Verification, and Test Methodology: Four-Value Logic and Signal Resolution in Verilog, Test Methodology Signal Generators for Test benches, Sized Numbers.
Introduction to Design Methodology: Digital Systems and Embedded Systems, Real-world circuits. Design Methodology: Design Flow-Architecture.

UNIT - II	9 Hours

Verilog Modelling Styles:
Behavioral Modelling: Latches and Level-Sensitive Circuits in Verilog, Cyclic Behavioural Models of Flip- Flops and Latches, Behavioural Models of Multiplexers, Encoders, Decoders and Arithmetic Circuits. **Dataflow Modelling:** Boolean Equation-Based Models of Combinational Logic, Propagation Delay and Continuous Assignments. Linear-Feedback Shift Register. Tasks & Functions. **Structural Modelling:** Design of Combinational Logic, Verilog Structural Models, Top-Down Design and Nested Modules. (Hands-on using Xilinx Vivado tool)

UNIT - III	9 Hours

Synthesis of Digital Sub-systems: Synthesis of Combinational Sub-systems: Introduction to Synthesis, Synthesis of Combinational Logic, Synthesis of Sequential Logic with Latches, Synthesis of Three-State Devices and Bus Interfaces. Synthesis of Sequential Sub-systems: Synthesis of Sequential Logic with Flip- Flops, Synthesis of Explicit State Machines, Registered Logic, State Encoding, Synthesis of Implicit State Machines, Registers and Counters. (Hands-on using Xilinx Vivado)

UNIT - IV	9 Hours

System Implementation and Fabrics: CPLD vs FPGA Architecture - Programming Technologies-Chip I/O Programmable Logic Blocks- Fabric and Architecture of FPGA. Xilinx Virtex 5.0 Architecture - Xilinx Virtex VI Architecture – ALTERA Cyclone II Architecture - ALTERA Stratix IV Architecture, Hardcore and Softcore FPGA.

UNIT - V	9 Hours

Processor Design and System Development: Design of Processor Architectures: Functional Units for Addition, Subtraction and Multiplication (overview). Design: Hierarchical Decomposition STG-Based Controller Design, Efficient STG-Based Sequential Binary Multiplier. **Algorithms and Architectures for Digital Processors:** Algorithms, Nested-Loop Programs, and Data Flow Graphs.
Design Example: Halftone Pixel Image Converter Baseline Design for a Halftone Pixel Image Converter: NLP-Based Architectures for the Halftone Pixel Image Converter, Concurrent ASMD-Based Architecture for a Halftone Pixel Image Converter
Digital Filters and Signal Processors: Finite-Duration Impulse Response (FIR) Filter, Digital Filter Design Process, Infinite-Duration Impulse Response (IIR) Filter. (Examples such as counter, sequence detector, sequence generator etc are implemented on Airtex-7 FPGA board)

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

CO1	:	Define the IEEE-1364 standard and identify different modeling styles to build digital systems.
CO2	:	Analyze digital systems and build small-scale applications using Interfacing concepts.
CO3	:	Design and verify the behavior of digital circuits using digital flow.
CO4	:	Demonstrate the skill of cost-effective system designs through proper selection of implementation.

Reference Books

1. Advanced Digital Design with the Verilog HDL, Michael D. Ciletti, 2nd Edition, 2015, PHI, ISBN: 978–0–07–338054–4.
2. Digital Design: An Embedded Systems Approach Using VERILOG, Peter J. 1st Edition, 2010, Ashenden, Elsevier, ISBN: 978-0-12-369527-7
3. Digital Systems Design Using Verilog, Charles Roth, Lizy K. John, ByeongKil Lee,1st Edition, 2015, Cengage Learning, ISBN-10: 1285051076
4. Fundamentals of Digital Logic with Verilog Design, Stephen Brown and Zvonko Vranesic, 6th Edition, 2014, McGraw Hill publication, ISBN: 978–0–07–338054–4
5. Verilog HDL: A Guide to Digital Design & Synthesis, Samir Palnitkar, SunSoft Press, 1st Edition, 1996, ISBN: 978-81-775-8918-4.

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: I						
Course Code	:	MPE415DL	**ADVANCED TECHNOLOGIES IN POWER ELECTRONIC CIRCUITS AND APPLICATIONS**	CIE Marks	:	50
Credits L-T-P	:	0-0-2	*(Design Thinking/ Skill Lab)*	SEE Marks	:	50
Hours/Week	:	4	*(Practice)*	SEE Duration	:	3 Hours

Contents

Design thinking is a methodology which provides a solution-based approach to solving problems. It is extremely useful when used to tackle complex problems, as it serves to understand the societal needs involved, reframe the problem in human-centric ways, create numerous ideas in brainstorming sessions and adopt a hands-on approach to prototype and testing.

The 5 Stages in the Design Thinking Process

Stage 1: Empathize—Compile Users' Needs.
Stage 2: Define—State Users' Needs and Problems.
Stage 3: Ideate—Challenge Assumptions and Create Ideas.
Stage 4: Prototype—Start to Create Solutions.
Stage 5: Test—validate the solutions obtained.

The five stages of design thinking will help students to apply the methodology to solve complex problems that occur in product designs. The students are encouraged to apply the 5 stages in the Design Thinking Process to solve the problems in the area identified.

The broad area identified for the M.Tech in Power Electronics is as under:

1. Advanced power converter circuits with Wide Band Gap (WBG) devices for renewable energy applications.
2. Advanced controllers for EV motors.
3. Soft Computing Techniques (SCT) in power electronics.

Course Outcomes: After going through this course, the student will be able to:		
CO1	:	Demonstrate a clear understanding of the principles and stages of the design thinking process, including empathy, ideation, prototyping, and testing.
CO2	:	Apply design thinking methodologies to address complex real-world challenges and drive innovation.
CO3	:	Analyse and evaluate the success of design solutions and identify areas for improvement.
CO4	:	Develop creativity, problem-solving skills and learn iterations, trial and error, and failure that are all part of the creative learning process.

Reference Books

1. https://onlinecourses.nptel.ac.in/noc22_mg32/preview

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	:	HSS116EL	**TECHNICAL ENGLISH**	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 Hrs**
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 Hrs**
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	**10 Hrs**
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.
2. Valerie Lambert, Elaine Murray, English for Work – Everyday Technical English, Pearson Education, 2003, ISBN- 0 582 539633.
3. David Bonamy, Christpher Jacques, Technical English – First Course Book, Pearson Education, 2008.
4. S Sumant. Technical English I, The McGraw Hill, 2011, ISBN -978 81 8209 308 9.

Assessment and Evaluation Pattern (Online Mode)		
	CIE (Online Mode)	**SEE (Online Mode)**
Weightage	**50%**	**50%**
Test – I	Each test will be conducted for 50 marks adding to 100 marks. Final test marks will be reduced to 40 marks	**Final assessment will be conducted for 50 marks**
Test – II		
Experiential Learning	**10 Marks**	
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		
Maximum Marks	**50 Marks**	**50 Marks**
Total marks for the course	**50**	**50**

SEMESTER: II						
Course Code	:	MPE221IA	**POWER ELECTRONIC CONVERTERS - II**	CIE Marks	:	100 + 50
Credits L-T-P	:	3-0-1	*(Theory & Practice)*	SEE Marks	:	100 + 50
Hours	:	45L+45EL+30P	*(Professional Core Course with Integrated Lab) -3*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

Isolated DC-DC Converters: Principle of operation, Analysis and Design of isolated DC/DC converters Flyback, Forward, Push Pull, Half Bridge and Full bridge topologies in continuous and discontinuous current mode operation.

UNIT - II	**9 Hours**

Resonant Converters: Introduction to soft switching, comparison between zero voltage and zero current switching, classification, ZVS, ZCS converters, series resonant, parallel resonant and series-parallel resonant converter topologies: analysis and design.

UNIT - III	**9 Hours**

Closed loop Control of DC-DC converters: Basic control techniques: Voltage control, current control, Design of type 2 and type 3 error amplifiers, PWM ICs for DC-DC Converters.

UNIT - IV	**9 Hours**

Advanced Converters: For renewable energy integration and EV battery charging applications: Interleaved converters, High boost converter, Z source converter, Converters with multiple inputs and multiple outputs, Matrix converters, Bidirectional converters.

UNIT - V	**9 Hours**

Design of magnetic: Design of transformers.

Modelling and Stability analysis of converters

small signal modelling, State space average modelling of non-isolated converters. Optimizing the utility interface with power Electronic Systems: need for improved utility interface, single phase and 3 phase utility interfaces.

LABORATORY	**30 Hours**

1. Design, Simulation and Implementation of Flyback converter in open loop and closed loop
2. Design, Simulation and Implementation of Forward converter in open loop and closed loop
3. Design, Simulation and Implementation of half bridge and full bridge converter in open loop and closed loop
4. Simulation and implementation of ZCS Converter
5. Simulation and implementation of ZCS Converter
6. Simulation and implementation Series resonant converter
7. Simulation and implementation Parallel resonant converter
8. Simulation and implementation Series parallel resonant converter.
9. Simulation of matrix Converter
10. Simulation of high boost Converter
11. Simulation of Z source converter
12. Simulation of Interleaved converters

Course Outcomes:

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

CO1	:	Analysis of isolated DC-DC, Resonant and Advanced converters
CO2	:	Design of DC-DC converter for power supply specifications in closed loop

		condition.
CO3	:	Evaluate the performance parameters of converters
CO4	:	Implementation of converters for renewable source integration and EV battery charging applications.

Reference Books

1. Power Electronics Converters, Applications, and Design, Ned Mohan, Tore M. Undeland, William P. Robbins, 3rd Edition, Wiley India Pvt Ltd, 2011. ISBN: 978-0-471-22693-2.
2. Power Electronics, Daniel w Hart, 1st Edition, 2014, McGrawHill Education, ISBN-13: 978-0073380674.
3. Power Electronics, Circuit Devices and Applications, M. H. Rashid, 3rd Edition, 1998, PHI, ISBN10: 0131011405.
4. Power Electronics Essentials & Applications, L Umanand, 1st Editon, 2013, Willey Publisher, ISBN-978-81-265-1945-3.

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	:	MPE322IA	**POWER ELECTRONICS IN RENEWABLE ENERGY INTEGRATION**	CIE Marks	:	100 + 50
Credits L-T-P	:	3-0-1	*(Theory & Practice)*	SEE Marks	:	100 + 50
Hours	:	45L+45EL+30P	*(Professional Core Course with Integrated Lab) -4*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

Introduction to Renewable Energy Systems: Environmental aspects of energy: Impacts of renewable energy generation on environment - Qualitative study of renewable energy resources: Ocean energy, Biomass energy, Hydrogen energy, Fuel cells - Solar PV: Operating principles, solar cell and their characteristics, Wind Energy: Nature of wind, Types, control strategy, operating area.

Power quality issues with renewable energy integration: Voltage fluctuations, harmonic distortion, frequency stability, reactive power management, power imbalance and dispatch challenges, flicker, grid code compliance.

UNIT - II	**9 Hours**

Wind Energy Conversion Systems

Review of reference theory fundamentals - Principle of operation and analysis: Induction Generator: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT - III	**9 Hours**

Integration Techniques:

Solar: Block diagram of solar photo voltaic system: Line commutated converters (inversion-mode) - Boost and buck-boost converters (overview)- selection of inverter, battery sizing, array sizing.

Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters.

UNIT - IV	**9 Hours**

Wind and PV Systems Configurations

Standalone operation: Fixed and variable speed wind energy conversion systems (WECS), solar system – Grid connection Issues -Grid integrated SCIG and PMSG based WECS-Grid Integrated solar system.

Maximum Power Point Tracking (MPPT)

Techniques Used in Solar PV Systems: Perturb and Observe (P&O) MPPT Techniques, Hill Climbing (HC) Method, Incremental Conductance (InC) method.

Techniques Used in wind power generation system: TSR control, HCS control, Optimal torque (OT) control

UNIT - V	**9 Hours**

Hybrid Renewable Energy Systems

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems.

LABORATORY	**30 Hours**

1. a) V – I characteristics of a PV panel with and without partial shading

   b) Performance analysis of series and parallel connected PV with and without partial shading

2. DC – DC buck-boost converters for two-stage PV applications.
3. Design of 1-phase inverter for PV system- ON/OFF load.
4. Grid connected PV system synchronization and its performance analysis.
5. Simulation study on PV system.
6. Simulation of Wind energy generator.
7. Wind energy turbine emulator.
8. Grid connected wind energy generation using PMSG.
9. Simulation study on Hybrid (PV – Wind) power system.
10. Simulation on Intelligent controller for hybrid system

Innovative Experiment:

1. Design and analysis of renewable based charging station.
2. PV -Wind based hybrid system using Fuzzy logic controller

Course Outcomes:

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

CO1	:	Analyse various types of renewable energy technologies that are used to harness electrical power (wind and PV systems) and he operating principle and analysis of various types of Wind generators.
CO2	:	Analyse various wind and PV systems.
CO3	:	Evaluate the performance of wind and PV systems.
CO4	:	Design of PV system using DC-DC converters & inverters and design of wind systems using PMSG

Reference Books

1. S. N. Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009.
2. Rashid. M. H "Power electronics Hand book", Academic press, 2001.
3. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993
4. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.

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	:	MPE223B1	**PWM TECHNIQUES IN POWER ELECTRONIC CIRCUITS**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+ 30T	*Program Specific Courses (Elective) (Group-B)*	SEE Duration	:	3 Hours

UNIT - I	9 Hours

Introduction: Purpose of PWM control of converters, Fourier series, Harmonic voltages and their effects.

Basic PWM techniques: Triangle-comparison based PWM - single pulse. Multiple pulse, SPWM, modified, SPWM and phase displacement techniques, Third harmonic injection PWM (THIPWM), Bus-clamping PWM, selection of power electronics devices for high and low switching frequencies.

UNIT - II	9 Hours

Advanced PWM Techniques: Hysteresis band current control PWM, Harmonic Cancellation techniques Concept of space vector, Conventional space vector PWM and bus-clamping PWM, Advanced bus-clamping PWM, Comparison of PWM techniques, design considerations.

UNIT - III	9 Hours

Analysis-I

line current ripple: Synchronously revolving reference frame; error between reference voltage and applied voltage; integral of voltage error; evaluation of line current, ripple; hybrid PWM for reduced line

dc link current: Relation between line-side currents and dc link current; dc link current and inverter state; rms dc current ripple over a carrier cycle; rms current rating of dc capacitors.

torque ripple: Evaluation of harmonic torques and rms torque ripple, hybrid PWM for reduced torque ripple

UNIT - IV	9 Hours

Analysis-II

inverter's loss: Simplifying assumptions in evaluation of inverter loss, dependence of inverter loss online power factor, influence of PWM techniques on switching loss, design of PWM for low inverter loss.

Effect of inverter dead-time effect: Requirement of dead-time, effect of dead-time online voltages, dependence on power factor and modulation method, compensation of dead-time effect.

UNIT - V	9 Hours

PWM for multilevel inverters: Extension of sine-triangle modulation to three-level inverters, Extension of conventional space vector modulation to three-level inverters.

Over modulation: Per-phase approach to over modulation, Space vector approach to over modulation, A perspective from the synchronously revolving d-q reference frame.

Course Outcomes:

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

CO1	:	Analyse the basic concepts of switching techniques for power converters.
CO2	:	Analyse basic and explore advance PWM methods for inverters and converters.
CO3	:	Evaluate performance parameters like current ripple, torque ripple and losses.
CO4	:	Design a PWM controller IC for a given application.

Reference Books

1. Erickson R W, Chapman Hall, Fundamentals of Power Electronics, 1st Edition, 1997, Springer Publisher, ISBN 0-412-08541-0.
2. Ned Mohan, Tore M. Undeland, William P Robbins, Power Electronics Converters, Applications, and Design, 3rd Edition, Wiley India Pvt Ltd, 2011, ISBN: 978-0-471-22693-2.
3. Euzeli Cipriano dos Santos Jr. and Edison Roberto Cabral Da Silva, Advanced Power Electronics Converters - PWM Converters Processing AC Voltages,1st Edition, 2014, Willey – IEEE Press, ISBN: 9781118880944.
4. D. Grahame Holmes, Thomas A. Lipo, Pulse Width Modulation for Power Converters: Principles and Practice, Wiley-IEEE Press, 1st Edition, 2003, ISBN:978-0471208143.

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	:	MPE223B2	**HVDC TRANSMISSION**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+30T	*Program Specific Courses (Elective) (Group-B)*	SEE Duration	:	3 Hours

UNIT - I	9 Hours

HVDC Power Transmission Technology: Historical sketch, existing HVDC projects, Classification of HVDC links, Components of HVDC transmission system, Comparison of AC and DC Transmission, Application of DC Transmission, Modern trends in DC Transmission, Ground Return- advantages and disadvantages. Choice of converter configuration.

UNIT - II	9 Hours

HVDC Converter: Introduction to line commutated converter, analysis of six and twelve pulse converter without overlap. Effect of smoothing reactor. Two and three level voltage source converter, pulse width modulation. Analysis of converter two and three, three and four valve conduction. Conduction modes. 12 pulse detailed analysis

UNIT - III	9 Hours

Control of Converters and HVDC Link: Converter control characteristics, firing angle control, CEA control, Starting and stopping of DC link, Power control, frequency control. Reactive power control, tap changer control. Control of voltage source converter.

Converter Faults and Protection: Converter faults, protection against over voltages, over currents in converter station. Surge arrester. Protection against faults in voltage source converter.

UNIT - IV	9 Hours

Smoothing Reactor and DC Line: Smoothing reactors, effects of corona loss, DC line insulators, Transient over voltages in DC line, protection in DC line. Detection and protection of faults, DC breakers.

Reactive Power Control: Reactive power control in steady state and transient state. Sources of Reactive power, SVC and STATCOM

UNIT - V	9 Hours

Power Flow Analysis in AC/DC System: Introduction to DC system model, procedure, inclusion of constraints, Power flow analysis under dynamic conditions, power flow with VSC based HVDC system. Introduction to stability concepts, analysis of voltage stability in asynchronous AC/DC system.

Multi Terminal DC System: Introduction, type, control and protection.

Course Outcomes:

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

CO1	:	Analyse modern long distance transmission technology, and related issues.
CO2	:	Analyze the control of converter and faults in the system.
CO3	:	Evaluate the power control in AC/DC systems and its modeling.
CO4	:	Design DC reactor, filters and transmission line as per the specifications.

Reference Books

1. Direct current Transmission, Kimbark E.W. Vol 1, Wiley Interscience,1971. ISBN 0471475807, 9780471475804.
2. High Voltage Direct Current Power Transmission system- Technology and Systems Interactions, Padiyar K R, 1992, Wiley Eastern Ltd, ISBN-13: 978-1906574772.
3. High voltage direct current transmission, Arrillage, 1st Edition, 1983, Peter pregrinus Ltd., London, ISBN 0906048974, 9780906048979.

4. High voltage direct current power transmission, Adamson C Hingorani N G, Grraway ltd, London, 1960.

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	:	MPE223B3	**SMARTGRID TECHNOLOGIES AND IoT APPLICATIONS**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+30T	*Program Specific Courses (Elective) (Group-B)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

Introduction to Smart Grid

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.

UNIT - II	**9 Hours**

Smart Grid Technologies

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

UNIT - III	**9 Hours**

Smart Metering

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

UNIT - IV	**9 Hours**

Power Quality Management in Smart Grid

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT - V	**9 Hours**

Smart Grid Communication System

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security issues for Smart Grid.

Course Outcomes:

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

CO1	:	Analyse the concepts of Smart grid.
CO2	:	Evaluate the various communication and measurement technologies in smart grid.
CO3	:	Analysis and stability of smart grid.
CO4	:	Evaluate renewable energy resources and storages integrated with smart grid along with high performance computing for smart grids

Reference Books

1. Smart Grid: Technology and applications, Ekanayake J., Jenkins N., Liyanage K., Wu, J., Yokoyama A., 1st Edition, 2012, Wiley Publications, ISBN 978-0-470-97409-4.

2. Smart Grids, Nouredine Hadjsaid and Jean-Claude, 1st Edition, 2012, Wiley Publications, ISBN – 978-1-84821-261-9.

3. Communication Networks for Smart Grids: Making Smart Grid Real (Computer

Communications and Networks,), Kenneth C. Budka, Jayant G. Deshpande, Marina Thottan, Springer, 1st Edition, 2014, ISBN:978-1447163015.

4. Smart Grid: Fundamentals of Design and Analysis, James Momoh, 1st Edition, 2012, Wiley-IEEE Press, ISBN: 978-0-470-88939-8.

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	:	MPE223B4	**AI IN POWER ELECTRONICS**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+30T	*Program Specific Courses (Elective) (Group-B)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

Introduction to AI & ML

Definitions and scope of AI and ML Overview of AI methods: Supervised, Unsupervised, and Reinforcement Learning, tools and frameworks (e.g., Python, TensorFlow, MATLAB)

AI Techniques: Basics of ANN and backpropagation, Introduction to fuzzy sets and membership functions, fundamentals of Genetic Algorithms (GA) and Optimization.

UNIT - II	**9 Hours**

AI for Power Devices

Device-level control and optimization: AI-based switching techniques for MOSFETs and IGBTs, Dynamic performance enhancement using AI algorithms.

Thermal and reliability management: AI for junction temperature prediction and thermal runaway prevention, Lifetime estimation of power electronic devices using AI.

Fault detection and protection: Real-time fault isolation in semiconductor devices, AI-driven protection schemes for device failure mitigation

UNIT - III	**9 Hours**

AI-based Control of Power Converters

AI in control of DC-DC converters: Implementation of AI for MPPT in solar PV systems, AI-enhanced stability in buck, boost, and buck-boost converters.

AI-driven control of DC-AC inverters: Real-time modulation techniques using neural networks, Fault-tolerant control strategies.

Adaptive control of AC-DC converters: Power factor correction using AI.

UNIT - IV	**9 Hours**

AI in Electrical Drives

AI-based motor control: Neural network-based speed and torque control of AC and DC drives, Optimization of V/F control in induction motors using AI

Fault detection in electrical drives: AI-driven fault diagnosis for motor windings and bearings, Predictive maintenance of drive systems

Energy efficiency enhancement: AI for loss minimization in motor drives, Adaptive control for dynamic load conditions

UNIT - V	**9 Hours**

AI in Converter Efficiency and Reliability Enhancement

Efficiency optimization of power converters: Loss minimization using AI-based algorithms, Thermal management of converters with AI predictions.

Reliability improvements: AI for fault prediction and isolation in converters, Health monitoring of power electronic components

Course Outcomes:

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

CO1	:	Evaluate the principles of Artificial Intelligence (AI) and its applications in power electronics.
CO2	:	Analyze how AI techniques can optimize and control power electronic systems.
CO3	:	Develop practical skills in implementing AI algorithms for power electronic applications.
CO4	:	Evaluate current research and industrial trends in AI-driven power electronics.

Reference Books
1. A. P. Kaushik and T. S. Rathore, "Artificial Intelligence and Machine Learning for Engineers", WILEY publication, 2nd Edition, 2008, ISBN: 9788126527410.
2. Ned Mohan, Tore M. Undeland, and William P. Robbins, "Power Electronics: Converters, Application", WILEY publication, 3rd Edition, 2009, ISBN 978-81-317-0534-6.
3. Charu Aggarwal, " Neural Networks and Deep Learning ", Springer, 2nd Edition, 1998, ISBN:978-81-203-2373-5.
4. S. R. Doradla and A. Tripathi, " Optimization of Power Electronics ", CRC Press, 3rd Edition, 2011, ISBN: 978-0-470-74376-8.
5. “Artificial Intelligence and Machine Learning for Power Electronics” by X. Wang.
6. Research papers and articles from IEEE Xplore, Elsevier, and other journals.

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	:	MCS324C1	**COMPUTER VISION WITH DL**	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**

Image Formation Models: Introduction: Overview and Applications.
Image formation: Digital images for representing 2D, 3D, and moving objects. The human eye and digital camera models. Photometric information: Colour: Physics of Colour, human perception of Colour, Colour models (RGB, HSI).
Geometric-information: Representing points, lines, planes, surfaces, and shapes in 3D, nature and structure of medical images. Two-dimensional and three- dimensional geometric transformations of images and 3D scenes

UNIT - II	**9 Hours**

Image Processing: Image Processing: Point operators, Linear filtering, Fourier Transform, Geometric transformation. Image filtering: Gray-level transformations, histograms, convolution, noise reduction, spatial and Fourier domain filtering and convolution, Gaussian filtering, and image resolution pyramids.
Using Open CV: Smoothing Images, Median Filter, Gaussian Filter, Bilateral Filter, Changing the Shape of Images, Thresholding, Calculating Gradients, Performing Histogram Equalization

UNIT - III	**9 Hours**

Features Detection and Classification: Feature detection and matching: gradient vector, Canny's edge detection, Harris-corner detector. Contours: Model fitting, Total LSE, Least Median Square Error. RANSAC, Hough transform. Image stitching, clustering techniques, K-mean clustering, PCA**,** Using Open CV: RANSAC Algorithm, SIFT Algorithm

UNIT - IV	**9 Hours**

Image-based rendering: Image classification using Artificial Neural Networks and CNN, View-dependent texture maps
Application: Photo Tourism. Video-based rendering, Video-based animation, Video textures
Application: Animating pictures

UNIT - V	**9 Hours**

Real time use cases: Computer Vision Methods for Video Content Analysis: Object detection, Face detection, Pedestrian detection, Face recognition, Eigenfaces, Active appearance and 3D shape models, Application: Personal photo collections. Instance recognition, Geometric alignment, Large databases**,** Application: Location recognition, Recognition databases and test sets.

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

CO1	:	Explore and acquire knowledge on fundamentals of Computer Vision concepts.
CO2	:	Analyze and interpret the inherent difficulties encountered in Computer Vision.
CO3	:	Apply Computer Vision techniques to solve problems in the visible world around us.
CO4	:	Investigate and draw inferences by processing Images in real-time applications.

Reference Books
1. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer Verlag, 2013 Edition, ISBN-13: 978-1848829343, ebook:http://szeliski.org/Book/
2. Practical Machine Learning and Image Processing: For Facial Recognition, Object Detection, and Pattern Recognition Using Python, Himanshu Singh, 1st Edition, Apress, ISBN:978-1-4842- 4149-3
3. Computer Vision: A Modern Approach, David Forsyth and Jean Ponce, 2nd edition, 2015, Pearson Education India, ISBN-10: 9332550115, ISBN-13: 978-9332550117
4. Introductory Computer Vision, Imaging Techniques and Solutions, Adrian Low, 2nd Edition, 2010, BS Publications, ISBN-13 9788178001977.

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	:	MDC324C2	**ADHOC NETWORKS**	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: Introduction to Cellular and Ad hoc wireless networks, Applications of ad hoc networks, Issues in ad hoc wireless networks, Medium access scheme, Routing, Multicasting, Transport layer protocols, Pricing scheme, Quality of Service provisioning, Self-organization, Security, Address and security discovery, Energy management, Scalability.

UNIT - II	9 Hours

MAC Protocols: Issues in designing a MAC Protocol for ad hoc wireless networks, design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classification of MAC Protocols, Contention based Protocols, Contention based Protocols with Reservation mechanism, Contention Based MAC Protocols with Scheduling Mechanisms

UNIT - III	9 Hours

Routing Protocols: Design issues and classification, Table-driven, On-demand and Hybrid routing protocols, Routing protocols with efficient flooding mechanisms, Hierarchical and Power-aware routing protocol.

UNIT - IV	9 Hours

Multicast Routing Protocols: Design issues and operation, Architecture reference model, Classification, Tree-based and Mesh based protocols, Energy-Efficient multicasting, Multicastingwith Quality-of-Service guarantee, Application dependent multicast routing.

UNIT - V	9 Hours

Quality of Service and Security Issues: Issues and challenges in providing QoS, Classification of QoS solutions, MAC layer solutions, Network layer solutions, QoS frameworks, Network security issues. Energy Management: Need, Classification of battery management schemes, Transmission powermanagement schemes, System power management schemes.

Course Outcomes:

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

CO1	:	Understand the fundamental of ad hoc wireless networks and cellular networks.
CO2	:	Analyze contention-based MAC protocols and routing protocols for ad hoc networks
CO3	:	Analyze the design aspects and the limitation of the Multicast routing Protocols
CO4	:	Evaluate the performance of ad hoc networks using quality of service and Energy management

Reference Books

1. C. Siva Ram Murthy, B. S. Manoj, Ad-Hoc Wireless Networks: Architectures and Protocols, 2012,1st Edition, Prentice Hall, New Jersey. ISBN- 978-81-26547-86-9.
2. C-K. Toh, AdHoc Mobile Wireless Networks: Protocols and Systems, 2011, 1st Edition, PrenticeHall, New Jersey. ISBN- 978-01-30078-17-9.
3. Mohammad Ilyas, The Handbook of AdHoc Wireless Networks, 2012, 1st Edition, CRC press,Florida. ISBN -978-03-67248-26-0.
4. Minoru Etoh, Next Generation Mobile Systems 3G and Beyond, 2011, 1st Edition, Wiley Publications, NewJersey. ISBN: 978-04-70091-51-7.

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	:	MPE324C3	**INTELLIGENT CONTROL TECHNIQUES IN ELECTRICAL DRIVES**	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
Faculty Coordinator:						

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	:	Analyse the concepts ANN and Fuzzy Logic.
CO2	:	Analyse 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	:	MVE324C4	**SEMICONDUCTOR MANUFACTURING**	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

An Introduction to Microelectronic Fabrication: Semiconductor Substrates, Crystallography and Crystal Structure, Crystal Defects, Czochralski Growth, Bridgman Growth of GaAs, Float Zone Growth, Wafer Preparation and Specifications

UNIT - II	9 Hours

Hot Processing and Ion Implantation: Diffusion, Fick's Diffusion Equation in One Dimension, Atomistic Models of Diffusion, Analytic Solutions of Fick's Law, Diffusion Coefficients for Common Dopants, Analysis of Diffused Profiles, Diffusion in SiO2, Simulations of Diffusion Profiles

UNIT - III	9 Hours

Thermal Oxidation: The Deal–Grove Model of Oxidation, The Linear and Parabolic Rate Coefficients, The Initial Oxidation Regime, The Structure of SiO2, Oxide Characterization, The Effects of Dopants During Oxidation and Polysilicon Oxidation, Silicon Oxynitrides, Alternative Gate Insulators, Oxidation Systems, Numeric Oxidations

UNIT - IV	9 Hours

Resistivity: Two-Point Versus Four-Point Probe, Wafer Mapping, Resistivity Profiling, Contactless Methods, Conductivity Type, Contact Resistance and Schottky Barriers, Metal-Semiconductor Contacts, Contact Resistance, Measurement Techniques, Schottky Barrier Height, Comparison of Methods

UNIT - V	9 Hours

Statistical Process Control: Statistics Review: Distributions & Estimation, Hypothesis Tests and Control Chart, Control Charts, Advanced Control Charts, Nested Variance, Experimental Design

Course Outcomes:

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

CO1	:	Acquire the concepts of fabrication process and characterization techniques of IC technology.
CO2	:	Analysis of different process parameters in IC fabrications.
CO3	:	Define different standard operating procedure in IC fabrication.
CO4	:	Evaluate different analytic techniques in fabrication process.

Reference Books

1. Stephen A. Campbell, "Fabrication Engineering at the Micro and Nanoscale", Third Edition, University of Minnesota, Oxford University Press, 2008.
2. Dieter K. Schroder, "Semiconductor Material and Device Characterization", Wiley - IEEE, 2006.
3. Yuan Taur, Tak H. Ning, "Fundamentals of Modern VLSI Devices", 2nd edition , 2013 Cambridge University Press, ISBN: 978-1107635715.
4. Richard Jaeger, "Introduction to Microelectronic Fabrication": Volume 5, Modular Series on Solid State Deviced, 13 November 2001.

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 Course Global Elective 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 Course Global Elective 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, 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	:	MCN325DC	**CYBER FORENSICS AND CYBER LAWS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*(Interdisciplinary Basket Course-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 **9 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 **9 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 **9 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: 0128016353

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	:	MCV325DD	**INDUSTRIAL SAFETY AND HEALTH**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*(Interdisciplinary Course Global Elective 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)		
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	:	MCV325DE	**ADVANCED TECHNOLOGIES FOR TRANSPORTATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*(Interdisciplinary Course Global Elective 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)		
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	:	MEC325DF	**DESIGN & 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	*Professional Core Courses (Cluster Electives) (Group-C)*	SEE Duration	:	3 Hours

UNIT - I — **9 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 — **9 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 — **9 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 — **9 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 — **9 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 augmented 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

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	:	MEE325DG	**ELECTRIC VEHICLE TECHNOLOGY**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*(Interdisciplinary Course Global Elective Group-D)*	SEE Duration	:	3 Hours

UNIT - I	**9 Hours**

History, Basics of Electric Vehicles, Components of Electric Vehicle, General Layout of EV, EV classification: Battery Electric Vehicles (BEVs), Hybrid Electric Vehicle (HEV), Fuel-Cell Electric Vehicles (FCEVs) Comparison with Internal Combustion Engine: Technology, Advantages & Disadvantages of EV, National Policy for adoption of EVs.

UNIT - II	**9 Hours**

Electric Drive-Trains: Introduction to various electric drive-train topologies in EV and HEV, Power flow control in electric drive-train topologies, classification of electric machines used in automobile drivetrains.

E-Motor Drives Configuration (Control Block diagrams): Induction Motor Drive, Permanent Magnet (PM) motor Drive & Switched Reluctance Motor (SRM) Drive.

UNIT - III	**9 Hours**

Battery Energy Storage: Types of Battery, Introduction to Electrochemical Battery, Electrochemical Reactions, Battery Parameters: Battery Capacity, Discharge Rate, Charging Rate, SOC, SOD, SOH, DOD, Specific Energy, Specific Power, Energy Efficiency,

Battery Management Systems (BMS): Introduction to BMS, Objectives of the BMS: Discharging control, Charging control, Cell Balancing; BMS topologies: Distributed Topology, Modular Topology and Centralized Topology.

UNIT - IV	**9 Hours**

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage, Fuel Cell based energy storage, Super Capacitor based energy storage, Hybridization of different energy storage devices. Introduction to BMS and its topologies.

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, Classification of different energy management strategies, Comparison of different energy management strategies and implementation issues of energy management strategies.

UNIT - V	**9 Hours**

Charging Infrastructure: Basic Requirements for Charging System, Charger Architectures, Grid Voltages, Frequencies, and Wiring, Charging Standards and Technologies, SAE J1772. On-board chargers and Off-board chargers, Topologies and Standards, Types of Charging Station Charging Station Placement for Electric Vehicles: A Case Study.

Course Outcomes:

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

CO1	:	Analyse the basics of electric and hybrid electric vehicles, their architecture, technologies and modelling.
CO2	:	Analyze various electric drives suitable for electric vehicles.
CO3	:	Discuss and implement different energy storage technologies used for electric vehicles and their management system.
CO4	:	Analyse various charging methods, requirements, standards and types of charging for EV and HEV.

Reference Books
1. Modern Electric Vehicle Technology C.C. Chan and K.T. Chau, 1st Edition, 2001, Oxford university press, ISBN 0 19 850416 0.
2. Battery Management system for large Lithium Battery Packs, Davide Andrea, 1st Edition, 2010, ARTECH HOUSE, ISBN-13 978-1-60807-104-3.
3. Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, 1st Edition, 2018, Wiley, ISBN 9781119063667.
4. Hybrid Vehicles from Components to System, F. BADIN, Ed, 1st Edition, 2013, Editions Technip, Paris, ISBN 978-2-7108-0994-4.

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	:	MET325DH	**ELECTRONIC NAVIGATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL	*Professional Core Courses (Cluster Electives) (Group-C)*	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 Course Global Elective 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. 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 Course Global Elective Group-D)*	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 Course Global Elective 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, accessibility, availability and other factors of User Interface design patterns.
CO3	:	Design and implement techniques of implementing design patterns.
CO4	:	Evaluate the design patterns 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 Course Global Elective 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. 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. 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.
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 Course Global Elective 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.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**

SEMESTER: 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 Course Global Elective 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-hierarchical 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

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	:	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 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: 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.
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.

SEMESTER: II						
Course Code	:	MPE427SL	**F28379D CONTROLLER FOR POWER ELECTRONICS**	CIE Marks	:	50
Credits L-T-P	:	0-0-2	*(Skill Lab)*	SEE Marks	:	50
Hours/Week	:	04	*(Practice)*	SEE Duration	:	3 Hours

Module:1
The components of the F28379D core -Mapping external devices to the F28379D core - peripherals and Peripheral Interface - Code composer studio - Assembly Programming using F28379D- Instruction Set - Basic programs

Module:2
Pin Multiplexing (MUX) and General Purpose I/O Overview - Multiplexing and General Purpose I/O Control Registers - Introduction to Interrupts - Interrupt Hierarchy – Interrupt Control Registers - Initializing and Servicing Interrupts in Software.

Module:3
ADC Overview - Operation of the ADC in the DSP - Overview of the Event manager (EV) - Event Manage interrupts - General Purpose (GP) Timers - Compare Units - Capture Units and Quadrature Enclosed Pulse (QEP) Circuitry - General Event Manager Information.

Module:4
Configurations, PWM Generation, Dead band unit, Sine PWM, Embedded Coding through MATLAB.

Module:5
Control and Modelling of Power Converter as plant, Analog and Digital Control, Steady state model of DPWM, Analog and Digital PWM, dynamic modelling of DPWM.

Module:6
Introduction to Discrete Equivalent in Digital Control Implementation, Numerical Integration Methods for Discrete Equivalent.

Module:7
Current programmed Power Converters and Sampling Instants, Control loop design and validation Using SFRA Tool.

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

CO1	:	Acquire a basic knowledge about fundamentals of F28379D microcontrollers.
CO2	:	Acquire a basic knowledge about programming and system control to perform a specific task.
CO3	:	Develop programming skills in embedded systems for various applications.
CO4	:	Model based programming design for Embedded Applications

Reference Books

1. LAUNCHXL-F28379D Overview, Texas Instruments.
2. LAUNCHXL-F28379D User's Guide, Texas Instruments

RUBRIC FOR CONTINUOUS INTERNAL EVALUATION (CIE-Lab)		
1	Conduction of the experiments relevant to the modules & Report	15
2	Design and testing of the Prototype / Projects / Modules	20
3	Final presentation and report	15
	MAXIMUM MARKS FOR THE SEE	**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.

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

SEMESTER: III						
Course Code	:	MPE331TA	**MODELLING AND DESIGN OF POWER ELECTRONIC CIRCUITS**	CIE Marks	:	100
Credits L-T-P	:	3-1-0	*(Theory)*	SEE Marks	:	100
Hours	:	45L+45EL+ 30T	*(Professional Core Course)*	SEE Duration	:	3 Hours

UNIT - I	9 Hours

Computer Simulation of Power Electronic Converters and Systems: Challenges in computer simulation, simulation process, Types of analysis, mechanics of simulation, circuit-oriented simulators, equation solvers, comparison of circuit oriented simulators and equation solvers.
Modelling of Systems: Input-Output relations, differential equations and linearization, state space representation, transfer function representation.
MNA and ST approaches: Nodal analysis, Modified Nodal analysis, the sparse tableau approach. Nonlinear circuits The Newton-Raphson Method, computation time, convergence issues, nonlinear circuit equations, Practical limit.

UNIT - II	9 Hours

Introduction to transient simulation: Discretization of time, transient analysis, Accuracy and stability, Explicit and Implicit Schemes. Method for Transient Simulation Introduction, Numerical methods for solving ODEs, Stability of numerical methods. Stiff equations, Adaptive step size, (excluding compact representation of RK formulas, multistep method, generalised linear multi step method) Transient analysis in circuit simulation, Equivalent circuit approach, and practical aspects.

UNIT - III	9 Hours

Modelling of Power Converters:
DC-DC Converters: Average model of the converter, Circuit Averaged model of the converter (Buck & Boost).
DC-AC Converters:
Single Phase: Half Bridge (Switched & Averaged Model)
Three Phase: Averaged Model of Two-Level VSC, Model of Two-Level VSC in αβ & *dq* Frame

UNIT - IV	9 Hours

Closed Loop Control of DC-DC converters
Closed Loop control: Control requirements, Compensator structure, Design of Compensator, Design example.
Closed Loop Performance Functions: Audio Susceptibility, Input Admittance, Output Impedance
Effect of Input filter on the converter performance, Design criteria for selection of Input filter, Design example.

UNIT - V	9 Hours

Closed Loop Control of DC-AC converters
Single Phase: AC-Side Control Model of Half-Bridge Converter, Control of Half-Bridge Converter, Feed-Forward Compensation.
Three Phase: Control model in *aβ*-Frame, Control model in *dq*-Frame. Case Studies.

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

CO1	:	Analyse necessity of modelling and challenges in computer simulation.
CO2	:	Evaluate steady state and transient problems in modelling of Power electronic systems.
CO3	:	Analyse techniques to solve power electronic circuits.

CO4	:	Apply the design methods for modeling SMPS with case studies.

Reference Books

1. Power Electronics: Converters Applications and Design, Ned Mohan, Tore M. Undeland, William P.Robbins, 3rd Edition, Wiley Publications, 2007, ISBN: 978-8126510900.
2. Simulaton of Power Electronic Circuits: M.B. Patil, V. Ramanarayanan, V.T. Ranganathan, Narosa Publications, ISBN 978-81-7319-989-9.
3. Power Electronics: Essentials and applications: L. Umanand, Wiley India Pvt, Ltd, Reprint 2012, ISNB No: 978-81-265-1945-3.
4. Power Electronics: Devices, Circuits And Matlab Simulations, Alok Jain, 1st Edition, 2011,Penram International Publishing, ISBN-13: 978-8187972389.

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: III						
Course Code	:	MPE232E1	**ELECTROMAGNETIC COMPATIBILITY**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Online Course)*	SEE Marks	:	100
Hours	:	16	*Professional Elective Courses (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 EMC - Relevant concepts from electromagnetic field theory
Week 2: Non-ideal or high-frequency behavior of components
Week 3: Crosstalk or near--eld coupling
Week 4: EM topology & grounding
Week 5: EM Shielding
Week 6: Surge protection and filters
Week 7: Problem of Intentional electromagnetic interference, Lightning protection
Week 8: EMC measurements and Standards

Reference Books

1. Henry.W. Ott, "Noise reduction techniques in electronics systems", John Wiley publication, 3rd Edition, 2015, ISBN: 978-0-470-18930-6.
2. Laszlo Tihanyi, "Electromagnetic compatibility in Power Electronics", Newnes publications,1st Edition,1995, ISBN: -0-7803-0416-0.
3. William D Greason, "Electrostatic Damage in Electronics: Devices and Systems", John Wiley and sons INC, 4th Edition, 1986, ISBN:978-0471915394.
4. White, R. J., "Handbook Series of Electromagnetic Interference and Compatibility", Don White consultants Inc., 1st Edition, 1981, ISBN: 9781848215047.

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.

SEMESTER: III						
Course Code	:	MPE232E2	**INTRODUCTION TO OPERATING SYSTEMS**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Online Course)*	SEE Marks	:	100
Hours	:	16	*Professional Elective Courses (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
Week 2: Memory Management
Week 3: Processes
Week 4: Interrupts and Context Switching
Week 5: Scheduling
Week 6: Synchronization
Week 7: Deadlocks
Week 8: Operating System Security

Reference Books

1. Russ Cox, Frans Kaashoek, Robert Morris, “xv6: a simple, Unix-like teaching operating system" Revision 8.
2. Adraham Silberschatz, Pert B. Galvin, and Greg Gagne, 'Operating System Concepts'', Wiley-India edition, 10th Edition, 2021, ISBN: 978-1119800361.
3. Andrew S. Tanenbaum, 'Modern Operating Systems'', PHI Learning Private Limited, New Delhi, 3rd edition, 2009, ISBN: 978-8120339040.
4. The xv6 source code is available via git clone git://pdos.csail.mit.edu/xv6/xv6.git.

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.

SEMESTER: III						
Course Code	:	MPE232E3	**MACHINE LEARNING**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Online Course)*	SEE Marks	:	100
Hours	:	16	*Professional Elective Courses (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 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. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 1st Edition, 2012, ISBN: 978-0262018029.
2. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory To Algorithms", Cambridge University Press, 3rd Edition, 2015, ISBN: 978-1107512825.
3. S Sridhar, M Vijayalakshmi, "MACHINE LEARNING", Oxford University Press, 1st Edition, 2021, ISBN: 978-0190127275.
4. Anuradha Srinivasaraghavan, Vincy Joseph, "Machine Learning", Wiley, 1st Edition, 2020, ISBN: 978-8126578511.

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.

SEMESTER: III						
Course Code	:	MVE232E4	**SENSOR TECHNOLOGIES: PHYSICS, FABRICATION AND CIRCUITS**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Online Course)*	SEE Marks	:	100
Hours	:	16	*Professional Elective Courses (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: Sensors and Transducers – Basics, Introduction to Sensors, Materials for sensors, Multidisciplinary Aspects of Sensors, Introduction to Sensor Parameters
Week 2: Sensor Parameters-II, Sensor Parameters-III, Sensor Parameters-IV, Sensor Parameters-V, Numerical Examples
Week 3: Introduction: Physics of Sensors, Capacitive Sensor Architecture, Different Types of Capacitive Sensors, Thermal Sensors Basics, Dynamic Condition of Thermal Sensors
Week 4: Classification of Thermal Sensors, Chemical Sensor Basics, Electrochemical Sensors Impedimetric Sensors, Numerical Examples
Week 5: Physics of Optical Sensors, Physics of Magnetic Sensors, Physics of Acoustic Sensors Physics of Microfluidic Sensors, Various Sensor Geometries and Examples
Week 6: Microfabrication Technologies, Deposition Techniques, Physical Vapor Deposition, Chemical Vapor Deposition, Patterning Techniques
Week 7: Lithography Techniques, Basics of Etching Techniques, Dry Etching Techniques Optical and Electron Microscopy, Other Microscopy Techniques
Week 8: Sensor System: Basic Circuits, Amplifier Circuits, Instrumentation Amplifier, Filter Circuits Sensor System: Experimental Demonstration

Reference Books

1. I.R. Sinclair, “Sensors and Transducer”, Newnes Oxford, 3rd Edition, 2021, ISBN: 978-8120321984.
2. E.A. Doebelin, “Measurement Systems: Application & Design”, McGraw Hill, 4th Edition, 1990, ISBN: 978-0070173385.
3. B. Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw-Hill Int. Edition, 2001, ISBN: 978-9325983274.
4. A. Paul, M. Bhattacharjee, R. Dahiya, “Solid-State Sensors”, Wiley and EEE, 2023, 2020, ISBN: 978-1119473046.

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

SEMESTER: III						
Course Code	:	MPE433P	**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	:	MPE434N	**INTERNSHIP**	CIE Marks	:	50
Credits L-T-P	:	0-0-6		SEE Marks	:	50
Hours/ Week	:	12		SEE Duration	:	3 Hours

Guidelines

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	:	MPE341F1	**EMBEDDED SYSTEMS DESIGN**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Online Course)*	SEE Marks	:	100
Hours	:	16	*Professional Elective Courses (NPTEL) (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 Embedded System, ASICs and ASIPs
Week 2: Designing Single Purpose Processors and Optimization
Week 3: Introduction to FPGAs and Synthesis
Week 4: Verilog Hardware Description Language (Verilog HDL)
Week 5: Microcontrollers and Power Aware Embedded System Design
Week 6: Real Time Operating System
Week 7: Real Time Scheduling Algorithms
Week 8: Modelling and Specification

Reference Books

1. Daniele Lacamera, "E.mbedded Systems Architecture", Packt Publishing, 2nd Edition, 2023, ISBN: 978-1803239545

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.

SEMESTER: IV						
Course Code	:	MPE341F2	**POWER QUALITY IMPROVEMENT TECHNIQUES**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Online Course)*	SEE Marks	:	100
Hours	:	16	*Professional Elective Courses (NPTEL) (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: Concept of Power Quality: Frequency variations, voltage variations- sag and swell, waveform distortion –dc offset, harmonics, inter-harmonics, notching and noise.

Week 2: Representation of harmonics, waveform, harmonic power, measures of harmonic distortion; Current and voltage limits of harmonic distortions: IEEE, IEC, EN, NORSO.

Week 3: Causes of Harmonics: 2-pulse, 6-pulse and 12-pulse converter configurations, input current waveforms and their harmonic spectrum; Input supply harmonics of AC regulator, integral cycle control, cycloconverter, transformer, rotating machines, ARC furnace, TV and battery charger.

Week 4: Elimination/ Suppression of Harmonics: High power factor converter, multi-pulse converters using transformer connections (delta, polygon) Passive Filters: Types of passive filters, single tuned and high pass filters, filter design criteria, double tuned filters, damped filters and their design.

Week 5: PWM Inverter: Voltage sourced active filter, current sourced active filter, constant frequency control, constant tolerance band control, variable tolerance band control.

Week 6: Active Power Filters: Compensation principle, classification of active filters by objective, system configuration, power circuit and control strategy.

Week 7: Hybrid Shunt Active power filter: Principle of operation, analysis and modelling.

Week 8: Unified power quality conditioner, voltage source and current source configurations, principle of operation for sag, swell and flicker control.

Reference Books

1. Derek A. P., "Power Electronic Converter Harmonics", IEEE Press, 1st Edition, ISBN: 9780780353947.
2. Arrillaga J., Smith B. C., Watson N. R. and Wood A. R., "Power System Harmonic Analysis", Wiley India, 2nd Edition, 2008, ISBN: 978-0471975489.
3. Dugan R. C., McGranaghan M. F. and Beaty H. W., "Electrical Power System Quality", McGraw-Hill International Book Company, 3rd Edition, 2013, ISBN: 978-1259005572.

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.

SEMESTER: IV						
Course Code	:	MPE341F3	**FACTS DEVICES**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Online Course)*	SEE Marks	:	100
Hours	:	16	*Professional Elective Courses (NPTEL) (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: FACTS: Concept & Power Electronic Controllers.
Week 2: Power Electronic Controllers and PWM techniques.
Week 3: Static Shunt Compensators
Week 4: Static Shunt Compensators
Week 5: Static Series Compensators
Week 6: Static Series Compensators and Static Voltage and Phase Angle Regulators.
Week 7: Unified Power quality Conditioner (UPQC) and Unified Power Flow Controller (UPFC).
Week 8: Interline Power Flow Controller (IPFC) and application of FACTS device.

Reference Books

1. Hingorani N. G. and Gyugyi L., "Understanding FACTS", IEEE Press, Standard Publishers Distributors, 1st Edition, 1999, ISBN: 978-0780334557.
2. Song Y. H. and Johns A. T., "Flexible AC Transmission Systems (FACTS)", IEE Press, 1st Edition, 1999, ISBN: 978-0852967713.
3. Mathur R. M. and Varma R. K., Thyristor Based FACTS Controllers for Electrical Transmission Systems, John Wiley and Sons, 1st Edition, 2002, ISBN: 978-0471206439.

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.

SEMESTER: IV						
Course Code	:	MPE341F4	**OPTIMAL CONTROL**	CIE Marks	:	NA
Credits L-T-P	:	2-0-0	*(Theory - NPTEL Online Course)*	SEE Marks	:	100
Hours	:	16	*Professional Elective Courses (NPTEL) (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 Performance Index, Basic Concept of calculus of variation, The basic variational problem, Fixed end point problem, Free end point problem.

Week 2: Free end point problem (Continued), Free end point problem (Continued), Free end point problem (Continued), Optimum of a function with conditions, Optimum of Functions with Conditions (Lagrange Multiplier Method).

Week 3: Optimum of a functional with conditions, Variational Approach to Optimal Control Systems Variational Approach to Optimal Control Systems (continued), Linear Quadratic Optimal Control Systems, Linear Quadratic Optimal Control Systems (Continued).

Week 4: Linear Quadratic Optimal Control Systems (Continued), Linear Quadratic Optimal Control Systems (Continued), Linear Quadratic Optimal Control Systems (Continued), Linear Quadratic Optimal Control Systems (Optimal Value of Performance Index), Infinite Horizon Regulator Problem.

Week 5: Infinite Horizon Regulator Problem (Continued), Analytical Solution of Matrix Differential Riccati Equation (State Transition Matrix Approach), Analytical Solution of Matrix Differential Riccati Equation (Similarity Transformation Approach), Analytical Solution of Matrix Differential Riccati Equation (Similarity Transformation Approach) (Continued), Frequency Domain Interpretation of LQR (Linear Time Invariant System).

Week 6: Frequency Domain Interpretation of LQR, (Linear Time Invariant System) (Continued), LQR with a Specified Degree of Stability, Inverse Matrix Riccati Equation, Linear Quadratic Tracking System, Discrete-Time Optimal Control Systems.

Week 7: Discrete-Time Optimal Control Systems (Continued), Discrete-Time Optimal Control Systems (Continued), Matrix Discrete Riccati Equation, Analytical Solution of Matrix Difference Riccati Equation, Analytical Solution of Matrix Difference Riccati Equation (Continued).

Week 8: Optimal Control Using Dynamic Programming, The Hamilton-Jacobi-Bellman (HJB) Equation, LQR System Using H-J-B Equation, Time Optimal Control System, (Constrained Input) Time Optimal Control System (Continued)

Reference Books

1. D.E.Kirk, “Optimal Control Theory : An Introduction”, PrenticeHall,EnglewoodCliffs,NJ,1970, ISBN: 978-0486434841.
2. L. Lewis, “Optimal Control”, John Wiley & Sons, Inc., New York, NY,1986, ISBN: 978-0471033783.
3. M. Gopal, “Modern Control System Theory”, New Age International, 1994, ISBN: 978-0470221570.
4. Sage A.P. & White C. C. “Optimum Systems Control”, Prentice Hall, 2nd Edition, 1997, ISBN: 978-0136382966.

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.

SEMESTER: IV						
Course Code	:	MPE442P	**MAJOR PROJECT**	CIE Marks	:	100
Credits L-T-P	:	0-0-18		SEE Marks	:	100
Hours/ Week	:	36		SEE Duration	:	3 Hours

Guidelines

9. Major Project is to be carried out for a duration of 18 weeks
10. Student have to implement the Major Project individually.
11. Students are required to select topics related to their PG Program Specialization after extensive Literature Survey and analyzing the Research gaps.
12. Students will be assigned to guides in accordance with the expertise of the faculty.
13. 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
14. 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.
15. 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.
16. It is mandatory for the students to present/publish their project work in National/International Conferences/Journals
17. 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.
18. 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%

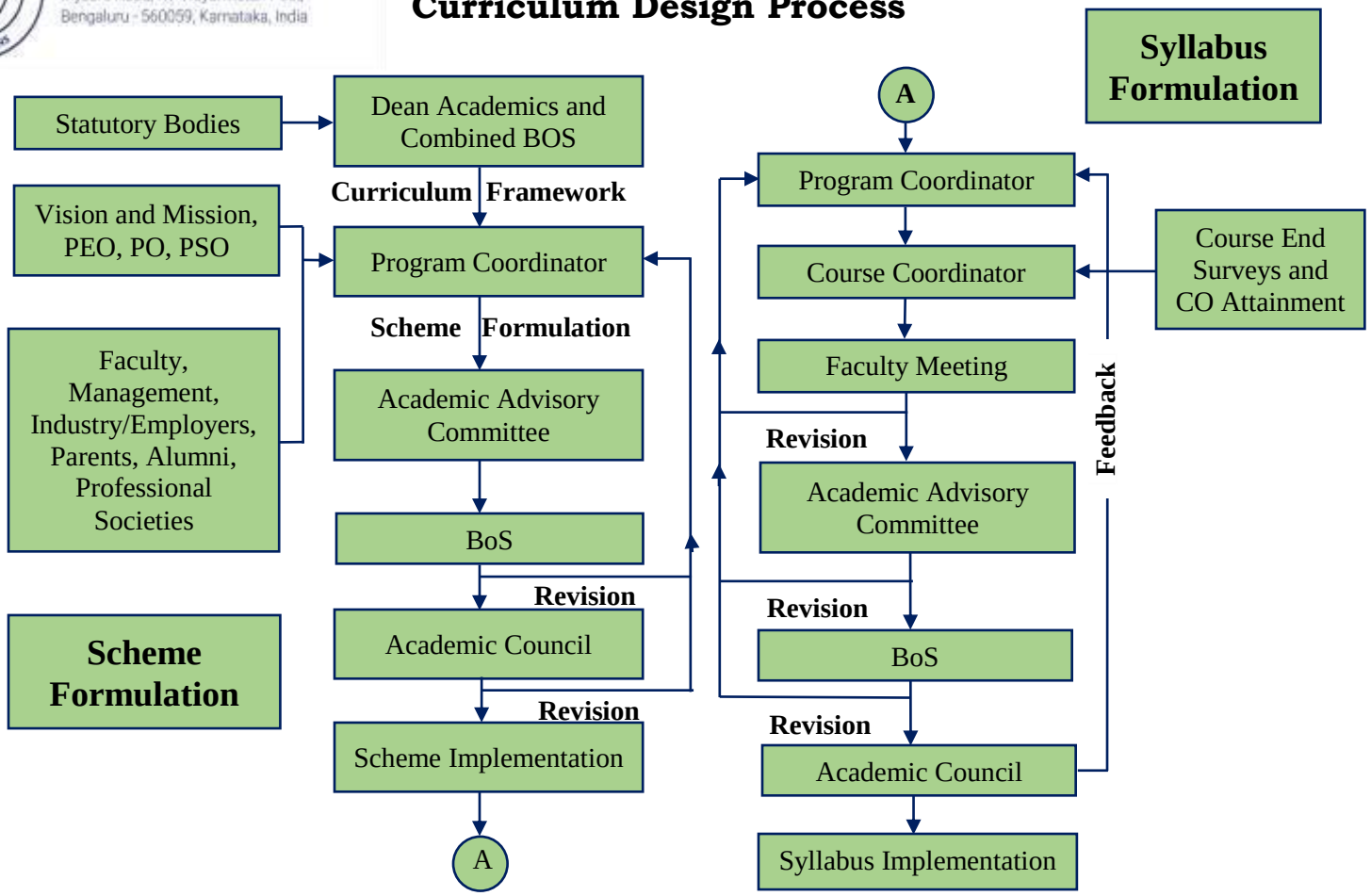
Scheme for Semester End Evaluation (SEE):
Major Project SEE evaluation shall be conducted in two stages. This is initiated after fulfilment of submission of Project Report and CIE marks.
Stage-1 Report Evaluation: Evaluation of Project Report shall be done by the Guide and an External examiner.
Stage-2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

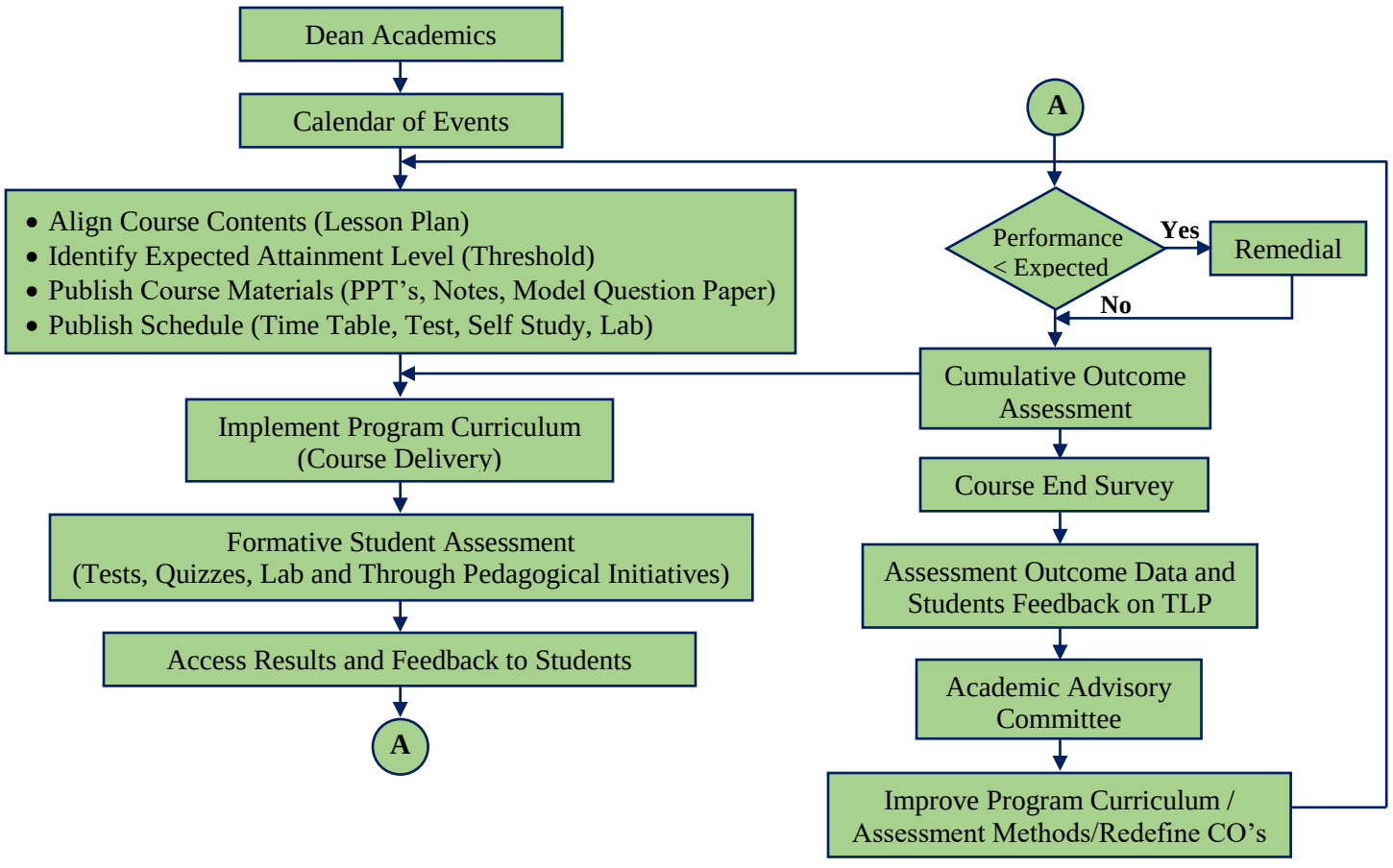
SEE procedure is as follows:

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

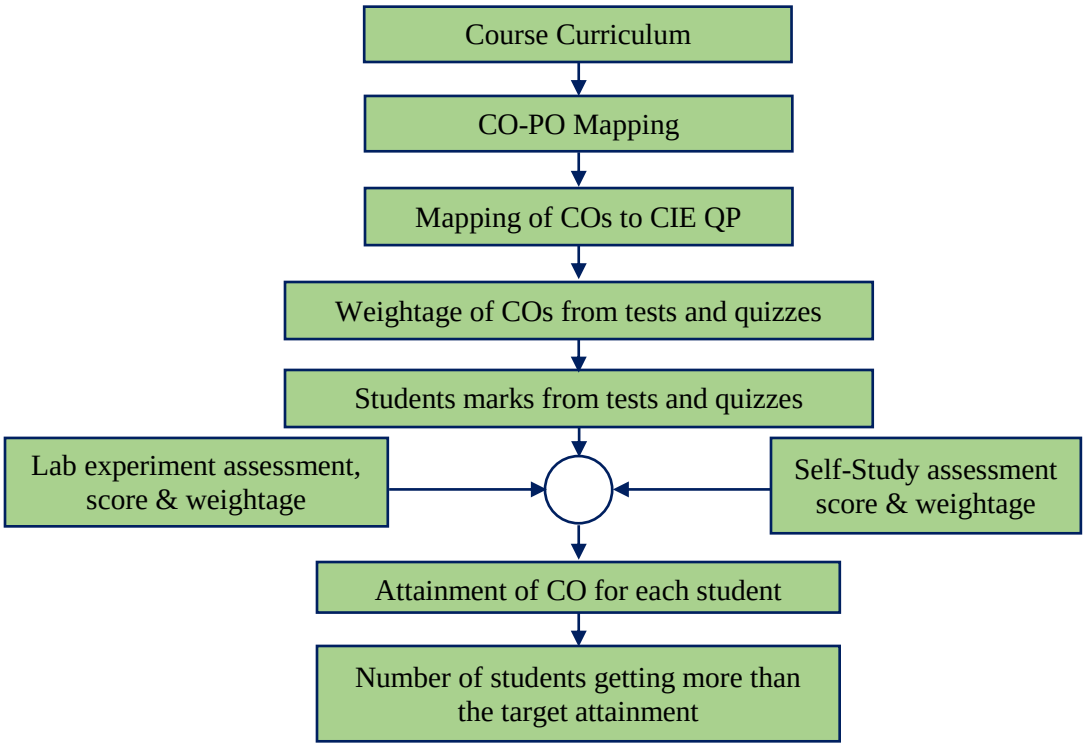
Curriculum Design Process



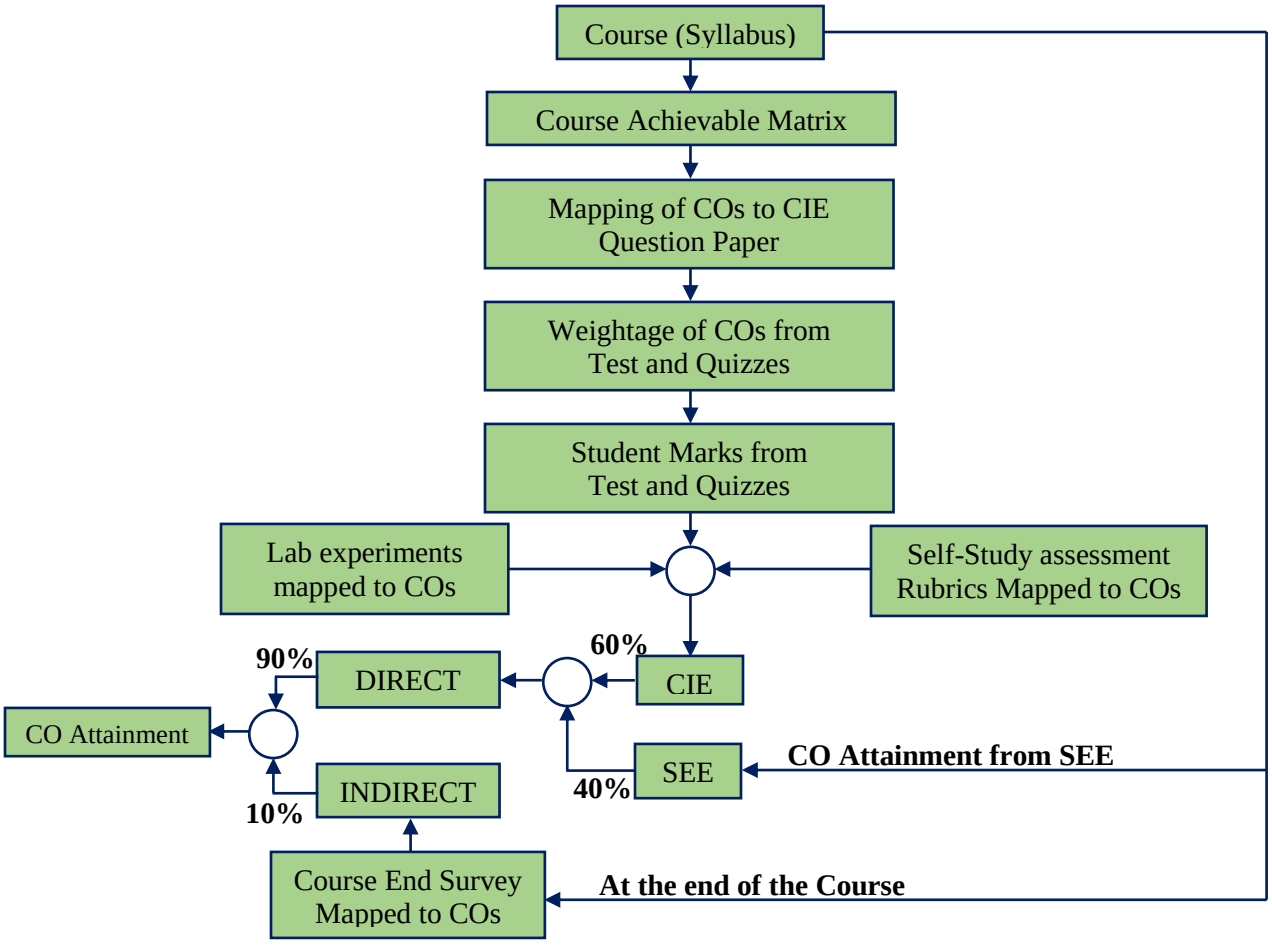
Academic Planning and Implementation



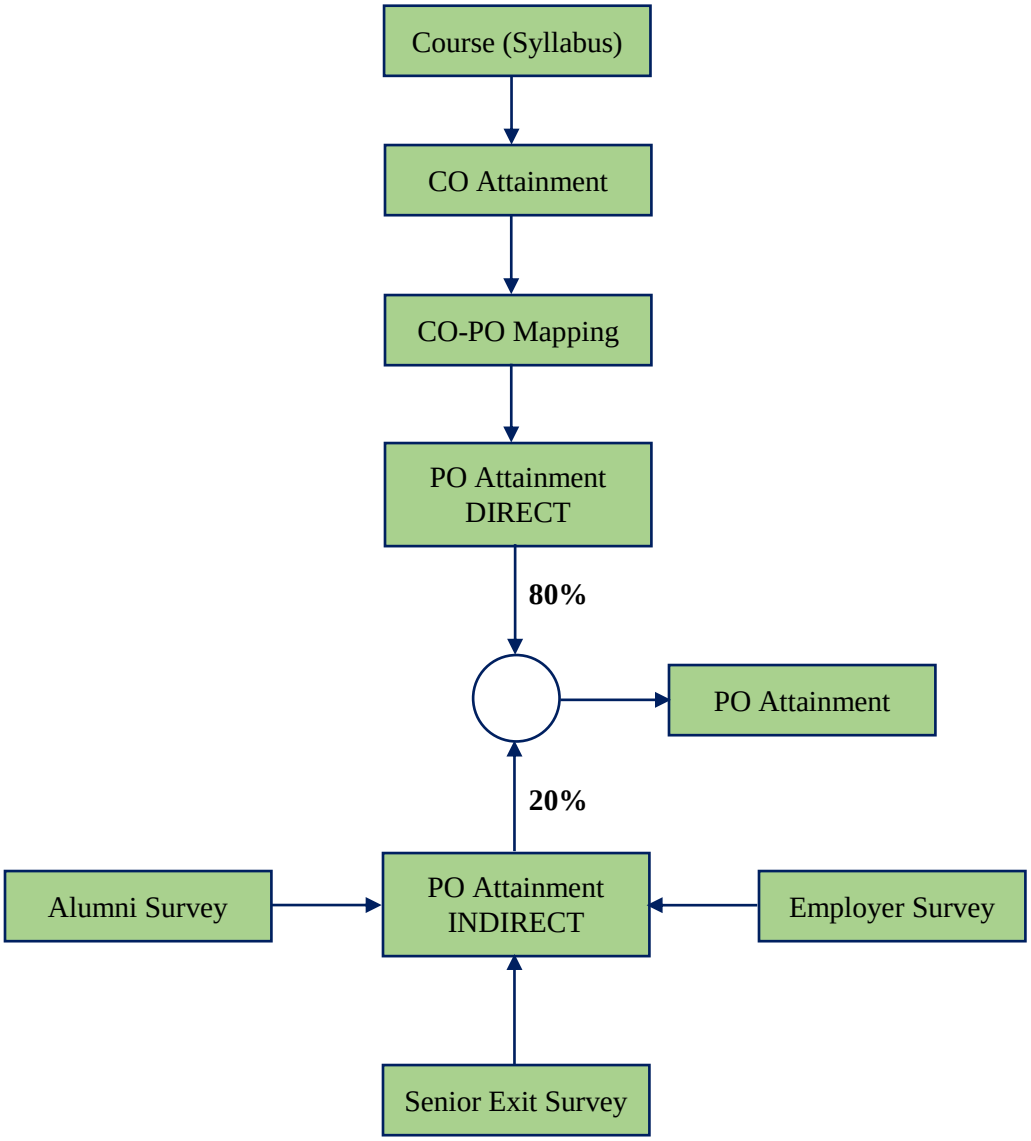
Process For Course Outcome Attainment



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